National Marine Fisheries Service
Endangered Species Act Section 7
Biological and Conference Opinion

Title: Biological and Conference Opinion on the Proposed Implementation of a Program for the Issuance of Permits for Research and Enhancement Activities on Cetaceans in the Arctic, Atlantic, Indian, Pacific, and Southern Oceans

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: Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce

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1 INTRODUCTION

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

The Federal action agency shall confer with the NMFS on any action which is likely to jeopardize the continued existence of any species proposed for listing or result in the destruction or adverse modification of proposed critical habitat under NMFS jurisdiction (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 50 C.F.R. §402.14.

Section 7(b)(3) of the ESA requires that at the conclusion of consultation, or conference if combined with a formal consultation, NMFS provides an opinion stating whether the Federal agency’s action is likely to jeopardize ESA-listed species or destroy or adversely modify designated critical habitat. If NMFS determines that the action is likely to jeopardize listed species or destroy or adversely modify critical habitat, NMFS provides those reasonable and prudent alternatives that allow that can be taken by the Federal agency or the applicant and allow 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 action agency for this consultation is the NMFS, Office of Protected Resources, Permits and Conservation Division (hereafter the NMFS Permits and Conservation Division). The NMFS Permits and Conservation Division proposes to implement a program for the issuance of permits for research and enhancement activities on cetaceans pursuant to section 10(a)(1)(A) of the ESA and section 104 of the Marine Mammal Protection Act (MMPA) of 1972, as amended (16 U.S.C. §1361 et seq.). The purpose of the proposed permits are to allow an exception to the moratorium and prohibition on takes established under the ESA and MMPA in order to allow numerous researchers in the scientific community to conduct scientific research on marine mammals worldwide.

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" (§4(19)). Harm is further 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." While the U.S. Fish and Wildlife Service further defines harass by regulation (50 C.F.R. §17.3), until NMFS promulgates a regulatory definition, we rely on NMFS' interim guidance, which defines harass as an act that create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering" (NMFSPD 02-110-19).

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

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

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

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

NMFS' interim ESA harass definition does not specifically equate MMPA Level A or Level B harassment, but shares some similarities with both in the use of the terms "injury/injure" and a focus on a disruption of behavior patterns. Since the proposed permits will authorize take under both the ESA and MMPA, our ESA analysis, which relies on NMFS' interim guidance on the ESA term harass, may result in different conclusions than those reached by the NMFS Permits and Conservation Division in their MMPA analysis. Given that the MMPA takes a more conservative approach in considering any act that has the potential to disrupt behavioral patterns as harassment, while under the ESA such acts must significantly disrupt normal behavioral patterns, there may be circumstances in which an act is considered harassment, and thus take, under the MMPA but not the ESA.

This consultation, biological and conference opinion (opinion), and incidental take statement, were completed in accordance with section 7(a)(2) of the statute (16 U.S.C. 1536 (a)(2)), associated implementing regulations (50 C.F.R. §§402.01-402.16), and agency policy and guidance was conducted by NMFS Office of Protected Resources Endangered Species Act Interagency Cooperation Division (hereafter referred to as "we"). This biological and conference opinion and incidental take statement were prepared by NMFS Office of Protected Resources ESA Interagency Cooperation Division in accordance with section 7(b) of the ESA and implementing regulations at 50 C.F.R. §402.

This document represents the NMFS ESA Interagency Cooperation Division's opinion on the effects of the proposed action on threatened and endangered species and critical habitat that have been proposed or designated for those species (see Table 6 and Table 10). A complete record of this consultation is on file at the NMFS Office of Protected Resources in Silver Spring, Maryland.

1.1 Background

The ESA mandates the protection and conservation of threatened and endangered species, and prohibits the taking, import, and export of these species, with limited exceptions for scientific research and enhancement of propagation or survival, pursuant to ESA section 10(a)(1)(A) and its implementing regulations (50 C.F.R. §222).

As of July 30, 2018, there are 38 existing ESA/MMPA scientific research permits issued by NMFS Permits and Conservation Division for ESA-listed cetaceans in the wild. One additional scientific research permit authorizes auditory research on stranded cetaceans on the beach or in rehabilitation facilities. An additional 25 permits are solely for the import/export/receipt of cetacean parts. Based on permits issued by the NMFS Permits and Conservation Division over the last 15 years, approximately 40 permits are active for research and enhancement activities on ESA-listed cetaceans at any time. Permits for research and enhancement activities on cetaceans often use similar research methods, which have been modified over time to improve the scientific understanding of cetacean biology and ecology. Adjustments in research methods and techniques have also been made to reduce adverse impacts to cetaceans being researched. Considering the large number of individual permits, including the section 7(a)(2) consultations over a substantial number of years, NMFS Permits and Conservation Division's high level of understanding of the potential effects to cetaceans under a variety of research methods, and the workload to consider and issue permits individually, the NMFS Permits and Conservation Division has proposed to implement a new program for the issuance of permits for research and enhancement activities on cetaceans. The program for the issuance of permits for research and enhancement activities on cetaceans will set an annual permit cycle, conservation and mitigation measures, proposing limits and authorizing takes for deep-implantable tags, internal program review, monitoring the effects of the permits, monitoring the status of ESA-listed cetaceans, standard reporting schedule by permitted researchers, adaptive management, and annual reporting to the NMFS ESA Interagency Cooperation Division. Evaluating all permits at specific times each year and having a programmatic consultation in place is expected to: (1) enhance species conservation and management via a holistic assessment of impacts which should minimize impacts to species or distinct population segments (DPSs) from duplication of research effort; (2) reduces the NMFS Permits and Conservation Division processing time for scientific research and enhancement permit applications; and (3) create efficiency by consolidating multiple section 7 consultations into one programmatic process.

In this consultation, we build up on our long-term evaluation of research activities from previous consultations, considering these previous research permits as part of the *Environmental Baseline* (Section 10) and evaluating the effects of authorizing researchers to continue to conduct research activities under scientific research permits.

The NMFS Permits and Conservation Division requested a formal programmatic ESA section 7 consultation to ensure that the cetacean research permitting program is not likely to jeopardize ESA-listed species or to destroy or adversely modify designated critical habitat.

1.2 Consultation History

This consultation is based on information provided in the (1) NMFS Permits and Conservation Division's biological assessment, and supporting documents, on the implementation of a permitting program for the issuance of permits for research and enhancement activities on cetaceans; (2) correspondence and discussions between the NMFS Permits and Conservation Division and the NMFS ESA Interagency Cooperation Division; (3) applicant's permit applications; and (4) the best available scientific and commercial information from the literature for analyzing the effects of the proposed action on ESA-listed species.

Our communication with the NMFS Permits and Conservation regarding this consultation is summarized as follows:

- On April 5, 2018, we had a kick-off meeting with the NMFS Permits and Conservation Division and agreed to provide them with a species and critical habitat list as part of technical assistance.
- On April 12, 2018, we provided the NMFS Permits and Conservation Division with a species and critical habitat list for the programmatic consultation. An updated species list was provided on May 29, 2018.
- On June 15, 2018, the NMFS Permits and Conservation Division provided us with a description of the research area in order to help with determinations for foreign species during technical assistance.
- On June 18, 2018, we provided the NMFS Permits and Conservation Division with status of the species descriptions for marine mammals likely to be included in the programmatic biological assessment.

- On August 9, 2018, we met with the NMFS Permits and Conservation Division to discuss locations of foreign species, a summary of historical take data analysis on cetacean research activities, and framework limits on deep-implantable tagging activities.
- On August 10, 2018, we provided the NMFS Permits and Conservation Division with examples of recent biological opinions with extensive not likely to adversely affect sections that may help justify determinations in the draft programmatic biological assessment.
- On August 13, 2018, we met with the NMFS Permits and Conservation Division to continue discussing limits on deep-implantable tagging activities as well as approach to evaluating research activities involving active acoustics (e.g., playbacks and prey mapping).
- On August 16, 2018, we met with the NMFS Permits and Conservation Division and Dr. Amy Scholik-Schlomer, NMFS Marine Mammal and Sea Turtle Division, to further discuss their approach to evaluating research activities involving active acoustics as well as setting up a user spreadsheet for researchers and analysts using the revised 2018 NMFS marine mammal acoustic technical guidance. The NMFS Permits and Conservation Division informed us that they will not authorize MMPA Level A harassment (i.e., injury) under the cetacean research permitting program.
- On August 21, 2018, the NMFS Permits and Conservation Division provided us with a draft of Chapter 1 of the programmatic biological assessment for our review.
- On September 5, 2018, we provided the NMFS Permits and Conservation Division with our comments and edits on the draft of Chapter 1 of the programmatic biological assessment.
- On September 28, 2018, we received a request from the NMFS Permits and Conservation Division for initiation of ESA section 7 programmatic consultation for their cetacean research permitting program. The initiation package included a programmatic biological assessment. The initiation package requested review of and response to the programmatic biological assessment to inform if it is complete or if additional information is needed by October 31, 2018. The NMFS Permits and Conservation Division requests that the consultation conclude by March 28, 2019.
- On October 23, 2018, we met with the NMFS Permits and Conservation Division to discuss the timeline, process, and answer any initiation questions regarding the programmatic biological assessment. The NMFS Permits and Conservation Division will amend the programmatic biological assessment to address any of our comments, concerns, or questions. We plan to hold regularly scheduled meetings to discuss and address any further issues. Also, we determined there is sufficient information to initiate formal consultation.
- On November 2, 2018, we provided the NMFS Permits and Conservation Division with an initiation letter.

- On December 22, 2018, consultation was held in abeyance for 38 days due to a lapse in appropriations and resulting partial government shutdown. Consultation resumed on January 28, 2019.
- On January 31, 2019, we met with the NMFS Permits and Conservation Division to discuss the timeline for the revised programmatic biological assessment and consultation given the partial government shutdown. The NMFS Permits and Conservation Division plans to provide the revised programmatic biological assessment by the end of February 2019. The NMFS Permits and Conservation Division will also discuss pending applications for stand-alone or batched consultations that may be extended or delayed so we can focus on the programmatic consultation.
- On February 28, 2019, we met with the NMFS Permits and Conservation Division to discuss the status of permit applications for Dr. Dan Engelhaupt, Dr. Heidi Pearson, and NMFS Southeast Fisheries Science Center as well as the revised programmatic biological assessment and timing of the programmatic consultation. The NMFS Permits and Conservation Division plans to provide the revised programmatic biological assessment in early March 2019. We plan to complete the programmatic consultation by the end of April 2019.
- On March 8, 2019, we received a revised programmatic biological assessment and summary document with responses to comments from the NMFS Permits and Conservation Division.
- On March 29, 2019, we received a revised programmatic biological assessment with edits to the map for the various DPSs of humpback whales, corrected Table 11, and added clarification on how the NMFS Permits and Conservation Division will evaluate the requested take numbers for deep-implantable tags on humpback whales in areas with small DPSs in relation to the ten percent limits.
- On June 10, 2019, we received a revised programmatic biological assessment with clarifications on tagging pregnant females and mothers with neonates; updated annual reporting due date to 60 days after the permit year ends and pushing the NMFS Permits and Conservation Division report to NMFS ESA Interagency Cooperation Division by 30 days; revised cetacean historical data numbers due to missing NMFS Marine Mammal Laboratory reports and included four North Pacific right whales tagged under a permit report not included in the historical data set reported in the biological assessment; clarified deep-implantable tags are intended and/or designed to anchor in the fascia and/or muscle and do not include dart/barb tags that miss the target location; clarified reasons why dart/barb tags are not authorized for Southern Resident DPS of killer whales; and revised Appendix 3 (draft permit) with revised conditions.

2 THE ASSESSMENT FRAMEWORK

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

"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 designated critical habitat for the conservation of an ESA-listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features (50 C.F.R. §402.02).

The final designations of critical habitat for green, leatherback, and loggerhead turtles used the term primary constituent element or essential features. The new critical habitat regulations (81 FR 7414; February 11, 2016) replace this term with physical or biological features. The shift in terminology does not change the approach used in conducting a "destruction or adverse modification" analysis, which is the same regardless of whether the original designation identified primary constituent elements, physical or biological features, or essential features. In this consultation, we use the term physical or biological features to mean primary constituent elements or essential features, as appropriate for the specific designated critical habitat.

An ESA section 7 assessment involves the following steps:

Description of the Proposed Action (Section 3): We describe the proposed action and those aspects (or stressors) of the proposed action that may have direct or indirect effects on the physical, chemical, and biotic environment.

Interrelated and Interdependent Actions (Section 4): We identify interrelated and interdependent actions. *Interrelated* actions are those that are part of a larger action and depend on that action for their justification. *Interdependent* actions are those that do not have independent use, apart from the action under consideration.

Action Area (Section 5): We describe the action area with the spatial extent of those stressors.

Potential Stressors (Section 6): We identify the stressors that could occur as a result of the proposed action and affect ESA-listed species and designated critical habitat.

Species and Critical Habitat Not Likely to be Adversely Affected (Section 7): We identify the ESA-listed and designated critical habitat that are likely to either not be affected or are not likely to be adversely affected by the stressors.

Species Likely to be Adversely Affected (Section 8): We identify the ESA-listed species that are likely to co-occur with those stressors in space and time and evaluate the status of those species and habitat.

Status of Species Likely to be Adversely Affected (Section 9): We examine the status of each species that would be adversely affected by the proposed action throughout the action area.

*Environmental Baseline (*Section 10): We describe the environmental baseline in the action area including: past and present impacts of Federal, state, or private actions and other human activities in the action area; anticipated impacts of proposed Federal projects that have already undergone formal or early section 7 consultation, and impacts of state or private actions that are contemporaneous with the consultation in process.

Effects of the Action (Section 11): We identify the number, age (or life stage), and gender of ESA-listed individuals that are likely to be exposed to the stressors and the populations or sub-populations to which those individuals belong. We also consider whether the action "may affect" designated critical habitat. This is our exposure analysis. We evaluate the available evidence to determine how individuals of those ESA-listed species are likely to respond given their probable exposure. We also consider how the action may affect designated critical habitat. This is our response analyses. We assess the consequences of these responses of individuals that are likely to be exposed to the populations those individuals represent, and the species those populations comprise. This is our risk analysis. The adverse modification analysis considers the impacts of the proposed action on the essential habitat features and conservation value of designated critical habitat.

Cumulative Effects (Section 12): Cumulative effects are the effects to ESA-listed species and designated critical habitat of future state or private activities that are reasonably certain to occur within the action area (50 C.F.R. §402.02). Effects from future Federal actions that are unrelated to the proposed action are not considered because they require separate ESA section 7 compliance.

Integration and Synthesis (Section 13): In this section we integrate the analyses in the consultation to summarize the consequences to ESA-listed species and designated critical habitat under NMFS' jurisdiction.

Conclusion (Section 14): With full consideration of the status of the species and the designated critical habitat, we consider the effects of the action within the action area on populations or subpopulations and on essential habitat features when added to the environmental baseline and the cumulative effects to determine whether the action could reasonably be expected to:

- Reduce appreciably the likelihood of survival and recovery of ESA-listed species in the wild by reducing its numbers, reproduction, or distribution, and state our conclusion as to whether the action is likely to jeopardize the continued existence of such species; or

- Appreciably diminish the value of designated critical habitat for the conservation of an ESA-listed species, and state our conclusion as to whether the action is likely to destroy or adversely modify 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, then we must identify 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).

In addition, we include an incidental take statement (Section 15) that specifies the impact of the incidental take, reasonable and prudent measures to minimize the impact of the incidental take, and terms and conditions to implement the reasonable and prudent measures (ESA section 7(b)(4); 50 C.F.R. §402.14(i)). We also provide discretionary conservation recommendations that may be implemented by action agency (Section 16) (50 C.F.R. §402.14(j)). Finally, we identify the circumstances in which reinitiation of consultation is required (Section 17) (50 C.F.R. §402.16).

To comply with our obligation to use the best scientific and commercial data available, we collected information identified through searches of *Google* scholar and literature cited sections of peer reviewed articles, species listing documentation, and reports published by government and private entities. This consultation is based on our review and analysis of various information sources, including:

- Information submitted by the NMFS Permits and Conservation Division and the applicants;
- Government reports (including NMFS biological opinions, recovery plans, and stock assessment reports);
- National Oceanic and Atmospheric Administration (NOAA) technical memorandums;
- Annual reports; and
- Peer-reviewed scientific literature.

These resources 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 critical habitat for the conservation of ESA-listed species.

3 Description of the Proposed Action

"Action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies. The NMFS Permits and Conservation Division has requested programmatic consultation on the proposed implementation of a program for the issuance of permits for research and enhancement activities on cetaceans in the Arctic, Atlantic, Indian, Pacific, and Southern Oceans. There is no sunset data on the program for the issuance of permits for research and enhancement activities on cetaceans. The cetacean research permitting program combines elements from the existing approach for issuing permits for research and enhancement activities on cetaceans with elements that are completely new. Both the existing and the new features of the program for the issuance of permits for research and enhancement activities on cetaceans (hereafter referred to as the cetacean research permitting program) are identified and discussed in this section of the consultation, which is organized as follows: (1) overall process for managing the program and for the issuance of permits for research and enhancement activities on cetaceans under section 10(a)(1)(A) of the ESA and section 104 of the MMPA; (2) proposed implementation of a program for the issuance of permits for research and enhancement activities on cetaceans; (3) processing permit applications and take allocations; (4) general permit terms and conditions; (5) annual permit cycle; (6) cetacean research and enhancement activities and associated mitigation measures; (7) authorized research and enhancement activities; (8) conservation measures; (9) proposed limits for cetacean research permitting program; (10) authorizing deep-implantable tags; (11) fitness-level impacts; (12) internal program review; (13) monitoring the effects of the permits for research and enhancement activities; (14) monitoring of the status of ESA-listed species; (15) standard reporting schedule; (16) adaptive management; (17) annual reporting to the NMFS ESA Interagency Cooperation Division; and (18) funding and carrying out cetacean research and enhancement activities.

3.1 Overall Process for Issuing Permits for Research and Enhancement Activities on Cetaceans

The NMFS Permits and Conservation Division's mandate is the protection and conservation marine mammals and threatened and endangered species, and prohibition of the take, import, and export of all protected species. Exceptions for take, import, and export for scientific research and enhancement purposes are allowed provided special exception permits are applied for and received in accordance with ESA section 10(a)(1)(A) and its implementing regulations (50 C.F.R. §222) and MMPA Section 104 and its implementing regulations (50 C.F.R. §216).

The NMFS Permits and Conservation Division processes permits and authorizations pursuant to section 10(a)(1)(A) of the ESA and section 104 of the MMPA for takes directed to protected species under NMFS jurisdiction. The issuance of a permit depends upon the types of activities to be performed, the species' listing status, and the applicable regulations. All marine mammals are protected under the MMPA and some are listed under the ESA. The NMFS Permits and Conservation Division streamline the permitting requirements under both statutes by processing joint ESA/MMPA permits for research and enhancement activities on ESA-listed marine mammals. Consequently, some MMPA regulatory requirements and practices are applied to the permitting of ESA-listed species where the ESA statute and regulations are silent or the MMPA is more restrictive. This policy complies with ESA regulations (50 C.F.R. §222.101[b] and 222.308[b]), simplifies permitting for applicants and the NMFS Permits and Conservation Division, and maintains consistency in the management of permits across species and/or taxa.

The NMFS Permits and Conservation Division process these permits and recommend to the Director of the Office of Protected Resources whether a permit should be issued or denied. The ESA, MMPA, and NMFS's implementing regulations for each statute establish information requirements for permit applicants. Detailed information regarding what types of activities require permits and who may apply for permits, as well as instructions specific to the different types of protected species permits and authorizations are available on the NMFS Permits and Conservation Division's website at: https://www.fisheries.noaa.gov/permit/esa-scientific-research-and-enhancement-permits. The overall process (flow chart) that the NMFS Permits and Conservation Division follows for the main steps to process and the issuance of ESA/MMPA permits is shown in Figure 1.

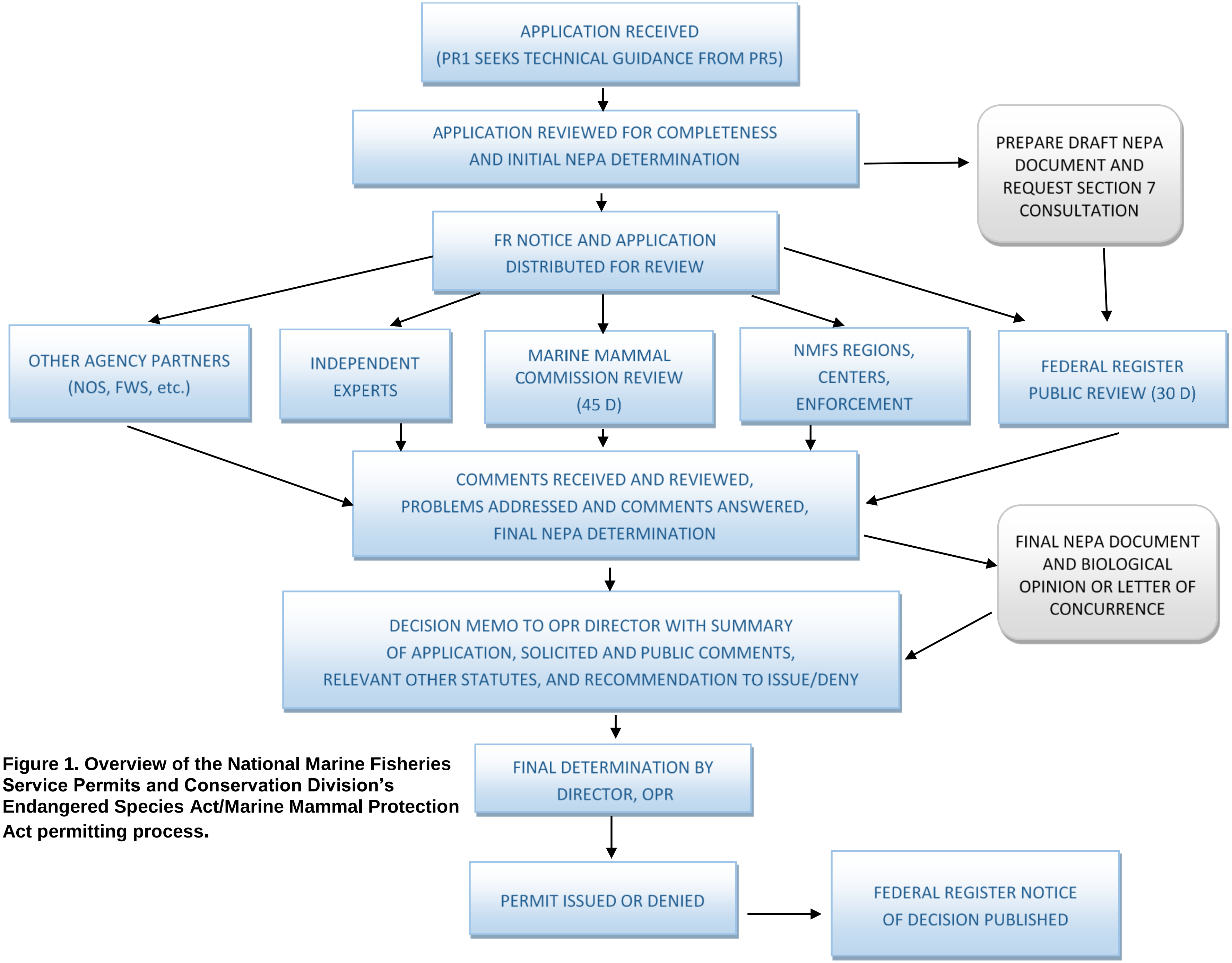


Figure 1. Overview of the National Marine Fisheries Service Permits and Conservation Division's Endangered Species Act/Marine Mammal Protection Act permitting process.

3.1.1 Application Submission and Review

A copy of NMFS Permits and Conservation Division's ESA/MMPA application instructions for marine mammal research and enhancement permits is provided in Section 19.1. An applicant must describe the species, age or life stage, and sex to be taken; the manner, frequency, and duration of the takes; the qualifications of the personnel to conduct the proposed action; the justification for such taking as it relates to conservation and recovery of the species; information on the effects of the take; and appropriate monitoring and mitigation to minimize adverse impacts. The applicant must provide sufficient information about the activity to (1) allow NMFS Permits and Conservation Division to determine whether permit issuance will comply with all applicable statutory and regulatory issuance criteria, and (2) assess the potential environmental impacts of permit issuance.

The Animal Welfare Act (7 U.S.C. 2131) and its implementing regulations (9 C.F.R. Parts 1-4) require marine mammal researchers to obtain Institutional Animal Care and Use Committee (IACUC) review and approval when they (1) receive federal funding, and (2) conduct research involving an invasive procedure and/or which can harm or materially alter the behavior of the animals under study. This excludes research and enhancement activities that may result in MMPA Level B harassment such as behavioral observation and photo-identification. NMFS, other government agencies, non-profit organizations, universities, etc. are subject to IACUC review if both criteria are met. In some cases, applicants such as universities require IACUC oversight regardless of the source of funding. Documentation received from an IACUC may assist with NMFS Permits and Conservation Division's determination of whether the action (1) is humane under the MMPA, and (2) will operate to the disadvantage of ESA-listed species. These IACUC reviews support the Director of the Office of Protected Resources' decision to issue or deny a permit for the proposed actions.

An application that satisfies some but not all of the applicable criteria for permit issuance will be returned without prejudice to the applicant with an explanation of the deficiencies. NMFS Permits and Conservation Division provide an opportunity for the applicant to supply the deficient information within a 60-day timeframe. The permit process cannot proceed further until the NMFS Permits and Conservation Division have received a complete application.

3.1.2 Determination of Level of Environmental Analysis

NMFS Permits and Conservation Division makes an initial determination regarding the appropriate level of National Environmental Policy Act (NEPA) review for the complete application. NEPA requires federal agencies to integrate environmental values into their decision-making processes by considering the environmental impacts of their proposed actions and reasonable alternatives to those actions. To meet this requirement, federal agencies must either prepare a detailed analysis (an environmental assessment or an environmental impact statement or classify the action as categorically excluded from the requirements of NEPA.

In general, scientific research and enhancement permits are categorically excluded from the need to prepare an environmental assessment or environmental impact statement (NAO-216-6A). To support this categorical exclusion determination, NMFS Permits and Conservation Division's program has a robust administrative record including numerous (i.e., over 50) environmental assessments with findings of no significant impact for all of the procedures included in this programmatic consultation. A categorical exclusion is defined as: a category of actions which does not individually or cumulatively have a significant effect on the human environment and which have been found to have no such effect in procedures adopted by a Federal agency in adoption of these procedures (Section 1507.3) and for which, therefore, neither an environmental assessment nor an environmental impact statement is required (40 C.F.R §1508.4). In July 2017, the Chief of the NMFS Permits and Conservation Division was delegated authority for the determination of the appropriate level of NEPA analysis for each permit.

Through their assessment of the impacts of the proposed action under NEPA including numerous finding of no significant impact determinations for marine mammal research, NMFS Permits and Conservation Division ensure permitted research will not have a significant adverse effect on the target marine mammals, non-target species, and the environment.

3.1.3 Endangered Species Act Section 7 Consultation

ESA/MMPA permit applications submitted to NMFS Permits and Conservation Division for take of ESA-listed cetaceans and pinnipeds may require formal intra-agency consultation. In some applications, NMFS Permits and Conservation Division determines whether the proposed action will result in harassment under the ESA, and if not, informal consultation is required. Currently, upon receipt of a permit application, NMFS Permits and Conservation Division requests a consulting biologist from the NMFS ESA Interagency Cooperation Division be assigned to the application for technical assistance, coordination, and initial reviews. This includes establishing a list of all proposed and ESA-listed species and proposed and designated critical habitat in the action area as well as reviewing the application for completeness.

For individual permits, if the action may affect but is not likely to adversely affect proposed or ESA-listed species or proposed or designated critical habitat, NMFS Permits and Conservation Division submit a memorandum to the Chief of the NMFS ESA Interagency Cooperation Division with the description of the proposed action, NMFS Permits and Conservation Division's rationale for a not likely to adversely affect determination, and a request for concurrence. If the proposed action will result in adverse effects under the ESA, NMFS Permits and Conservation Division prepares a memorandum for the Chief of the NMFS ESA Interagency Cooperation Division requesting formal consultation, along with information required by 50 C.F.R. §402.14(c), a copy of the application, and a draft permit.

For implementing the proposed programmatic consultation, NMFS Permits and Conservation Division will be responsible for ensuring that submitted permit applications that fall within the scope of the programmatic consultation are processed in accordance with the proposed requirements of the opinion. NMFS Permits and Conservation Division will prepare annual reports to NMFS ESA Interagency Cooperation Division to demonstrate compliance. Permit applications that fall outside of the scope of the programmatic consultation will be processed as NMFS Permits and Conservation Division currently does, with an individual informal or formal consultation.

3.1.4 Public and Expert Comments

The next steps often occur simultaneously, but this is not required. In current practice, NMFS Permits and Conservation Division send the application out for scientific review and publish a Notice of Receipt in the *Federal Register* to begin a mandatory 30-day public comment period (50 C.F.R. §216.33). A 30-day public comment period is required for new permits and major modifications. Minor modifications (e.g., modifying tag designs that result in equivalent or lesser impacts) and authorization letters (e.g., adding co-investigators) do not require public comment periods. NMFS Permits and Conservation Division also distributes the application to the Marine Mammal Commission and its Committee of Scientific Advisors for a concurrent 45-day review period (50 C.F.R. §216.33). If requested, the Director of the Office of Protected Resources may extend a comment period or hold a public hearing on the application at his/her discretion.

Currently, and to support decision-making and assessment of the regulatory requirements for issuance of permits, NMFS Permits and Cooperation Division routinely request reviews of applications by the following:

- NMFS scientists, regional staff (including recovery coordinators) and other federal agencies and state agencies with expertise in the species or subject matter or with management responsibilities (to evaluate bona fide research criteria, appropriateness of methods, recovery value of research, management concerns, etc.).
- NMFS Office of Protected Resources veterinary medical officer with marine mammal experience (to evaluate animal welfare and whether the methods are humane; assess effects of methods, primarily for highly invasive or novel methods or use of drugs).
- NMFS Office of Protected Resources bioacoustician (Dr. Amy Scholik-Schlomer, NMFS Marine Mammal and Sea Turtle Division, to evaluate appropriateness of and impacts from methods that involve the intentional use of sound, such as acoustic playbacks for behavioral response studies).
- NOAA Office of Law Enforcement (to review enforcement records for previous violations of environmental laws including the ESA and/or MMPA for the principal investigator and co-investigators).
- The application may also be sent to appropriate experts with specific subject matter expertise at the discretion of the Director of the Office of Protected Resources.

Under the programmatic consultation, the same review will apply.

3.1.5 Analysis and Decision-Making

For both individual permits and permits that fall under the scope of this programmatic consultation, after the close of a public comment period, the NMFS Permits and Conservation

Division reviews all comments received from reviewers and the public and all substantive comments are addressed by the NMFS Permits and Conservation Division or the applicant. The NMFS Permits and Conservation Division then re-evaluate the issuance criteria for each permit in consideration of comments received and responses from the applicant, and make a final recommendation to the Director of the Office of Protected Resources on whether to issue or deny the permit. Under a programmatic framework, NMFS Permits and Conservation Division completes a checklist (Section 19.2) to document how an application does or does not meet MMPA and ESA issuance criteria to inform this decision. The decision to issue or deny a permit modification is based upon:

- Relevant ESA and MMPA issuance criteria (Section 19.2);
- Comments received on the permit application;
- For individual consultations outside the scope of the programmatic consultation – conclusion of the ESA section 7 consultation resulting in a biological opinion that the proposed action will not jeopardize the continued existence of the species or adversely modify or destroy critical habitat;
- For programmatic consultations, NMFS Permits and Conservation Division review an application and documents in the administrative record for that permit that the proposed actions fall within the scope of a given programmatic biological opinion;
- Whether or not the activity will result in significant environmental effects; and
- Any other information the Director of the Office of Protected Resources deems relevant.

In addition, after considering the comments and recommendations of all reviewers, NMFS Permits and Conservation Division reassesses the level of NEPA analysis required for the proposed action. If that determination requires a more extensive environmental analysis than was determined in the initial NEPA review (i.e., from a categorical exclusion to an environmental assessment or from an environmental assessment to an environmental impact statement), the new NEPA analysis must be completed before the permit process can continue. If additional NEPA analysis is not required, the process continues.

If the permit is issued, a *Federal Register* Notice of Issuance is typically published within ten days, and the permit holder must date and sign the permit and return a copy of the signature page to the NMFS Permits and Conservation Division as certification of their acceptance of the permit terms and conditions (50 C.F.R. §216.33). The permit is effective upon the permit holder signing the permit. In signing the permit, the permit holder agrees to abide by all terms and conditions set forth in the permit and acknowledges that the authority to conduct certain activities specified in the permit is conditional and subject to authorization by the Director of the Office of Protected Resources. If the permit is denied, the Director of the Office of Protected Resources must provide the applicant with an explanation for the denial (50 C.F.R. §216.33). The applicant or any party opposed to a permit may seek judicial review of the terms and conditions of the permit or of a decision to deny the permit. Review may be obtained by filing a petition for review with the appropriate U.S. District Court as provided for by law (50 C.F.R. 216.33).

3.1.6 Legal Authorities, Policies, and Regulatory Requirements

This section summarizes federal laws and regulations applicable to marine mammal research and enhancement. NMFS Office of Protected Resources standards and practices as they relate to ESA section 7 consultation are discussed further below.

3.1.6.1 Endangered Species Act

The ESA (16 U.S.C. 1531 et seq.) was established to conserve and protect threatened and endangered species. Section 2 of the ESA sets forth the purposes and policy of the ESA, which include providing a means to conserve threatened and endangered species' ecosystems and providing programs for the conservation of such species. It is the policy of the ESA that all federal agencies must seek to conserve threatened and endangered species and use their authorities to further the purposes of the ESA.

Section 7 of the ESA requires consultation with the appropriate federal agency (either NMFS or the U.S. Fish and Wildlife Service) for federal actions that "may affect" an ESA-listed species or adversely modify designated critical habitat. NMFS Permits and Conservation Division's issuance of a permit and carrying out research and enhancement activities affecting ESA-listed species or designated critical habitat, directly or indirectly, are federal actions subject to these consultation requirements. NMFS is required to ensure against jeopardy of any threatened or endangered species or in the destruction or adverse modification of designated critical habitat for such species. Such determinations must be made using the best scientific and commercial data available. Regulations specifying the procedural requirements for these consultations are found at 50 C.F.R. Part 402.

Section 9 of the ESA prohibits the take, import, and export of endangered species unless a lawful exception is made, such as through issuance of a permit.

Under section 10(a)(1)(A) of the ESA, NMFS Permits and Conservation may grant permits to take ESA-listed species for scientific purposes or for the purpose of enhancing the survival or propagation of the species. In consideration of the ESA's definition of conserve (with an ultimate goal of bringing a species to the point where listing under the ESA is no longer necessary – i.e., the species is recovered), permits issued pursuant to section 10 of the ESA must be for activities that are likely to further the conservation of the affected species.

NMFS regulations implementing the permit provisions of the ESA can be found at 50 C.F.R. Part 222. Regulations specifying requirements for issuance of ESA scientific research and enhancement permits are found at 50 C.F.R. §222.308.

Section 10(d) of the ESA requires that, for NMFS Permits and Conservation Division to issue permits under section 10(a)(1)(A) of the ESA, NMFS must find that the permit:

- Was applied for in good faith;
- If exercised will not operate the disadvantage of the species; and
- Will be consistent with the purposes and policy in section 2 of the ESA.

3.1.6.2 Marine Mammal Protection Act

The MMPA (16 U.S.C. 1361 et seq.) prohibits takes of all marine mammals in the United States (including territorial seas) with few exceptions. Section 104 of the MMPA provides exceptions for permits for bona fide scientific research on marine mammals and permits to enhance the survival or recovery of a species.

Under section 104 of the MMPA, scientific research and enhancement permits must specify:

- The number and species of marine mammals authorized to be taken or imported;
- The manner (for example, methods, including but not limited to, capture, care, and transportation), location, and duration of the activities; and
- Any other terms or conditions the Director of the Office of Protected Resources deems appropriate.

Applications for MMPA permits must be reviewed by the Marine Mammal Commission. NMFS may issue a permit under section 104 of the MMPA if the activities are consistent with the purposes of the MMPA and applicable regulations at 50 C.F.R. Part 216. NMFS must also find the manner of taking is "humane." The MMPA defines humane in the context of taking a marine mammal, as "that method of taking which involves the least possible degree of pain and suffering practicable to the mammal involved." If lethal taking of a marine mammal is requested, the applicant must demonstrate that using a non-lethal method is not feasible. For depleted species, NMFS must also determine activities resulting in lethal take will directly benefit the species or otherwise fulfill a critically important research need. Persons permitted to take marine mammals must submit reports on activities undertaken each year.

Under section 104 of the MMPA, a permit may also be issued for enhancing the survival or recovery of marine mammals in the activity:

- Is likely to contribute significantly to maintaining or increasing distribution or numbers necessary to ensure the survival or recovery of the species; and
- The activity is consistent with an existing recovery plan for the target species.

Regulations specifying general issuance requirements for permits issued under section 104 of the MMPA (50 C.F.R. §216.34) and specific requirements for issuance of scientific research and enhancement permits (50 C.F.R. 216.41) are included in Section 19.2.

Section 109(h) of the MMPA authorizes Federal, State, and local government employees, or NMFS stranding agreement holders, to take a marine mammal in a humane manner (including euthanasia) if it is for:

- The protection or welfare of the individual animal;
- The protection of public health and welfare; or
- The non-lethal removal of nuisance animals.

NMFS regulations implementing MMPA section 109(h) are found at 50 C.F.R §216.22 and 50 C.F.R. §216.27. For threatened and endangered marine mammals, an ESA section 10(a)(1)(A) enhancement permit is also required to undertake such activities. Therefore, such activities on ESA-listed species must be consistent with the ESA and carried out to enhance the survival of the species.

In limited circumstances under this programmatic consultation, NMFS Permits and Conservation Division may authorize the same methods used for research purposes for ESA enhancement purposes, depending on the nature and objectives of the proposed actions. One example is performing a hearing test (i.e., auditory evoked potential [AEP]) on a stranded animal taken under MMPA section 109(h) and ESA section 10(a)(1)(A), or on a non-releasable rehabilitated animal in captivity taken under the same authority. The hearing test may be conducted as research, but the results will inform the ESA enhancement activities as well.

3.1.6.3 National Environmental Policy Act

The NEPA (42 U.S.C. §4321 et seq.) requires federal agencies to integrate environmental values into their decision-making processes by considering the environmental impacts of their proposed actions and reasonable alternatives to those actions. NEPA is applicable to 'major' federal actions affecting the quality of the human environment. A major federal action is an activity that is fully or partially funded, regulated, conducted or approved by a federal agency. NMFS Permits and Conservation Division's issuance of research and enhancement permits, and any subsequent modifications to permits, represents federal approval and regulation of activities. Procedural requirements under NEPA are provided in the Council on Environmental Quality's implementing regulations (40 C.F.R. Parts 1500-1508).

NMFS has, through NAO 216-6A, established agency procedures for complying with NEPA and implementing regulations issued by the Council on Environmental Quality. NAO-216-6A specifies that issuance of scientific research permits under the ESA and MMPA is among a category of actions that are generally categorically excluded from further environmental review, except under extraordinary circumstances as outlined in the order.

As part of and in addition to NEPA, in determining whether to issue or deny an ESA/MMPA permit request, NMFS Permits and Conservation Division must consider whether the action will comply with other federal laws. NMFS Permits and Conservation Division works closely with other federal agencies to facilitate review of each permit based on the nature of the proposed actions to consider potential impacts to other resources protected by these laws, ensure coordination of activities, and ensure transparency in the Office of Protected Resources' decision-making process. The following is a list of federal laws that NMFS routinely considers:

- Animal Welfare Act – Sets standards and certification requirements for the humane handling, care, treatment, and transportation of captive marine mammals and established requirements for IACUCs.

- Coastal Zone Management Act – Provides for the preservation, protection, development, restoration, and enhancement of the resources of the Nation's coastal zone for this and succeeding generations.
- Convention on International Trade in Endangered Species of Wild Fauna – Ensures that international trade in specimens of wild animals and plants does not threaten their survival; in the United States, the Convention on International Trade in Endangered Species of Wild Fauna is implemented by section 8 of the ESA.
- Magnuson-Stevens Fishery Conservation and Management Act – Provides for the conservation and management of United States fishery resources.
- Migratory Bird Treaty Act – Established to conserve and protect migratory birds on a national and an international level.
- National Historic Preservation Act – Established to preserve historical and archaeological resources in the United States.
- National Marine Sanctuaries Act – Authorizes the Secretary of Commerce to designate and protect areas of the marine environment with special national significance due to their conservation, recreational, ecological, historical, scientific, cultural, archeological, educational, or esthetic qualities as national marine sanctuaries.

3.1.6.4 Regulatory Requirements for Endangered Species Act/Marine Mammal Protection Act Permits

Statutory and regulatory requirements common to all ESA/MMPA permits include the following:

- Regulatory requirements for issuing and modifying permits;
- General permit terms and conditions;
- Duration of permits;
- Mitigation measures to minimize impacts and ensure compliance with the MMPA and ESA;
- Monitoring requirements to determine the status of individual animals after they have been handled and the effects of research related disturbance, especially in relation to the incidence of serious injury and mortality;
- Requirements for timely dissemination of research results and notification of publications; and
- Types of information required in permit reports.

This section illustrates how each statute's requirements are incorporated into the permit process, decision-making, and management of permits. Where ESA regulations are silent on general permit requirements, NMFS Permits and Conservation Division has adopted MMPA regulatory requirements for consistency across species groups. Each section cites the applicable regulations from which each requirement originates.

Endangered Species Act /Marine Mammal Protection Act permits for scientific purposes or for the enhancement of propagation or survival of the species: Issuance criteria (50 C.F.R. §216.34, 216.41, and 222.308(c))

Endangered Species Act Issuance Criteria (50 C.F.R. §222.308(c))

In addition to the above requirements, ESA regulations identify issuance criteria specific to research and enhancement permits. In determining whether to issue a permit, the Director of the Office of Protected Resources (delegated by the Assistant Administrator), shall specifically consider, among other application criteria:

- Whether the permit was applied for in good faith;
- Whether the permit, if granted and exercised, will not operate to the disadvantage of such endangered species;
- Whether the permit would be consistent with the purposes and policy set forth in section 2 of the ESA;
- Whether the permit will further a bona fide and necessary or desirable scientific purpose or enhance the propagation or survival of the endangered species, taking into account the benefits anticipated to be derived on behalf of the endangered species;
- The status of the population of the requested species and the effects of the proposed action on the population, both direct and indirect;
- If a live animal is to be taken, transported, or held in captivity, the applicant's qualifications for the proper care and maintenance of the species and the adequacy of the applicant's facilities;
- Whether alternative non-endangered species or population stocks can and should be used;
- Whether the animal was born in captivity or was (or will be) taken from the wild;
- Provision for disposition of the species if and when the applicant's project or program terminates;
- How the applicant's needs, program, and facilities compare and relate to proposed and ongoing projects and programs;
- Whether the expertise, facilities, or other resources available to the applicant appear adequate to successfully accomplish the objectives stated in the application; and
- Opinions or views of scientists or other persons or organizations knowledgeable about the species, which is the subject of the application or of other matters germane to the application.

ESA regulations at 222.308(b) also dictate that permits for ESA-listed marine mammals be issued in accordance with MMPA provisions under 50 C.F.R. §216.

MMPA regulations include several issuance criteria that mirror the above ESA issuance criteria. Additional MMPA regulatory requirements apply, as follows:

Marine Mammal Protection Act General Permit Issuance Requirements (50 C.F.R. §216.34)

- Permit applicants must demonstrate that the proposed activity is:
  - Humane and does not present unnecessary risks to the health and welfare of marine mammals;
  - Consistent with all restrictions in 50 C.F.R. §216.41; and
  - By itself or with other activities, will not likely have a significant adverse impact on these species.
- Any import or export of marine mammals or parts will not result in the taking of marine mammals or marine mammal parts beyond those authorized by the permit.

Marine Mammal Protection Act Scientific Research and Enhancement Permit Issuance Requirements (50 C.F.R. §216.41)

In addition to general issuance criteria for all MMPA permit types, for scientific research and enhancement permits specifically applicants must demonstrate that:

- The proposed activity furthers a bona fide scientific or enhancement purpose.
- If the lethal taking of marine mammals is proposed:
  - Non-lethal methods for the research are not feasible; and
  - For depleted, endangered, or threatened species, the results will directly benefit that species, or will fulfill a critically important research need.
- Any permanent removal of a marine mammal from the wild is consistent with any applicable quota established by the Director, NMFS Office of Protected Resources.
- The proposed research will not likely have significant adverse effects on any other component of the marine ecosystem of which the affected species is a part.

For endangered species, the applicant must demonstrate that:

- The proposed research, by itself or in combination with other activities will not likely have a long-term direct or indirect adverse impact on the species.
- The proposed research will either:
  - Contribute to fulfilling a research need or objective identified in a species recovery or conservation plan;
  - Contribute significantly to understanding the basic biology or ecology of the species, or to identifying, evaluating, or resolving conservation problems for the species; or
  - Contribute significantly to fulfilling a critically important research need.

Application Review Checklist

These issuance criteria are included as part of NMFS Permits and Conservation Division's application review checklist (see Section 19.2). The lead permit analyst completes the issuance criteria checklist during processing and prior to permit issuance taking into consideration:

- The content of the permit application and any additional information provided; and

- Comments and responses during NMFS Permits and Conservation Division's review of the application as well as review by the following (as applicable):
    - NMFS ESA Interagency Cooperation Division;
    - Marine Mammal Commission and its Committee of Scientific Advisors;
    - NMFS regional offices (recovery coordinators and managers);
    - NMFS science centers (subject matter experts);
    - NMFS veterinary medical officer (e.g., for invasive procedures);
    - NMFS bioacoustician (for active acoustics);
    - State agencies;
    - Other Federal agencies with expertise or management responsibility;
    - Other select experts; and
    - The general public.

NMFS Permits and Conservation Division ask reviewers in particular to assess:

- The conservation and recovery value of the proposed research;
- Whether the study design, sample, size, methods, and mitigation are appropriate;
- Whether the expertise and resources are adequate; and
- Whether the activities are conducted in a humane manner.

Comments and responses are summarized in two memoranda transmitted from the Chief of the NMFS Permits and Conservation Division to the Director of the Office of Protected Resources: (1) an internal comment memorandum summarizing and addressing comments from NMFS regional offices, science centers, and other solicited experts; and (1) a memorandum recommending issuance or denial summarizing and addressing the Marine Mammal Commission, other Federal agency, and public comments. When completing the checklist, as applicable, the NMFS Permits and Conservation Division prepares an administrative record to include this criteria (e.g., a discussion in the internal memorandum).

The development of programmatic permitting paradigms is new in inception and implementation, and over time NMFS Permits and Conservation Division expects for the process to continue to evolve and improve. For example, as part of their development of standard research methods, NMFS Permits and Conservation Division are moving forward setting objective criteria to assess qualifications, and will seek to standardize this evaluation over time. Developing standard metrics for tagging qualifications will be a priority and will be done in consultation with expert taggers, NMFS scientists, Marine Mammal Commission, and NMFS ESA Interagency Cooperation Division. NMFS Permits and Conservation Division will continue to standardize application reviews, and the Deputy Chief of the NMFS Permits and Conservation Division will ensure consistency in the interpretation and analyses of the criteria in Section 19.1. These continuing improvements will be completed within the scope of the programmatic consultation framework and are not expected to result in re-initiation of consultation.

3.2 Proposed Implementation of a Program for the Issuance of Permits for Research and Enhancement Activities on Cetaceans

The NMFS Permits and Conservation Division's plan to process permit applications and manage permits with a programmatic consultation in place involves the implementation of:

- Tracking the allocation and use of take for each species or DPS;
- Monitoring the effects of research and enhancement activities on protected species;
- Monitoring the status of the ESA-listed species or DPS; and
- Reporting of this information and any adaptive management actions to the NMFS ESA Interagency Cooperation Division.

3.3 Processing Permit Applications and Take Allocation

When the NMFS Permits and Conservation Division issue a directed take permit for protected species, takes are authorized by ESA-listed species and location. If a permit holder does not use all of the takes authorized in a given year, the unused takes are forfeited and cannot be used in a subsequent year (with the exception of a one time, one-year permit extension for takes in the last year of the permit). This ensures that the NMFS Permits and Conservation Division's original assessment of the effects of the authorized research and enhancement activities remains valid over the life of the permit. Allocation of take in permits on an annual basis will generally remain unchanged going forward under a programmatic consultation framework. To date, the NMFS Permits and Conservation Division have processed individual permit requests as they are received, batching the processing of requests that have a similar nature and scope where possible for efficiency and streamlining of NEPA and ESA analyses and related paperwork. However, issuing permits on a case-by-case basis presents a challenge for tracking and monitoring authorized and reported take of ESA-listed species on an annual basis under a programmatic consultation framework. To address this, the NMFS Permits and Conservation Division is testing the feasibility of shifting to a set annual permit cycle for a species or taxa group, which began with sturgeon in 2017.

3.4 General Permit Terms and Conditions

Scientific research and enhancement permits issued under the ESA and MMPA require researchers to abide by general terms and conditions based on requirements of the statutes and regulations. As stated in the NMFS Permits and Conservation Division's ESA/MMPA permit template (Section 19.3), research and enhancement activities authorized in a permit must occur by the means, in the areas, and for the purposes set forth in the permit application, and are limited by the terms and conditions in a permit. Permit noncompliance constitutes a violation of the ESA/MMPA and may be grounds for permit modification, suspension, or revocation, and for enforcement action. A description of the general terms and conditions common to permits issued by the NMFS Permits and Conservation Division for all species is provided here. Additional terms and conditions specific to permits issued under the program for research and enhancement activities on cetaceans are described in the sections to follow.

All research and enhancement permits for cetaceans contain terms and conditions that address the following:

- Duration of permit;
- Number and kinds of protected species, locations, and manner of taking;
- Qualifications, responsibilities, and designation of personnel;
- Possession of permit;
- Reports;
- Notification and coordination;
- Observers and inspections;
- Permit modification, suspension, and revocation;
- Penalties and permit sanctions; and
- Acceptance of permit.

3.4.1 Duration of Permits

Each permit specifies an expiration date. Currently, the NMFS Permits and Conservation Division issues MMPA permits for up to five years and ESA permits covered under a programmatic consultation for up to ten years, as the ESA does not limit the duration of a permit. Under the MMPA, scientific research and enhancement permits and amendments may be valid for a maximum of five years from the date of issuance (50 C.F.R. §216.35(b)). The five-year period may be extended up to 12 months beyond that established in the original permit via a minor amendment (50 C.F.R. §216.39) to allow for uninterrupted continuation of research. The Permits and Conservation Division considers the extension requests for ESA/MMPA permits for work of a continuing nature if the permit holder has submitted a new application to continue the research and enhancement activities. To ensure that environmental analyses prepared for issuance of the permit under the MMPA, ESA, and the National Environmental Policy Act remain valid in extending the permit, the NMFS Permits and Conservation Division conditions the extension such that no additional take numbers of species is authorized over the life of the extension. Rather, the extension allows the permits holder to use any authorized takes remaining from the last year of the permit over an additional 12 months or until the permit holder has reached the take limit in the last year of the permit, whichever occurs first. When takes are exhausted, or the permit cannot be extended, then research and enhancement activities must stop until a new permit is issued. In the future, the NMFS Permits and Conservation Division may modify the MMPA regulations to allow for ten-year MMPA permits and if so, ten-year permit durations then apply to permits issued under this programmatic consultation. The permit also specifies that the permit holder may continue to possess biological samples of the target species acquired under the permit after permit expiration without additional written authorization, provided marine mammal samples are maintained as specified in the permit.

3.4.2 Number and Kinds of Protected Species, Locations, and Manner of Taking

Each permit contains a table outlining the number of animals authorized to be taken (by species, stock, or ESA listing unit), and the locations, manner, and time period in which they may be taken. In addition, authorized personnel (researchers) working under a permit may take photographs and video incidental to research or enhancement, provided it does not result in take not authorized by the permit. The Chief of the NMFS Permits and Conservation Division also may authorize non-essential activities (e.g., documentary film crew). These activities must not influence the research or enhancement or result in additional takes.

3.4.3 Qualifications, Responsibilities, and Designation of Personnel

All research and enhancement permits identify by name the researchers (principal investigator and co-investigator) authorized to direct and supervise the permitted activities. Individuals conducting permitted activities must possess qualifications commensurate with their roles and responsibilities. The roles and responsibilities of personnel operating under a permit are as follows:

- The permit holder is ultimately responsible for activities of individuals operating under the permit. Where the permit holder is an institution, the responsible party is the person at the institution who is responsible for the supervision of the principal investigator.
- The principal investigator is the individual primarily responsible for the taking, import, export, and related activities conducted under the permit. The principal investigator must be on site during activities conducted under this permit unless a co-investigator is present to act in place of the principal investigator.
- Co-investigators are individuals who are qualified to conduct activities authorized by the permit without the onsite supervision of the principal investigator. Co-investigators assume the role and responsibility of the principal investigator in the principal investigator’s absence.
- Research assistants work under the direct and on-site supervision of the principal investigator or co-investigator. Research assistants cannot conduct permitted activities in the absence of the principal investigator or co-investigator and are not named in the permit.

Personnel involved in permitted activities must be reasonable in number and essential to the conduct of the permitted activities. Essential personnel are limited to the following:

- Individuals who perform a function directly supportive of and necessary to the permitted activity (including operation of vessels or aircraft);
- Individuals included as backup for essential personnel; and
- Individuals included for training purposes.

Persons who require state or Federal licenses to conduct activities authorized under a permit (e.g., veterinarians, pilots) must be duly licensed when undertaking such activities. Permitted activities may be conducted on vessels or aircraft or in cooperation with individuals engaged in commercial activities, provided the commercial activities are not conducted simultaneously with the permitted activities, except with written approval of the Chief of the NMFS Permits and Conservation Division, such as for a news article or documentary film. The permit holder cannot require direct or indirect compensation from persons requesting to conduct activities under the permit. For permits held by NMFS offices, the NMFS Permits and Conservation Division may allow the responsible party or principal investigator to designate additional co-investigators and must provide a copy of the letter designating the individual to the NMFS Permits and Conservation Division on the day of designation.

3.4.4 Possession of Permit

Permits cannot be transferred or assigned to any other person. The permit holder and persons operating under the authority of a permit must possess a copy of the permit when engaged in a permitted activity. A copy of the permit must be attached to any means of containment in which a protected species or protected species part is placed for purposes of storage, transit, supervision or care.

3.4.5 Reports

Permit holders must submit annual and incident reports, and papers or publications resulting from the activities authorized by a permit. Research results must be published or otherwise made available to the scientific community in a reasonable period of time.

Annual reports must be submitted at the conclusion of each year for which a permit is valid, due 60 days after the end of each reporting period (either a calendar year or a 12-month period determined by field seasons or timing of issuance). The NMFS Permits and Conservation Division updated the report form for all species on February 1, 2018 to streamline reporting requirements for efficiency and to collect better information on observed responses and the condition of animals from research and enhancement activities.

As required by conditions of the permit, each annual report must include the following:

- A table reporting the number of animals taken, by species, activity, and location;
- A discussion of progress made toward meeting the permitted objectives;
- Problems encountered and steps to resolve such problems;
- Unauthorized take of animals or unintentional injuries or deaths of animals;
- Observed responses and effects permitted activities had on animals;
- Follow-up monitoring efforts and observations of subject animals;
- Steps taken to coordinate activities with NMFS Regional Offices and other permit holders; and
- Additional information as required by the permit on a case-by-case basis to monitor impacts of specific activities to animal health, effectiveness of protocols, etc. (see Section 19.3).

For the last year the permit is valid, the permit holder must submit a joint annual/final report after conclusion of research or expiration of the permit. In addition to the above information, the report must include the following details:

- A description of how project goals were accomplished or an explanation of why they were not accomplished;
- A description of how the activities benefited MMPA-depleted or ESA-listed species promoted recovery, or conserved the target species and fulfilled objectives listed in the recovery plan; and
- Identification of any new or improved mitigation measures.

Section 19.4 includes the NMFS Permits and Conservation Division's annual report form, which has been revised to improve the NMFS Permits and Conservation Division's monitoring capabilities and inform other section 7 consultations. On a case-by-case basis, the NMFS Permits and Conservation Division may determine that a permit also required additional "special" (e.g., research- or species-specific) reporting to closely monitor and evaluate the impacts of specific procedures. This may occur when more information is needed on the potential for harm or injury of a research procedure or when new scientific information (reports, publications, presentations, etc.) indicates that an activity may warrant closer monitoring for impacts to the target species or other portions of the environment. When such a report is required, the permit also will contain a requirement for annual reauthorization. In this scenario, the permit is temporarily suspended at the end of each permit year (12-month period) and the permit holder must report on the work that occurred during the year as noted above and any additional monitoring requirements, such as re-sighting data, photographs or tag transmissions of target animals, for the NMFS Permits and Conservation Division's review. Based on review of the report, veterinarian and expert opinions as warranted, and relevant information from the literature, the NMFS Permits and Conservation Division may modify, discontinue or reauthorize the activities under the permit for the next permit year. Special reports may be provided to the NMFS ESA Interagency Cooperation Division and NMFS regions to assist with consultations on non-research activities as well as recovery actions.

Incident reports are required for any events of serious injury or otherwise exceeding take authorized by the permit. This may include exceeding authorized take numbers, activities, species, or anticipated effects of the authorized research (e.g., expected responses to dart/barb tags and the incident with L95, a member of the Southern Resident DPS of killer whales). Incident reports must be submitted within two weeks of the incident and describe the events and steps that will be taken to reduce the potential for additional incidents. In these events, as required by the permit, researchers must cease permitted activities until the NMFS Permits and Conservation Division allows the work to resume. The NMFS Permits and Conservation Division will review the report and facts relevant to the incident, such as a necropsy report in the case of an unauthorized mortality, and determine whether the methods and protocols and/or permit requirements, such as mitigation measures or take numbers, need to be modified before work can resume.

3.4.6 Notification and Coordination

Permit holders must provide written notification of planned fieldwork to the applicable NMFS Assistant Regional Administrator(s) at least two weeks prior to initiation of a field trip/season and must include the locations of the intended field study and/or survey routes, estimated dates of research, and number and roles of participants. Permit holders must coordinate activities with other permit holders conducting the same or similar activities on the same species, in the same locations, or at the same times of year to avoid unnecessary, repeated disturbance of animals.

3.4.7 Observers and Inspections

At the request of NMFS, the permit holder must allow an employee of NOAA/NMFS or another designated other person to observe permitted activities. The permit holder must provide documents or other information relating to the permitted activities upon request.

3.4.8 Modification, Suspension, and Revocation

Permits are subject to suspension, revocation, modification, and denial in accordance with the provisions of subpart D (Permit Sanctions and Denials) of 15 C.F.R. §904. The Director, NMFS Office of Protected Resources, may modify, suspend, or revoke a permit in whole or in part under the following circumstances:

- To make the permit consistent with a change in the regulations prescribed under section 103 of the MMPA or section 4 of the ESA;
- In a case in which a violation of the terms and conditions of the permit is found;
- In response to a written request from the permit holder;
- If NMFS determines that the application or other information pertaining to the permitted activities includes false information; and
- 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.

Issuance of a permit does not guarantee or imply that NMFS will issue or approve subsequent permits or amendments for the same or similar activities requested by a permit holder, including those of a continuing nature.

3.4.9 Penalties and Permit Sanctions

A person who violates a provision of a permit, the ESA, MMPA, or the regulations at 50 C.F.R. §216 and 50 C.F.R. §222-226 is subject to civil and criminal penalties, permit sanctions, and forfeiture as authorized under the ESA, MMPA, and 15 C.F.R. Part 904. In addition, per ESA regulation, permits shall not be altered, erased, or mutilated, and any permit which has been altered, erased, or mutilated shall immediately become invalid. The Office of Protected

Resources is sole arbiter of whether a given activity is within the scope and bounds of the authorization granted in a permit. The permit holder must contact the NMFS Permits and Conservation Division for verification before conducting an activity if they are unsure whether an activity is within the scope of the permit. Failure to verify, where the NMFS Permits and Conservation Division subsequently determines that an activity was outside the scope of the permit, may be used as evidence of a violation of the permit, ESA, MMPA, and applicable regulations in any enforcement actions.

3.4.10 Acceptance of Permit

When a permit is issued by signature of the Director, Office of Protected Resources, the permit holder must date and sign the permit, and return a copy of the original signature to the Director, Office of Protected Resources. The permit is effective upon the permit holder's signing of the permit. In signing the permit, the permit holder:

- Agrees to abide by all terms and conditions set forth in the permit, all restrictions and relevant regulations under 50 C.F.R. §216 and 222-226, and all restrictions and requirements under the ESA and MMPA.
- Acknowledges that the authority to conduct certain activities specified in the permit is conditional and subject to authorization by the Director, Office of Protected Resources.
- Acknowledges that the permit does not relieve the permit holder of the responsibility to obtain any other permits, or comply with other Federal, State, local, or international laws or regulations.

3.5 Annual Permit Cycle

The NMFS Permits and Conservation Division has established a trial annual permit cycle for processing new sturgeon and sea turtle permit applications and major modifications. While this change is being tested, the NMFS Permits and Conservation Division are applying this concept to cetacean permit requests. Based on the number of cetacean permits for ESA-listed and non-ESA-listed species that the NMFS Permits and Conservation issue, they may develop more than one cycle to manage the workload. The permit cycle will have a set application deadline each year, giving six months to process the batch of permit requests. If a permit request is received after the submission deadline, at the discretion of the Deputy Division Chief of the NMFS Permits and Conservation Division, the request may either be merged into the batch or the applicant will have to wait until the next permit cycle for the request to be processed. The decision to include a permit request received after the application deadline will be based on the completeness and complexity of the permit request. Permit requests involving only minor modifications and permit authorizations will be processed throughout the year as they are received. These are simpler changes, often administrative in nature, that do not increase the risk of adverse impacts to the species and can be processed within a few weeks.

During each permit cycle, cetacean permit requests will be processed as discussed above. The NMFS Permits and Conservation Division will carefully review requested take numbers and researcher qualifications for invasive procedures. The NMFS Permits and Conservation Division's permit application instructions (Section 19.1) includes the qualification details that personnel must provide. For cetacean permits, research activities, such as deep-implantable tagging, with a higher risk of adverse impacts, analysts in the NMFS Permits and Conservation Division will be looking for applicants to demonstrate how they will minimize impacts from deep-implantable tagging by including details such as:

- Training and experience successfully conducting deep-implantable tagging;
- Inclusion of an IACUC or veterinary-approved protocols; and
- Inclusion of post-tag monitoring protocols.

The NMFS Permits and Conservation Division will use their online database, Authorizations and Permits for Protected Species (APPS), to track the annual number of authorized takes allocated in issued permits and the number of takes reported as used each year. The NMFS Permits and Conservation Division will generate a report using data from APPS to evaluate the takes at any time for each species by location.

For applications whose research activities details (e.g., area, research activities, nature, etc.) fall outside the scope of the action, the NMFS Permits and Conservation Division will process the permit request separately from the batched actions in the permit cycle and will seek individual consultation with the NMFS ESA Interagency Cooperation Division for the action. Any associated deep-implantable tagging for the permit will remain separate from the annual limits for that type of tag issued under the programmatic consultation. An example of such a permit request may be major tag modifications or novel tag designs that fall outside of the impacts discussed for existing tags. The NMFS Permits and Conservation Division do not foresee any such actions at this time and will pursue reinitiation of the programmatic consultation if needed should trends or shifts emerge in the research community.

3.6 Cetacean Research and Enhancement Activities and Associated Mitigation Measures

The following is a description of the general activities that may be authorized by the NMFS Permits and Conservation Division as part of the proposed implementation of a cetacean research permitting program. The authorized research and enhancement methods and protocols are commonly accepted by the researchers in the cetacean community and have been reviewed by the NMFS recovery coordinators and the Office of Protected Resources' veterinary medical officer for effects to cetaceans. In addition to these standard research and enhancement methods and protocols, researchers are required to consider and describe in their permit application additional precautionary measures they can make to further minimize potential impacts of their research and enhancement activities on individual cetaceans. The NMFS Permits and Conservation Division will seek individual consultations that are outside the scope of the programmatic consultations for research and enhancement methodologies that would not be able to follow the standard mitigation measures.

Descriptions of how mitigation measures will be incorporated into the applicant's research and enhancement program must be included in the permit application. Permits may authorize only what is described in a permit application (see Section 19.3); and thus, the permit application is binding, including the methods and mitigation included. Incorporation of additional terms and conditions in a permit also helps to mitigate possible adverse impacts to animals from the permitted activities. In addition to general terms and conditions common to all research and enhancement permits, each permit contains taxa- or species-specific conditions based on the nature of the proposed research and enhancement activities. The taxa-specific conditions are included within the conditions pertaining to the manner of taking, starting at Condition B.5 of the template (Section 19.3), and are discussed more in detail as part of the scope of the proposed action. The taxa-specific conditions chosen for a given permit are based on the research and enhancement activities the permit authorizes for a given species or taxa (e.g., conditions specific to vessel surveys, biopsy sampling, and suction-cup tagging large cetaceans). Additional species-specific requirements may be included based on consultation with NMFS recovery coordinators (e.g., adaptive management for the Gulf of Mexico subspecies of Bryde's whale). The general terms and conditions represent regulatory requirements applicable to all ESA/MMPA research and enhancement permits.

3.7 Authorized Research and Enhancement Activities

The NMFS Permits and Conservation Division proposes to issue scientific research permits to researchers to study cetaceans in all U.S., international, and foreign waters worldwide including the Arctic, Atlantic, Indian, Pacific, and Southern Oceans. The ESA-listed marine mammals that will be targeted in the proposed studies are in Table 10. Research methods include aerial and vessel surveys, passive acoustic monitoring, active (i.e., playbacks, prey mapping, AEPs, and remote ultrasound) acoustics, biological sampling (i.e., biopsy, breath, fecal, prey, skin, sloughed skin, and environmental DNA sampling),tagging, pinniped surveys, import/export and salvage of carcass, parts, or tissues, and captive studies.

3.7.1 Aerial Surveys

The proposed research and enhancement activities will include aerial surveys using manned aircraft and unmanned aircraft systems. Aerial surveys will take place year-round as needed for all cetacean species, subject to aircraft and funding availability.

Finding, identifying, and counting animals is the foundation of almost all research activities on cetaceans. Researchers use a variety of platforms on the sea and in the air to look for animals. Aerial surveys can be opportunistic or follow a strictly regimented design. Aerial surveys can be designed to find all species in the area or tailored to focus on a specific species. When researchers locate animals, they will then count all of the animals in the area. The data is used to examine abundance, group size, and social structure. Aerial surveys are also used for other research methods such as photo-identification, photogrammetry and videogrammetry, behavioral observations.

3.7.1.1 Line Transect Surveys

Line transect surveys is a sampling technique commonly used by researchers to estimate the abundance of cetaceans (Buckland et al. 2015). Researchers will look for animals while traveling along pre-determined tracklines. A basic assumption of line transect survey methodology is that animals directly on the trackline are seen by the visual observer. However, this assumption is known to fail for almost all wildlife surveys, in particular marine mammal surveys. Visibility bias is a function of both the animals not being available to observe, for example when submerged, while perception bias is when available animals are missed by observer. Perception biases arise due to observer inexperience or fatigue and due to conditions or behaviors that make the animals difficult to identify visually. Line transect surveys are designed to minimize biases and to yield the best possible abundance estimate.

Manned aerial surveys use conventional line transect sampling and are typically flown at an altitude of 213.4 meters (700 feet), but may range from 152.4 to 304.8 meters (500 to 1,000 feet), depending on the target species. They usually travel at airspeeds of 165 to 175 kilometers per hour (102.5 to 108.7 miles per hour). When possible, aerial surveys will be flown using a twin-engine, high-wing aircraft, such as de Havilland Twin Otter, Turbo Commanders, or Partenavias, but may include other aircraft types including helicopters. For coastal waters, small airplanes may be used. Depending on the research objectives and target species, aerial surveys may occur from the coast to 370.4 kilometers (200 nautical miles) offshore. Flight durations typically last four to six hours, but are dependent on aircraft capabilities, weather, transect lengths, and fuel constraints. The airplane or helicopter will fly along predetermined tracklines located systematically across the study area. The manned airplanes or helicopter may have a built-in camera system in the fuselage, or observers may use hand-held digital single lens reflex cameras for photography and photogrammetry. Many airplanes have bubble windows on either side of the airplane that expand the search area and allow observers to look down directly below the airplane.

The number of personnel and their duties depends on the size of the aircraft. A typical flight crew may consist of a pilot and co-pilot, a data recorder, left observer, and right observer. A belly observer or rest position may also be added to the science party of the flight crew, depending on the goals of the aerial survey and the cabin space inside the aircraft. Observers may be divided into two independent teams. Data will be recorded for all sightings of marine mammals and routine updates of time, global positioning system (GPS) location, and environmental conditions (e.g., Beaufort sea state, glare, and cloud cover).

When animals are observed by plane, researchers may count them. The observers may request that the pilot leave the trackline and circle back to the animals. Additional passes over the animals may help to count groups size, identify the species, determine the presence of calves, observe behavior, or conduct research methods such as photo-identification or photogrammetry. During circling, the airplane may increase in altitude to count large groups or decrease in altitude to identify species or take detailed photographs. The minimum altitude is typically around 91.4 meters (300 feet) for such descents.

In some cases, the circling is part of the systematic line transect sampling. The "circle-back" procedure consists of the airplane continuing along the trackline for approximately 30 seconds after animals are first observed, then the airplane flies back toward the group of animals in a wide arc, maintaining the same altitude. The aerial survey will then recover the same trackline and observers will make a second count of the animals. Circling events typically last from less than ten minutes to one hour, depending on factors such as research objectives, species or Beaufort sea state.

Under certain circumstances, researchers may conduct a strip transect survey oriented to a visual feature such as coastline, fjord or ice lead; however, these are uncommon because the theoretical assumptions required to make a strip transect analysis valid are rarely met.

If an animal or group of animals exhibit avoidance or evasive behaviors to the aircraft, researchers will move on to a different group of animals. Animals may sometimes respond to changes in the aircraft's engine pitch or shadows projected when it dives rapidly.

3.7.1.2 Non-Line Transect Surveys

Researchers may use airplanes, helicopters or other aircraft to search for animals. These flights typically do not follow predetermined tracklines, but may be organized around geographic features such as the coast or leads in sea ice. Non-line transect surveys are typically flown at an altitude of 91.4 to 304.8 meters (300 to 1,000 feet) depending on target species, weather, and survey objectives. Standard line transect surveys are designed to collect data on the distribution and abundance of cetacean species. Non-line transect surveys may focus on a particular species. Researchers will use aircraft to locate animals and then use research methods such as photography and videography, photogrammetry and videogrammetry, and behavioral observations to collect data on animals. Data collected during non-line transect surveys may be used to examine distribution, abundance, group size, feeding, body condition, body size, entanglements, or social structure. In some cases, aerial surveys will coordinate with research vessels on the water. Aircraft can cover wider distances more quickly and may be able to find animals quicker than observers on a research vessel. When researchers find animals, the research vessel can be directed to their location. Researchers on the research vessel may approach the animals for a variety of objectives such as photo-identification, biopsy sampling, health assessment, or tagging. Aircraft may be used to locate tagged animals that emit a VHF signal.

During aerial surveys, aircraft may circle the animals. Helicopters may hover over the animals. The circling or hovering typically lasts less than 15 minutes. Flight durations typically last four to six hours, and are dependent on aircraft capabilities, weather, transect lengths, and fuel constraints.

3.7.1.3 Photography and Videography

Researchers will conduct photography and videography during aerial surveys. Close approaches will be conducted in a manner that minimizes aircraft noise without sudden changes in speed or course. The approach distance and location of the aircraft relative to the animal is typically 213.4 meters (700 feet) with brief descents or circling no lower than 91.4 meters (300 feet), but will vary by species. Encounter times for photography and videography is typically less than ten minutes to an hour in duration, but may be extended in certain circumstances (e.g., for detailed images).

Researchers will take photographs with a digital camera, and specifically recommend digital single lens reflex cameras. Digital photography will allow the researcher to instantly review images and allows them to move on and avoid additional aerial survey effort. Digital cameras with a telephoto zoom lens may be used to obtain the required images without approaching animals too closely. Video may be collected by researchers' digital single lens reflex or other cameras to complement the still images and behavioral data.

Researchers will limit the number of passes made during aerial surveys to collect photographs or videos in order to minimize the time spent in the vicinity of the target animal(s). Flight durations may be longer for groups of animals because of the need to identify multiple individuals. As requirements of the permit (see Section 19.3), researchers must approach animals cautiously and retreat if behaviors indicate the approach may interfere with reproduction, feeding, or other vital functions. For all species, approaches for photographs and video will be conducted in such a way as to ensure no separation of a mother and calf. Approaches for photographs or video typically will be terminated under the following circumstances:

- Photographs or video is obtained of all individuals present;
- Observed cessation of a critical behavior, including feeding, mating, or nursing; or
- Target animal(s) exhibit obvious avoidance of the aircraft or other behavior indicative of disturbance (behavior varies by species).

Photographic Identification

Researchers widely use photo-identification using variation in natural markings, as well as scars, in a variety of studies on cetaceans to address topics such as population abundance and structure, survival and other demographic parameters, regional and migratory movements, reproductive status and history, behavioral and social ecology, body condition and health status, and anthropogenic interactions (e.g., entanglement, vessel collisions). Data on the identification of individuals is commonly tied to tissue sampling for genetic, diet, hormone, pollutant, and other analyses. Researchers have been using photo-identification for more than four decades on numerous species of cetaceans (both mysticetes [i.e., baleen whales] and odontocetes), which has provided invaluable to long-term studies of individual animals across much of their lifetimes.

Markings to be photographed for identification of individuals vary by species. Prominent scars on any part of the body are useful for identification of individuals and will be photographed for any animal of any species. For large cetaceans, natural markings include ventral fluke pattern and shape of the trailing edge (e.g., humpback whales); shape of the fluke (e.g., blue whales, sperm whales, North Atlantic right whales, North Pacific right whales, Southern right whales); dorsal fin shape, size, and markings; pigmentation patterns on the flanks and body, including mottling, blazes, and chevrons (e.g., blue whales, fin whales, gray whales); scars specifically made by cookie-cutter sharks (e.g., sei whales); pattern of callosities on the head (North Atlantic right whales, North Pacific right whales, Southern right whales); and coloration of the head and chin (e.g., bowhead whales). For most small cetaceans, natural markings include the shape, size, and nicks or other changes to the margins or other structure of the dorsal fin or ridge; although natural markings on the body can also be used for some species, including pigmentation patterns (e.g., killer whales) and cookie-cutter shark bites or other scars (e.g., beaked whales).

Researchers will take photographs for identification of individuals with digital single-lens reflex cameras. Digital photography allows the user to instantly review images and determine whether sufficient coverage has bene obtained to identify target individuals; thus, allowing the research to evaluate spending more time with animals. Use of a telephoto zoom lens on the camera is encouraged so that the research can obtain the images for photo-identification without approaching the animals too closely. When the researchers return to the laboratory, photographs will be compared to a catalog of distinctive individuals to determine or confirm identification of individuals. All research activities for photo-identification will cease when clear photographs have been obtained of all individuals present.

Thermal Imaging

Researchers may use thermal imaging, or infrared thermography, as a non-invasive tool to detect animals from long distances (approximately one kilometer [0.5 nautical miles]). Thermal imaging is used to study cetacean diving and feeding patterns and strategies, and assess animal health. Researchers are able to detect animals feeding near the water surface, when they leave "tracks" of colder water upwellings created by the beats of flukes as it travels through warmer surface waters. Thermal imaging can be used to assess animal health by evaluating "hotspots" on the animal's body, which appear to represent areas of healing from invasive tagging, injuries, or skin lesions.

Researchers will photograph the target animal(s) using a high-resolution infrared camera to capture images for photo-identification, video documentation, and behavioral observations. The camera may be used in combination with a telephoto zoom lens, infrared micrometer, forward looking infrared radiometer, and infrared (eight to 14 micron wavelengths or "far infrared") detectors that depend upon emitted infrared light, reflected infrared light, and temperature differentials between animals and backgrounds. Infrared imaging may be used for assessment of wound healing from invasive tagging and focuses on tag attachment sites, especially the entire dorsal fin (when the tag is attached). Images will be captured before and after tag loss at various time intervals post-tagging. Researchers will take images of individuals that have wounds or injuries on the dorsal fin or back from bites from cookie-cutter sharks, larger predatory sharks, conspecific interactions, or propeller wounds.

3.7.1.4 Photogrammetry and Videogrammetry

Researchers may use photogrammetry and videogrammetry as a non-invasive research method to collect morphometrics of cetaceans. This will inform research objectives on topics such as animal health, body condition, and reproductive status. The research method will allow for simultaneous photographic identification of individual animals. Photogrammetry and videogrammetry may be done from aerial surveys and vessel surveys, in conjunction with other research methods such as photo-identification and behavioral observations. Researchers will bring the photographs and video back to the laboratory for analysis, which will include quantifying size and shape, geographic variations within species, or stocks, structure, and proportion of calves. Vertical photographs will be used to illustrate the condition of cetaceans and allowing researchers to obtain an accurate count of cetaceans.

Photographs and videos of target animals will be collected from a camera mounted on the manned or unmanned aircraft with animal measurements quantified based on altitude and focal length to scale. The altitude and encounter time may vary based on the size of the target species and study objectives, but are expected to be within the distances and times described for manned and unmanned aerial surveys. Research methods using unmanned aircraft systems are limited by the unit's battery life. An example of photogrammetry and videogrammetry using unmanned aircraft systems is shown in Figure 2 (Durban et al. 2015).

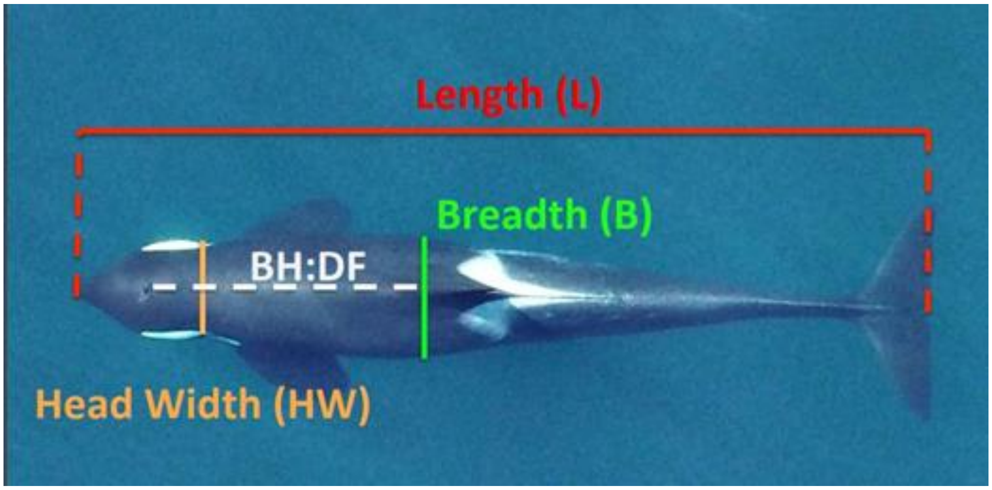


Figure 2. Example of photogrammetry of an individual from the Southern Resident distinct population segment of killer whale.

3.7.1.5 Behavioral Observations

Researchers conduct observations of cetaceans for many purposes including observing natural behaviors, focal follows, observing reactions to anthropogenic or research activities (e.g., military or construction activities and active acoustic playbacks), and monitoring individuals following an invasive procedure (e.g., tagging). Behavioral observations or focal follows may occur during aerial surveys.

During aerial surveys, cetaceans are typically observed at distances greater than 213.4 to 304.8 meters (700 to 1,000 feet); however, the approach distance varies based on species and purpose for observation. Researchers may approach animals closer (up to 91.4 meters [300 feet]) for detailed images, and then retreat to 213.4 to 304.8 meters (700 to 1,000 feet) for behavioral observations or focal follow. Researchers may observe target animals using the naked eye, handheld binoculars, or Big-Eye binoculars and may collect photographs and videos to document the behavioral observations. Behavioral observations may last from 10 minutes to several hours. Other research and enhancement activities may occur concurrently with the behavioral or monitoring observations, including photography, videography, and photo-identification. For behavioral observations, researchers generally maintain a distance (typically greater than 213.4 meters [700 feet]) sufficient to minimize effects from the presence of the aircraft and avoid changes to the animal’s natural behaviors. For monitoring, observations are conducted in a similar manner as described for behavioral observations. The goal of monitoring is typically to observe cetaceans for effects from research or anthropogenic activities depending on the study objectives. Researchers generally maintain a distance typically greater than 21.4 to 304.9 meters (700 to 1,000 feet) and photographs and videos are taken to document the target animals.

3.7.1.6 Manned Aerial Surveys

Manned aerial surveys are generally larger platforms used to complement research objectives such as abundance estimates for marine mammals. Manned aerial surveys will be conducted using fixed-wing aircraft (e.g., NOAA De Havilland Twin Otter, Partenavia P68-C, Cessna Skymaster T337) and rotary-wing aircraft. Aerial surveys will use basic data collection procedures and equipment outlined in (Smultea et al. 2009), but the aircraft type, computer, camera, and other details may vary. As discussed above, manned aerial surveys are generally used for line and non-line transect surveys as well as focal follows, at higher altitudes then unmanned aerial surveys. Drops in altitude for purposes of species identification may occur for short periods of time (e.g., less than ten minutes). Manned aerial surveys are typically conducted using a combination of pilot, back-up pilot, data recorder, and observers. Observers will rotate to avoid fatigue. Basic sighting and environmental data as well as locations will be collected and recorded.

3.7.1.7 Unmanned Aerial Surveys

Unmanned aircraft systems are small platforms used to complement research objectives such as abundance estimates and health assessments by observation, photogrammetry, photography, and remote breath sampling. Aerial surveys using unmanned aircraft systems provide a small scale, low altitude aerial resource at a very low cost when compared to traditional aerial survey options. The low cost and ability to launch the platform from a research vessel or land provide increased survey time that can enhance health and population assessments of cetaceans. Unmanned aircraft systems may be fixed-wing units or rotary, having vertical take-off and landing capabilities. The type of unmanned aircraft system to be used will depend on the research method in use, such as population monitoring, mitigation monitoring, or focal animal follows (Verfuss et al. 2019). Payload components such as cameras, sensors, collection plates, etc. are mounted on the unit and may vary depending on the research objectives.

For the NMFS Permits and Conservation Division to consider permitting the use of unmanned aircraft systems, in addition to discussing how its use will achieve the proposed research objectives, the application must provide sufficient detail to evaluate the potential impacts of its use to protected species and how those impacts will be minimized. These include but are not limited to:

- Unit specifications (type, make, model, dimensions, weight);
- Qualifications of personnel operating the unit (e.g., Federal Aviation Administration licenses);
- Flight duration or encounter time with animals;
- Altitude of operation;
- Whether it has an auto-return feature; and
- Whether it will be flown beyond visual line of sight.

The NMFS Permit and Conservation Divisions application instructions include more details (see Section 19.1).

Further, as a standard requirement of research and enhancement permits, permit holders (including NOAA employees) are responsible for complying with Federal Aviation Administration requirements, including possessing any required licenses or permits needed for unmanned aircraft system operations.

Fixed-Wing Unmanned Aircraft Systems

Fixed-wing unmanned aircraft systems have long, flat wing surfaces and are analogous to airplanes. Units can be small and lightweight (see Figure 3), similar to vertical take-off and landing unmanned aircraft system units or can measure up to 3.1 meters (10 feet) in wing span (see Figure 4). Units may have a batter life of up to three or more hours based on current technology and the size of the unit; however, the NMFS Permits and Conservation Division expect encounter times with animals could increase as technology improves battery life with time. Unlike vertical take-off and landing unmanned aircraft system units, fixed-wing unmanned aircraft system units are manually launched by hand, rail, or catapult. Both unit types are operated in the same manner. Essentially, the flight team is composed of two individuals, a pilot in charge and a ground station operator. The unmanned aircraft system is controlled by the pilot and the ground operator provides the pilot with live video, telemetry data (altitude, position, battery, orientation) and status of each control switch on the radio control unit. The unmanned aircraft system returns to its launch site (or the location of the ground station) when it receives the signal to come home or when there is a loss of link with the radio control unit. The NMFS Permits and Conservation Division may authorize fixed-wing unmanned aircraft system units to fly beyond line of sight in very remote areas, such as the high Arctic, with little air traffic and an extremely low chance of in-air collision.

Figure 3. Example of a small and lightweight fixed-wing unmanned aircraft system, the eBee Plus by senseFly.

Figure 4. Example of a larger fixed-wing unmanned aircraft system, the Puma AE by AeroVironment.

Vertical Take-Off and Landing Unmanned Aircraft Systems

Vertical take-off and landing unmanned aircraft systems (e.g., quadcopter or hexacopter) have rotary blades, similar to a helicopter, and are small in size. They are typically less than 1 square meter (10.8 square feet) and weight under 2.3 kilograms (5 pounds) with payload. The units are almost silent in flight, with sound pressure levels less than 5 decibels re: 1 µPa (rms) at 30 meters (98.4 feet). Example units previously permitted for research and enhancement activities include the APH-22 hexacopter (Figure 6), DJI Phantom, and SnotBot.

Vertical take-off and landing unmanned aircraft systems are remotely operated and may be launched from land and small or large research vessels. The unit often contains a camera which will be used to photograph animals at various altitudes (depending on the target species or DPS), but they typically fly at 15.2 meters (50 feet) or higher. Typical flight time is 15 to 20 minutes and the maximum endurance is about 35 minutes based on current battery technology. During research operations the unit may usually make two to three passes over a target animal or group to get multiple photogrammetric-quality images (see Figure 5). The amount of time the unit will be over an individual is typically one to two minutes.

Figure 5. Example of photogrammetry capabilities using SnotBot under Permit No. 18636-01.

Breath Sampling by Vertical Take-Off and Landing Unmanned Aircraft Systems

The vertical take-off and landing unmanned aircraft systems may be used to collect breath samples for health studies, hormone analysis, and genetics. Researchers will locate target animals using a small research vessel and the operator will track the individual so they are prepared when the animal surfaces to blow. The research vessel will remain a farther distance from the target animal(s) to avoid disturbance while the unmanned aircraft system approaches them for breath sampling. The unmanned aircraft system will follow the animal for about 15 minutes; however, the encounter time is partly driven by battery life. Therefore, the encounter time can be longer (e.g., 30 minutes) if the researchers are using more than one unmanned aircraft system or technological advances lengthen the unit's battery life. Generally, encounters are limited to the minimum time needed to collect the breath sample. To collect breath samples, a sterile collection device (e.g., polymerase chain reaction [PCR] plate, petri dish, nylon fabric) will be directly attached to the unmanned aircraft system, which will be flown through the animal's exhalant cloud no lower than 1.5 meters (5 feet) above the animal and water's surface. In some cases, researchers will attempt to collect consecutive breath samples from the same animal to ensure enough breath sample is collected.

Genetic and hormone samples from an animal's exhalant will be used to provide information on the health and reproductive status of an individual. In some scenarios, researchers may use two unmanned aircraft system units simultaneously in which one unit will fly at a lower altitude over target animals to collect breath samples, while the second unit will fly at a higher altitude and at a farther distance to monitor other animals within a group for signs of disturbance from any of the research and enhancement activities. While not required, using a second unit in this manner can help ensure the potential reactions from animals are observed and recorded for assessing impacts from research and enhancement activities.

Figure 6. Example of a vertical take-off and landing unmanned aircraft system, the APH-22, used for breath sampling under Permit Nos. 19091 and 17355.

3.7.2 Vessel Surveys, Close Approaches, and Documentation

Vessel surveys are the primary means by which cetacean researchers collect data on cetacean species as they provide a platform for researchers to collect a wealth of information on cetacean biology. Here we describe the vessel surveys and associated close approaches more generally and then in each section below, detail the individual research activities that will follow close approaches.

3.7.2.1 Vessel Surveys

Researchers may conduct vessel surveys as a research method to count cetaceans. Vessel surveys can be opportunistic or follow a strictly regimented design. Vessel surveys can find all cetacean species in the area or be tailored to focus on a specific species. Once researchers locate the animals, they are typically counted to examine abundance, group size, and social structure. Other research methodologies conducted during vessel surveys include photography and videography, behavioral observations, active acoustics, passive acoustic monitoring, biological sampling, and tagging. In some cases, researchers may count and observe animals from land, but this generally does not require a permit.

3.7.2.2 Line Transect Surveys

Line transect surveys is a sampling technique commonly used by researchers to estimate the abundance of cetaceans (Buckland et al. 2015). Researchers will look for animals while traveling along pre-determined tracklines. A basic assumption of line transect survey methodology is that animals directly on the trackline are seen by the visual observer. However, this assumption is known to fail for almost all wildlife surveys, in particular marine mammal surveys. Visibility bias is a function of both the animals not being available to observers, for example when submerged, while perception bias is when available animals are missed by observers. Perception biases arise due to observer inexperience or fatigue and due to conditions or behaviors that make the animals difficult to identify visually. Line transect surveys are designed to minimize biases and to yield the best possible abundance estimate.

Large Research Vessels

Research vessels (often greater than 50 meters [164 feet] long) use conventional line transect sampling by traveling along predetermined, randomly-placed systematic tracklines within a study area. They usually travel at speeds of approximately 19 kilometers per hour (10 knots). Tracklines are typically designed to run perpendicular across bathymetry lines. Observers will be stationed on the research vessel (usually the flying bridge deck and/or bridge wings) and will search the area from directly ahead to abeam of the research vessel using the naked eye, handheld binoculars (7 by 50), and pedestal-mounted Big-Eye binoculars (25 by 150). Observations typically occur during all daylight hours. The height of the research vessel above the water surface and the binoculars allow observers to see animals many kilometers away. Depending on the resources available and study purposes, there may be multiple teams of observers that rotate during the daylight hours or act independently of each other. Observers collect data on Beaufort sea state, visibility, glare, heading, latitude, longitude, etc. are recorded at regular intervals for subsequent distance sampling analysis.

When animals are sighted, the bearing and reticle (a measure of radial distance is recorded for data analysis. At the initial sighting, the species and group size may be recorded. The researchers may decide to turn the research vessel off the trackline to approach the animals. The decision to turn the research vessel off the trackline is based on several factors including research objectives, species, animal behavior, weather conditions, or presence of gear in the water. Closer approaches allow observers to better identify the animals to species, or the lowest taxonomic group possible, and to obtains counts that are more accurate. Close approaches by large research vessels are conducted at the minimum speed needed to close the distance between the research vessel and the animal(s), which is usually 19 kilometers per hour (10 knots) or less. If a cetacean chooses to approach the research vessel to bowride, the research vessel may maintain the same constant speed or the research vessel may decrease to half or quarter speed. The research vessel will typically stop approaches when they are within 300 meters (984.3 feet) or greater from the animals in order to avoid disrupting the group or causing them to break into smaller groups. The research vessel will typically approach from the behind or side of the animals. Researchers will stop approaches to animals that exhibit signs of distress (e.g., tail-slapping, forceful exhalations, sustained evasive behavior) as required by the permit (see Section 19.3).

Researchers will make group size estimates of the animals and then use other research methods such as photo-identification and biopsy sampling for the study. They may launch a smaller research vessel from the large research vessel to collect biological samples or conduct tagging. When the researchers have concluded the other research methods, the research vessel will return to the planned trackline and search for animals.

Small Research Vessels

Researchers may use small research vessels (approximately 6 to 7 meters [19.7 to 23 feet] for line transect surveys to estimate the abundance of animals in coastal waters. They usually travel at speeds of approximately 35 kilometers per hour (19 knots). Observers will be stationed on the research vessel and will search the area from abeam to about 20 degrees on either side of the trackline using the naked eye or handheld binoculars (7 by 50). Researchers will rotate between two observer positions and driving the research vessel. If the driver sights animals, they will remain silent until the animals pass the beam of the research vessel. This will allow for an estimate of the number of groups missed by the primary observers. Researchers will record data on Beaufort sea state, visibility, glare, observer, heading, latitude, and longitude. Observations typically occur during all daylight hours.

When animals are sighted, the researchers may decide to turn the research vessel off the trackline to approach the animals, if necessary. Close approaches will be cautious and careful. The research vessel will typically approach by paralleling the animal’s direction of movement and travel at the same speed. Researchers will avoid any sudden changes in speed or direction. The research vessel will typically stop approaches when they are within 20 meters (65.6 feet) or greater from the animals in order to avoid disrupting the group or causing them to break into smaller groups. Researchers will stop approaches to animals that exhibit signs of distress (e.g., tail-slapping, forceful exhalations, sustained evasive behavior) and is also a requirement in the permit (see Section 19.3). Researchers will collect data for each sighting, which typically includes group size, age-class (e.g., adults versus calves), behavior, water depth, sea surface temperature, salinity, and other environmental conditions.

Researchers will make group size estimates of the animals and then use other research methods such as photo-identification and biopsy sampling for the study. When the researchers have concluded the other research methods, the research vessel will return to the planned trackline and search for animals.

3.7.2.3 Non-Line Transect Surveys

Researchers may use large or small research vessels to search for animals. These surveys typically do not follow predetermined tracklines, but may be organized around geographic features such as the coast or leads in sea ice. Standard line transect surveys are designed to collect data on the distribution and abundance of cetacean species. Non-line transect surveys may focus on a particular species or particular animal (e.g., a tagged cetacean). Researchers will use research vessels to locate animals, identify the species, and estimate group size and then use research methods such as photography and videography, photogrammetry and videogrammetry, behavioral observations, passive acoustic monitoring, biological sampling, and tagging to collect data on animals. Data collected during non-line transect surveys may include water depth, Beaufort sea state, salinity, sea surface temperature, and other environmental conditions.

Species-Specific Surveys

Calculating the abundance of some cetacean species may be challenging because it is difficult to obtain accurate and unbiased group size estimates of animals. For these species, researchers may use species-specific counts. A team of five or more observers, with one observer recording data, will typically conduct species-specific surveys. An example provided here is for sperm whales. Sperm whales spend most of their time underwater making their detection and enumeration difficult. Sperm whales surface and dive asynchronously, which is unlike many other cetacean species that may surface and dive in close unison. Also, groups of sperm whales tend to spread out over large areas (square kilometers or square miles).

In order to conduct more accurate counts of groups of sperm whales, researchers use a 90-minute count protocol. Sperm whales dive for periods of time that can exceed 45 minutes. Assuming that no sperm whale will dive for more than 75 minutes, a period of 90 minutes should provide an adequate opportunity for all sperm whales present in the area to be available for detection and enumeration by observers. When the 90-minute count protocol is part of the survey and a group of sperm whale is sighted, a 90-minute count will be initiated based on environmental conditions such as good visibility, low Beaufort sea state, and high sun angles.

Once the 90-minute count begins, the observers will spread out around the research vessel so that any animal that surface anywhere around the research vessel will be sighted. Observers not using Big-Eye binoculars will utilize the naked eye and handheld binoculars. The observers will report all sightings and dives to the data recorder. Observers will attempt to establish a group direction and center as soon as possible, which will likely not be apparent until the 90-minute count protocol is underway. Experienced researchers will help decide the proper course and speed for the research vessel to follow the group of animals. Ideally, researchers will want to follow from 0.8 to 1.6 kilometer (half to one mile) behind the center of the group of animals at an equal speed. At the end of the 90-minute period, all observers will record an independent estimate of the group size of sperm whales. All estimates consist of a high, low, and best count. Small research vessels will not interact with the group of animals during the 90-minute count protocol.

3.7.2.4 Close Approaches

Researchers may approach animals for a variety of research methods during vessel surveys. Researchers will approach target cetaceans in a manner that minimizes noise from the research vessel without sudden changes in speed or course. In general, approaches will be from behind the animal and not greatly exceed their speed (to the extent possible). As required in the permit (see Section 19.3), researchers will approach animals cautiously and retreat if behaviors indicate the approach may interfere with reproduction, feeding, nursing, or other vital functions. Approaches will be terminated if the target animals exhibit avoidance or evasive behaviors to the research vessel or other behavior indicative of disturbance. No mother and calf pairs will be separated.

3.7.2.5 Photography and Videography

Researchers will conduct photography and videography during vessel surveys. The research vessel may be range from a small research vessel powered by an outboard engine (e.g., rigid hull inflatable boat) to a large research vessel. The driver must have sufficient experience in both handling the research vessel and behavior of cetaceans to safely maneuver the research vessel in the presence of animals. Close approaches will be conducted in a manner that minimizes vessel noise without sudden changes in speed or course. The approach distance and location of the research vessel relative to the animal is typically 100 meters (328.1 feet), but may vary by cetacean species. Close approaches will generally be from behind the animals and will, to the extent possible, not greatly exceed the travel speed of the animals. For large cetaceans, the research vessel will typically be maneuvered at a slow speed to within 20 to 40 meters (65.6 to 131.2 feet) to the side of the animals on a parallel course. If the behavior of the cetacean is amenable, drivers may maneuver the research vessels to within 20 meters (65.6 feet) of large cetaceans to obtain higher resolution images. For small cetaceans, the research vessel will typically be maneuvered at a slow speed to within 5 to 20 meters (16.4 to 65.6 feet) to the side of the animals, depending on the size of the species. Photographs of bow-riding animals may be taken on an opportunistic basis from large or small research vessels. Bow-riding animals may approach the research vessel on their own, and a consistent speed will be maintained to avoid startling them. In cases where animal exhibit curiosity and actively approach the research vessel, the driver will typically move away slowly or shift the engine to neutral and float adrift until the animal departs on its own. Encounter times for photography and videography is typically less than ten minutes to an hour in duration, but may be extended in certain circumstances (e.g., for detailed images) for up to 12 hours.

Researchers will take photographs with a digital camera, and specifically recommend digital single lens reflex cameras. Digital photography will allow the researcher to instantly review images and allows them to move on and avoid additional vessel survey effort. Digital cameras with a telephoto zoom lens may be used to obtain the required images without approaching animals too closely. Video may be collected by researchers digital single lens reflex or other cameras to complement the still images and behavioral data.

Researchers will limit the number of approaches made during vessel surveys to collect photographs or videos in order to minimize the time spent in the vicinity of the target animal(s). Average time spent will vary by species and group size, but durations may be longer for groups of animals because of the need to identify multiple individuals. As requirements of the permit (see Section 19.3), researchers must approach animals cautiously and retreat if behaviors indicate the approach may interfere with reproduction, feeding, or other vital functions. For all species, approaches for photographs and video will be conducted in such a way as to ensure no separation of a mother and calf. Approaches for photographs or video typically will be terminated under the following circumstances:

- Photographs or video is obtained of all individuals present;
- Observed cessation of a critical behavior, including feeding, mating, or nursing; or
- Target animal(s) exhibit obvious avoidance of the research vessel or other behavior indicative of disturbance (behavior varies by species).

When research activities such as biopsy sampling or tagging are being conducted, they will be combined with approaches for photography and videography in order to minimize the potential disturbance to animals, unless the invasive research activity is deemed likely to prevent the taking of sufficiently quality photographs or video recordings.

Photographic Identification

Photographic identification (photo-identification) is a widely used method for identifying individual cetaceans. Researchers widely use photo-identification using variation in natural markings, as well as scars, in a variety of studies on cetaceans to address topics such as population abundance and structure, survival and other demographic parameters, regional and migratory movements, reproductive status and history, behavioral and social ecology, body condition and health status, and anthropogenic interactions (e.g., entanglement, vessel collisions) (Hammond et al. 1990). Photo-identification also allows researchers to determine if anthropogenic risk varies by age and/or reproductive class (van der Hoop et al. 2013), which helps inform protected species management. Data on the identification of individuals is commonly tied to tissue sampling for genetic, diet, hormone, pollutant, and other analyses. Researchers have been using photo-identification for more than four decades on numerous species of cetaceans (both mysticetes and odontocetes), which has provided invaluable to long-term studies of individual animals across much of their lifetimes.

Markings to be photographed for identification of individuals vary by species. Prominent scars on any part of the body are useful for identification of individuals and will be photographed for any animal of any species. For large cetaceans, natural markings include ventral fluke pattern and shape of the trailing edge (e.g., humpback whales); shape of the fluke (e.g., blue whales, sperm whales, North Atlantic right whales, North Pacific right whales, Southern right whales); dorsal fin shape, size, and markings; pigmentation patterns on the flanks and body, including mottling, blazes, and chevrons (e.g., blue whales, fin whales, gray whales); scars specifically made by cookie-cutter sharks (e.g., sei whales); pattern of callosities on the head (North Atlantic right whales, North Pacific right whales, Southern right whales); and coloration of the head and chin (e.g., bowhead whales). For most small cetaceans, natural markings include the shape, size, and nicks or other changes to the margins or other structure of the dorsal fin or ridge; although natural markings on the body can also be used for some species, including pigmentation patterns (e.g., killer whales) and cookie-cutter shark bites or other scars (e.g., beaked whales).

Researchers will take photographs for identification of individuals with digital single-lens reflex cameras. Digital photography allows the user to instantly review images and determine whether sufficient coverage has bene obtained to identify target individuals; thus, allowing the research to evaluate spending more time with animals. Use of a telephoto zoom lens on the camera is encouraged so that the research can obtain the images for photo-identification without approaching the animals too closely. When the researchers return to the laboratory, photographs will be compared to a catalog of distinctive individuals to determine or confirm identification of individuals. All research activities for photo-identification will cease when clear photographs have been obtained of all individuals present.

Researchers will approach animals during vessel surveys. For photographs of flukes of large cetaceans (e.g., humpback and sperm whales), the research vessel will typically maneuver at slow speeds to within approximately 25 to 50 meters (82 to 164 feet) behind the animal. For photographs of the body of large cetaceans, the research vessel will typically maneuver at slow speeds to within 20 to 40 meters (65.6 to 131.2 feet) to the side of the animal on a parallel course, catching up from behind to the perpendicular position of the animal. If necessary, the driver of the research vessel may maneuver to within 20 meters (65.6 feet) of large cetaceans to obtain high-resolution images. For photographs if dorsal fins and body of small cetaceans, the research vessel will typically maneuver at slow speeds to within approximately 5 to 20 meters (16.4 to 65.6 feet) behind the animal (depending on the size).

Underwater Photography and Videography

Underwater photography and videography will be used for many research purposes, but is typically used to observe and document behavior and communications or obtain detailed photographs or videos of animals. Detailed images can be used to document past evidence of entanglement or health status, or for photogrammetry. Researchers may obtain underwater photographs and video by snorkelers or divers in the water, or by remote methods such as pole-mounted cameras inserted into the water from research vessels or small, remote controlled semi-submersibles or remotely operated vehicles (e.g., Wave Glider).

For snorkelers or divers taking underwater photographs and videos, a research vessel will typically approach the animals to within 10 to 50 meters (32.8 to 164 feet) so that researchers can enter the water. Snorkelers or divers will approach the target animal until it is in view and then remain stationary to record underwater photography or videography. The researchers may also record behavioral observations and social interactions, and determine the sex of individuals. The distance of approach varies with the visibility of the water and the behavior of the animal. The typical distance is typically 10 to 25 meters (32.8 to 82 feet), but will be no closer than one body-length to the target animal. Underwater observations typically last 15 to 60 minutes, but may be up to six hours. The crew of the research vessel will stand by with the engine idling or off to assist the snorkelers or divers when underwater photography and videography is completed. When the snorkelers or divers have returned to the research vessel, an immediate debriefing will occur among the researchers. Each snorkeler or diver will record their observations vocally on the videotape to inform the subsequent interpretation of the video, and provide ancillary data such as date, time, location, number of animals, pod, gender identification, and other relevant social behavior or environmental conditions. Typically, two to three (maximum of four) snorkelers or divers will be in the water at the same time. Two to three of the researchers will observe (photograph or video) the target animals and one that is responsible for safety.

Snorkelers and divers will make every effort to avoid disturbing animals, as they want to study natural behaviors. Snorkelers and divers will not swim toward the target animal, unless they need to take specific photographs or video (to confirm identification or gender, etc.). Snorkelers and divers will continue observations and documentation until the animals travel beyond the limits or perform behaviors indicating clear disturbance from the researcher’s presence or research activities. Underwater photography and videography will be terminated if the target animals displace adverse behavioral reactions, or if snorkelers and divers are interfering with behaviors such as feeding, mating, or nursing. Researchers will not separate mother and calf pairs. Underwater research activities may also be terminated if the target animals are too amenable and approach snorkelers and divers too closely.

Thermal Imaging

Researchers may use thermal imaging, or infrared thermography, as a non-invasive tool to detect animals. Researchers will photograph the target animal(s) using a high-resolution infrared camera to capture images for photo-identification, video documentation, and behavioral observations (Figure 7). Researchers may approach target animals to within 5 to 10 meters (16.4 to 32.8 feet) in a small research vessel. The research vessel will slowly approach an animal or group of animals from behind or the side to minimize potential disturbance. The camera may be used in combination with a telephoto zoom lens, infrared micrometer, forward looking infrared radiometer (Figure 8), and infrared (eight to 14 micron wavelengths or “far infrared”) detectors that depend upon emitted infrared light, reflected infrared light, and temperature differentials between animals and backgrounds. Infrared imaging may be used for assessment of wound healing from invasive tagging and focuses on tag attachment sites, especially the entire dorsal fin (when the tag is attached). Images will be captured before and after tag loss at various time intervals post-tagging. Researchers will take images of individuals that have wounds or injuries on the dorsal fin or back from bites from cookie-cutter sharks, larger predatory sharks, conspecific interactions, or propeller wounds.

Figure 7. Example of thermal imaging being conducted by a researcher (Dr. Scott Kraus) at sea ([https://www.scientificamerican.com/articl/what-whales-do-at -night/](https://www.scientificamerican.com/articl/what-whales-do-at-night/)).

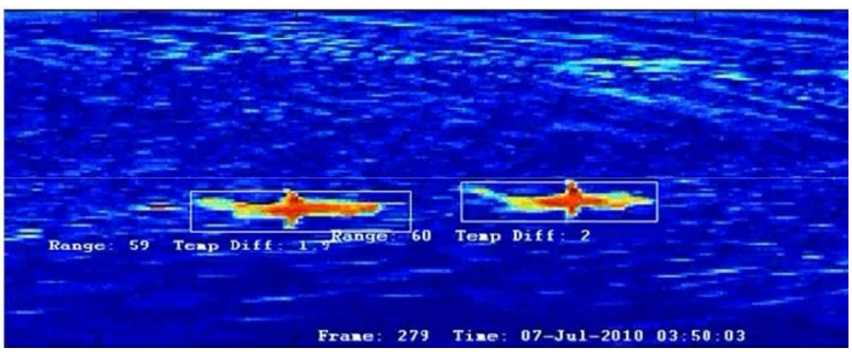


Figure 8. Example of the use of a land-based thermal imaging infrared system (FLIR Thermovision A40M) used for detecting Southern Resident distinct population segment of killer whales (Graber 2011).

3.7.2.6 Photogrammetry and Videogrammetry

Researchers may use photogrammetry and videogrammetry as a non-invasive research method to collect morphometrics of cetaceans. This will inform research objectives on topics such as animal health, body condition, and reproductive status. The research method will allow for simultaneous photographic identification of individual animals. Photogrammetry and videogrammetry may be done from aerial surveys and vessel surveys, in conjunction with other research methods such as photo-identification and behavioral observations. Researchers will use two methods of laser photogrammetry to measure animals from the water surface. Researchers will closely approach the target animal(s) in the same manner as described for photo-identification depending on the size of the species. Researchers may use laser rangefinders to record distance to the photographed animal, which allows the image measurements in pixels to be scaled to true size. Researchers may also use the alternative “laser-metric” approach, where two parallel laser pointers are mounted on a digital camera at known separation (Durban and Parsons 2006). The lasers are projected onto the animal’s dorsal fin or dorsal surface to provide a scale of known size, thus allowing measurements of body length and other morphometrics to be scaled to true size. The lasers will be away from the researchers’ and animals’ eyes, which are typically submerged beneath the water’s surface.

Both of these approaches use low-powered lasers that are safe for researchers and target animals. The laser rangefinders are typically Class 1M and low-powered and judged to be safe for all conditions of use. The laser-pointers used in the laser-metric approach are typically class IIIA lasers (less than 5 megaWatts), or lower power, which comply with the safety regulations for lasers administered by the U.S. Food and Drug Administration (http://www.fda.gov; FDA/CDRH Accession #0010873-09). There is no realistic risk to the health and safety of animals or researchers posed by brief exposure to such lasers, as they are judged to present health hazards only with prolonged exposure (greater than ten seconds) to the retina. Prolonged exposure (even for seconds) is not practically possible for moving animals that surface for a very short period of time. Researchers may use the dual laser approach underwater.

Researchers may conduct photogrammetry and videogrammetry underwater by divers or snorkelers or other remote methods. Underwater photogrammetry and videogrammetry is usually conducted on target animals when they become stationary, mill, or are swimming slowly. The advantage of videogrammetry is that it preserves a record of the target animal’s behaviors and social interactions. The dual laser approach may be used for single still images or videos. Snorkelers or divers in the field have used a digital video camera (e.g., Sonary DCR-TRV-7 or equivalent) in an underwater housing with a handheld high-frequency (200 to 400 Hertz) sonar device (e.g., Speedtech Depthmate). The NMFS Permits and Conservation Division expects the device used underwater to measure distances to be above the hearing range of marine mammals; however, each active acoustic device will be evaluated on a case-by-case basis under the Office of Protected Resource’s revised marine mammal acoustic technical guidance and input from the bioacoustician.

The snorkeler or diver will approach the target the target animals to obtain video for subsequent analysis of size. The researchers will attempt to take images of the animal’s full body length from lateral or topside views taken at right angles to the animal. Multiple images will be obtained to allow for reliability checks on measurements (using a coefficient variation statistic) and to make sure images do not have bending or curvature of the animal’s body, which may affect the researcher’s analysis. The angle of view of the lens is fixed at its widest, permitting calculation of the field of view of the camera at sonar-measured distance to the target animal. When the researchers capture an appropriate, the snorkeler or diver will trigger the sonar device to measure the distance from the camera lens to the target animal. The distance measured will be captured on the digital display of the sonar device and then recorded by placing it in front of the camera. The exact moment of triggering is captured on the video by a click sound from the sonar device. Depending on the target animal's behavior, a second snorkeler or diver equipped with a digital still camera in an underwater housing may be deployed to obtain still photographs of key underwater displays, physical appearance, flukes, or affiliations. Researchers are interested in obtaining reliable sizes of target animals using underwater photogrammetry and videogrammetry as it relates animals size to behavior and communication. Snorkelers and divers may collect data with a particular group of target animals typically from one to two hours, but may last several hours. Researchers take still frames from the photographs or video at the precise moment that a distance measure is obtained. Still frames are captured using a computer program (e.g., Adobe OnLocation) so that the image can be processed and analyzed. The length of the target animal is then calculated as a proportion of the calculated field of view of the camera at the animal's distance, as displayed on a computer screen (Spitz et al. 2000). Research activities will be stopped if the target animal(s) display signs of disturbance.

3.7.2.7 Behavioral Observations

Researchers may conduct behavioral observations for many purposes including monitoring individuals following an invasive research method (e.g., biopsy sampling or tagging) or reactions to anthropogenic or research activities (e.g., military or construction activities, active acoustic playbacks). Behavioral observations, including monitoring and focal follows, may occur concurrently with other research methods such as photography, photo-identification, passive acoustic monitoring, biological sampling, and tagging. Direct behavioral observations of cetaceans provide a wealth of information on their biology and important information needed by managers to effectively conserve and protect these species (see Mann 1999; Nowacek et al. 2016 for reviews). When combined with tagging data, these observations provide detailed information on both the surface and underwater behavior of cetaceans (Nowacek et al. 2016).

Researchers may conduct behavioral observations from research vessels of any size. Large cetaceans are typically observed at distances greater than 100 meters (328.1 feet) and small cetaceans are typically observed at distances greater than 50 meters (164 feet); however, the distance for approaches varies based on species and purpose for behavioral observation. Researchers may closely approach animals (up to 5 meters [16.4 feet] for detailed images, and then retreat to 50 to 100 meters (164 to 328.1 feet) for behavioral observations. Researchers may observe target animals using the naked eye, handheld binoculars, or Big-Eye binoculars and collect photographs and videos for documentation. Observations may last from 30 minutes to several hours, depending on the behavior of the animals and how amenable they are to the researchers.

To minimize impacts to behavior, researchers will typically observe target animals at distances greater than 50 to 100 meters (164 to 328.1 feet). Once behavioral observations begin, researchers will spread out around the research vessel so that all surfacings of animals will be sighted. Researchers will collect data on behavior such as diving, foraging, milling, and other behaviors relevant to other group members or species. Data will be collected continuously or at predetermined intervals during the encounter.

Monitoring

Researchers may conduct observations on cetaceans for monitoring. The goal of monitoring by researchers, depending on the study objectives, is to observe the effects of research activities or other anthropogenic activities on cetaceans. Researchers will typically monitor target animals at distances greater than 50 to 100 meters (164 to 328.1 feet) and may document observations with photographs and video.

Focal Follows

Researchers may conduct focal follows on cetaceans (including individuals, groups, and/or mother-calf pairs) using small research vessels. Researchers will follow target animals for up to 12 hours for observations. To minimize impacts to behavior, researchers will typically follow large cetaceans at distances greater than 100 meters (328.1 feet) and medium to small cetaceans at distances greater than 50 meters (164 feet).

If animals respond to the presence of the research vessel with avoidance or evasive behaviors, then researchers will increase the distance between the research vessel and target animals. Researchers will collect data dependent on research objectives, but may include photographs and videos, group size, association type, time at water surface, respirations, behavior, and environmental conditions.

3.7.2.8 Remotely Operated Vehicles

Remotely operated vehicles offer a way to closely approach cetaceans for observation and data collection, while keeping researchers and large research vessels further away from the animals. A variety of different devices can be used including amphibious vessels that can move between land and water, surface-based vessels, and submersible vessels. The use of remotely operated vehicles by researchers has been limited in recent years; however, filmmakers have used camouflaged research vessels to obtain video of non-ESA-listed cetaceans under the authority of commercial photography permits, and remotely operated vehicles are used to study other protected species, such as ESA-listed sea turtles. As technology continues to improve, remotely operated vehicles may get smaller, cheaper, and result in more researchers adopting these devices, similar to how unmanned aircraft systems have become population tools for research on cetaceans in recent years.

A remotely operated vehicle will typically be deployed from land or the research vessel at distances greater than 100 meters (328.1 feet) from target animals. Trained personnel will maneuver the remotely operated vehicle closer to the target animal(s) to within 50 meters (164 feet) for small cetaceans and 100 meters (328.1 feet) for large cetaceans. Remotely operated vehicles may move freely, or be tethered to the parent research vessel; however, any tethers will be designed to prevent entanglements, such as being made of a rigid material. Remotely operated vehicles come in many sizes from less than one to several meters long. Researchers will select the appropriate remotely operated vehicle for their research activities based on a combination of factors including target species, research objectives, oceanic conditions, and availability. Researchers may choose to camouflage their remotely operated vehicle as something else (e.g., as a rock, iceberg, bird, sea turtle) to try to minimize behavioral reactions by the target animals. Researchers targeting sea turtles are using autonomous remotely operated vehicles that track sea turtles by following an acoustic signal emitted by a tag attached to the sea turtle, and researchers targeting cetaceans may choose to adopt this research method in the future (see Section 3.7.5). Approach distances and duration of time spent with animals will be described in the application and limited by the device's range and battery duration, as well as the research objectives and animal's behavior.

Remotely operated vehicles are typically equipped with cameras and environmental sensors. Images from a remotely operated vehicle will be used for photo-identification, health assessment, gender identification, and behavioral observations. Remotely operated vehicles can film mother-calf interactions, feeding, mating, and other behaviors with minimum to no disturbance of the target animals. Remotely operated vehicles can be equipped with hydrophones to record sound or lasers to conduct photogrammetry.

3.7.3 Acoustics

The proposed research activities will include passive acoustic monitoring, active acoustics (i.e., playbacks and prey mapping), AEP or auditory brainstem response, and remote ultrasound.

3.7.3.1 Passive Acoustic Monitoring

Researchers may conduct passive acoustic monitoring for the presence of marine mammals underwater using acoustic recordings. For the purpose of permitting their use in the presence of cetaceans, research equipment can range from a single hydrophone suspended from a small research vessel to an array of hydrophone receivers towed from a larger research vessel. Bottom-mounted receivers that do not require deployment or maintenance in the presence of cetaceans, and therefore do not result in "take," do not require permitting and are not considered within the scope of this programmatic consultation. Recordings are monitored in real time by a technician on the research vessel. Sounds of interest (marine mammal whistles, echolocation clicks, burst-pulses, unusual or unidentified sounds, etc.) to the researchers are recorded onto a laptop or an external hard drive and fed into a software program (e.g., PAMGuard) for analysis.

Single Unit Hydrophone

When working from small research vessels, researchers may suspend a single hydrophone over the side while the research vessel is stationary in the presence of target animals (within 91.4 meters [300 feet] of large cetaceans and within 45.7 meters [150 feet] for smaller cetacean species). Approach distance are typically driven by other research activities (e.g., photo-identification) occurring during the same encounter. The hydrophone may be suspended up to 30 meters (98.4 feet) deep. Alternatively, a hydrophone may be mounted to the hull of the research vessel, which eliminates any risk of entanglement to ESA-listed species. Another single unit method involves the use of a diver or snorkeler in view of the target animal (e.g., singing humpback whale) and is equipped with a digital video camera with an attached digital audio tape recorder with an array of hydrophones to localize the singer (Schotten et al. 2005). This technique allows for concurrent song recording, behavioral recording, and body size measurement using videogrammetry. As in this last example, this research method usually occurs concurrently with other research activities such as photo-identification and behavioral observation. Therefore, encounter time with animals may vary depending on the objectives and suite of research methods to be performed; typically, encounters are expected to be an hour or less.

Towed Hydrophone Arrays

A towed array consists of a series of hydrophones mounted on polyvinyl chloride (a strong but lightweight plastic) tubing spaced at varying distances, towed by a cable from the research vessel. Lead weight is attached to the array end of the tow cable to sink it to a suitable tow depth based on the target species and can be deployed up to 450 meters (1,476.4 feet) from the research vessel, depending on the size. Towed arrays are typically deployed during daylight hours (approximately 12 hours), but may be conducted during the day and night (approximately 24 hours). When aboard a small research vessel, researchers may use a smaller array with portable towed hydrophones.

When holding station, the tow cable hangs vertically from the research vessel. When in survey mode, the towed hydrophone array can remain in the water for several hours or longer. When in stationary mode, the towed hydrophone array is typically kept in the water for about ten to 30 minutes, and is rarely deployed for longer than one hour. The towed hydrophone array has less tension when operated in the stationary mode, but it typically directed beneath the research vessel, and again has a smooth, streamlined profile that will help to reduce the risk of entanglement with ESA-listed species. For safety reasons, researchers will not deploy the towed hydrophone array within a group of surface feeding animals, for instance, or in any other situation where it seemed an entanglement risk is apparent. Towed hydrophone arrays may be deployed in conjunction with other procedures such as photo-identification and underwater photography depending on the research objectives, such as when recording the song of humpback whales.

3.7.3.2 Active Acoustics – Playbacks

Researchers may conduct active acoustic trials to study how cetaceans respond to different sounds. Such research activities provide empirical measurements of behavior in marine mammals and behavioral changes as a function of sound exposure so that sound producers and regulatory agencies can better understand, minimize, and manage noise impacts on protected species. These behavioral response studies document and quantify reactions or changes to natural and manmade sound stimuli (e.g., marine mammals calls, ship noise, naval exercises, drilling noise, pile-driving, or white noise). The sound source for an acoustic trial is typically from playbacks; however, other sound sources could be used for research purposes including pingers (e.g., to study the effects of bycatch reduction), and controlled exposure experiments using sound sources such as sonar or seismic airgun arrays to study behavioral and physiological responses (Gordon 2003; Southall 2012; Tyack 2003). All sound sources used by researchers will be evaluated using the criteria described below. When combined with other research methods (e.g., behavioral observations, biopsy sampling, and tagging), researchers can also investigate an animal's stress response and fine scale behaviors through animal movements and dive patterns.

Conceptually, an active acoustic experiment directed at cetaceans involves a set time of pre-exposure (baseline) observation of the target animals, that active acoustic exposure (or control), followed by a post-exposure period of animal monitoring. For active acoustic playbacks, sounds are typically broadcast through one or more underwater speakers (e.g., Lubell model LL-1424HP) deployed from a moving or stationary platform such as a research vessel. Researchers will visually monitor and document the behaviors of the targeted animals and any other marine mammals in the area of the experiment before, during, and after each exposure. Regardless of the sound source, the ensonified area for all active acoustic trials will be constantly monitored visually be researchers for non-target species. Researchers may also use passive acoustic monitoring in conjunction with visual monitoring during active acoustic trials. Trial and exposure durations will vary by project but usually only involve minutes of sound exposure per trial. In rare cases, researchers may expose target animals to active acoustics for several hours per day; however, all designs will be analyzed for impacts as described below in this section. Researchers may collect multiple trials per day and in most cases will not know if the same animal is targeted more than once per day. All life stages of animals may be targeted for study.

As defined by NMFS, sound types may be categorized as continuous or intermittent, which defines the temporal aspects of a source important for determining behavioral harassment, and non-impulsive or impulsive, which defines physical characteristics that cause a sound to be more or less likely to produce a noise-induced threshold shift in hearing. The NMFS Permits and Conservation Division expect that the majority of active acoustic trials to include only non-impulsive sound sources. An active acoustic experiment's characteristics will vary based on the study objectives. Therefore, they will limit the authorization of active acoustics for individual permit holders such that the received sound level for any target or non-target marine mammals in the action area does not result in ESA harm (MMPA Level A harassment), such as onset of permanent threshold shift (PTS) as defined in NMFS revised marine mammal acoustic technical guidance (NOAA 2018b). This will be achieved in the cetacean research permitting program by taking the following measures:

- Applying NMFS revised marine mammal acoustic technical guidance, or updated guidance when available, when assessing requests;
- Consulting with the Office of Protected Resource's bioacoustician (e.g., Dr. Amy Scholik-Schlomer, NMFS Marine Mammal and Sea Turtle Division) on each request;

- Calculating a conservative exclusion zone based on the sound's parameters (sound source level, frequency, duty cycle, exposure duration) and expected propagation through the study area to define the isopleth distance corresponding to the ESA harm (MMPA Level A harassment) threshold (peak sound pressure level and cumulative sound exposure level criteria for impulsive sound sources and cumulative sound exposure level criteria for non-impulsive sound sources) for the most sensitive marine mammal hearing group (e.g., high-frequency cetaceans) in the area based on unweighted received sound levels; and
- Assuming that an individual animal can be exposed to all trials, meaning that the NMFS Permits and Conservation Division evaluate the total cumulative sound exposure level from all playbacks conducted in a 24-hour period when assessing impacts and the potential for PTS onset.

Section 19.5 demonstrates an example of how the NMFS Permits and Conservation Division's cetacean research permitting program will ensure that requests for active acoustics (e.g., playbacks, prey mapping, and other research methods that may emit sound) do not result in ESA harm (MMPA Level A harassment) following the NMFS revised marine mammal acoustic technical guidance (NOAA 2018b) and based on conservative assumptions (e.g., auditory weighting functions are not incorporated and maximum exposure duration based on the most sensitive marine mammal hearing group). Additionally, if applicants want to consider additional factors, such as marine mammal auditory weighting functions, NMFS offers an optional user spreadsheet tool to evaluate active acoustic playback protocol.

As a term and condition of the permit (see Section 19.3), researchers must monitor the ensonified area and must stop the trial if any marine mammal approaches or enters the calculated exclusion zone for its respective hearing group or the most sensitive marine mammal hearing group (i.e., high-frequency cetaceans) to prevent the potential for the onset of ESA harm (MMPA Level A harassment). Because the exclusion zones are calculated for the most sensitive hearing groups that may be present (typically non-ESA-listed high-frequency cetaceans), this is a very conservative approach and the chance that any exposure can result in PTS is highly unlikely to occur. The NMFS Permits and Conservation Division acknowledge that shutdown of active acoustic experiments may not prevent all unintentional exposure to marine mammals; however, it is important to point out that a brief exposure to active acoustics does not necessarily mean that ESA harassment has occurred. The PTS onset thresholds in the cumulative sound exposure level metric are based on a 24-hour exposure. Most researchers, as discussed above, are not expected to be playing a type of sound (e.g., continuous) and for a duration that is likely to result in a PTS for an ESA-listed cetacean. Many factors (e.g., the hearing range of the exposed species, sound type, sound level, distance, and time exposed) must be considered in order to determine if harassment has occurred. The NMFS Permits and Conservation Division will review each application carefully using the parameters described above to determine if additional mitigation measures can be included in the study design or the permit to prevent ESA harm (MMPA Level A harassment) to target and non-target species. But in most cases, a PTS is not reasonably likely to occur given the nature of active acoustic trials for research purposes. Additional mitigation measures will be required in the permit depending on the behavior of target animals, the complexity of the sound source, and the proposed trial design. See Section 19.3 for mitigation measures for active acoustic playbacks.

3.7.3.3 Active Acoustics – Prey Mapping

Researchers may use active non-tactical sonar (e.g., echosounders) to map the distribution of cetacean prey or image target cetaceans. This can inform foraging studies and, when coupled with other active acoustic playback trials, support predictive ecological models and explanatory models quantifying the behavioral response of marine mammals to sound. Such information has been incorporated into the operating procedures for playback experiments on mysticetes (Friedlaender et al. 2016). Recent advances in cetacean tagging technologies, combined with scientific echosounders used to map prey abundance, have provided unprecedented data on predator-prey relationships among large whale species (e.g., Friedlaender et al. 2009; Hazen et al. 2009).

Researchers may intentionally operate an echosounder in close proximity to cetaceans (91.4 meters [300 feet] for large cetaceans such as mysticetes and sperm whales, 45.7 meters [150 feet] for smaller cetacean species). This is likely to occur in conjunction with other research vessel-based activities, such as photo-identification or tagging. This active acoustic monitoring may be conducted using a single, split, or multi-beam echosounder device, using one or more acoustic transducers. The echosounders will be mounted on the hull of the research vessel or a stationary platform and typically emit a narrow beam of brief, intermittent acoustic pings into the water column below. The echosounders are routinely used for fisheries surveys by researchers, NMFS, and other agencies. The frequencies of echosounders can range from 12 to several hundred kiloHertz, overlapping with the hearing range of some cetaceans and other marine mammals, and having pulse durations on the order of milliseconds (Lurton and Deruiter 2011). Duty cycle is a function of the frequency used and water depth but typically is 0.1 to one percent of the pulse duration. One example design is the Simrad EK-60 split-beam echosounder system with sources operating at multiple frequencies (ranging from 18 to 710 kiloHertz) to map prey in the vicinity of cetaceans. The EK-60 has a source level of 241 decibels re: 1 μPa (rms). Received levels will depend on the distance to the animal for a particular study. The transducers for this echosounder have a seven or 12-degree beam (for 38 and 120 kiloHertz respectively). The duration of pings is typically less than one millisecond to allow discrimination of small targets. The required characteristics for sound sources are detailed in the application instructions (see Section 19.1 for more details). Other models or variations of echosounder units can be authorized for use. In all cases, especially when the frequency is within the hearing range of marine mammals, the NMFS Permits and Conservation Division will ensure that their use does not result in ESA harm (MMPA Level A harassment), in consultation with the Office of Protected Resources bioacoustician (e.g., Dr. Amy Scholik-Schlomer) and following NMFS revised marine mammal acoustic technical guidance (NOAA 2018b), or updated in the future.

3.7.3.4 Auditory Evoked Potential or Auditory Brainstem Response Test

The AEP test, also referred to as Auditory Brainstem Response test, is a procedure used to evaluate the hearing abilities of individual cetaceans (Mulsow 2012; Nachtigall et al. 2007). The AEP technique involves playing a test sound stimulus while simultaneously recording the neural AEP from non-invasive surface electrodes contained within suction-cups, or sometimes from subdermal needle electrodes (typically only necessary for large cetaceans). For the scope of this programmatic consultation, the AEP test may be conducted on stranded cetaceans from the beach or in rehabilitation facilities.

The AEP test procedure for cetaceans is typically non-invasive and can be conducted in about 30 minutes to two hours. The AEP signals are usually collected through suction-cup electrodes, which are typically reusable 10 millimeter (0.4 inch) diameter gold cup electrodes embedded in 25 millimeter (1 inch) diameter silicon suction-cups. Standard electro gel is used on the electrodes to establish an electrical connection between the electrode and the skin. Suction-cup sensors have been successfully used on cetaceans as large as killer whales, pilot whales, and beaked whales (Brill et al. 1991; Brill and Harder 1991; Finneran et al. 2009; Houser and Finneran 2006b; Houser et al. 2008; Mohl et al. 1999; Schlundt et al. 2011) and has been benchmarked for use in hearing studies (Finneran and Houser 2006; Finneran and Schlundt 2006; Houser and Finneran 2006a; Houser and Finneran 2006b).

Sounds may be presented to the animal through a jawphone attached to the lower jaw via suction-cups (typically for odontocetes), or may be presented in water and the animals hear naturally through their lower jaws and/or other sound paths to the ear. A three-sensor configuration is used to record AEPs based on an expectation of where the optimal neural response can be measured. A reference electrode is attached near the dorsal fin and a recording electrode is attached about behind the blowhole. The electrodes are on the surface of the skin and are connected to an amplifier via wires.

Figure 9. The typical three-sensor configuration and jawphone for Auditory Evoked Potential testing (from File No. 21026).

Needle Electrodes

AEP recordings are attempted with suction-cup sensors first. However, if suction-cup sensors fail to obtain a signal (due to animal size or skin conditions that do not allow for suction-cup attachment), subcutaneous needle electrodes may be placed below the dermis and into the blubber layer for evoked responses to be recorded. Placement of the needle electrodes is the same as that described for placement of the suction-cup sensors. The 27-gram needle electrodes used are approximately one to two centimeters (0.4 to 0.8 inches) in length and are commercially available. For large cetaceans, the needle electrode lengths may also increase up to 10 centimeters (3.9 inches) in length.

Frequency and Sound Source Level

The frequencies used for AEP testing are optimized to the expected hearing range of the subject animal. These are typically from 1 to 200 kiloHertz for odontocetes and 1 to 60 kiloHertz for mysticetes. Sound source levels are expected to range from 60 to 150 decibels re: 1 µPa (rms). The maximum sound source level will be 160 decibels re: 1 µPa (rms) and will only be utilized if insensitivity at the highest frequencies are noted. The frequencies currently tested on cetaceans are generally staggered at half octave intervals across the expected range of hearing. AEP tests are generally conducted with the production of a click stimulus first. The click generates a robust evoked responses that can be used to verify that equipment is functioning correctly and provides a rapid initial screening of the subject’s auditory system. Once a robust response is detected, frequency-specific testing is performed with tonal signals. The signal duration for test signals vary from approximately 0.005 to 75 milliseconds, depending on the signal tested.

For the purposes of this programmatic consultation, each application will be evaluated on a case-by-case basis and the NMFS Permits and Conservation Division will consult with the Office of Protected Resource's bioacoustician (e.g., Dr. Amy Scholik-Schlomer) to ensure that the AEP test will not exceed temporary threshold shift (TTS) outlined in the NMFS revised marine mammal acoustic technical guidance (NOAA 2018b), or as updated in the future. The AEP test procedure will be conducted to ensure that it will not result in ESA harm (MMPA Level A harassment), such as onset of an auditory PTS. As the purpose of the AEP test is to measure the hearing ability of the subject animal, researchers do not intend on causing any TTS, PTS, or injury.

Hearing and Restraint

The hearing measurements can be made at the same time as other veterinary procedures are performed so as to minimize the time the animal is being held. The minimum handling time for determining a complete audiogram of a cetacean is typically 30 minutes, but AEP testing can take up to two hours. Hearing measurements can be conducted either in the water or in air on land. For in-air measurements, the subject animal may be required to have the rostrum lifted slightly off of the ground and propped up (typically smaller cetaceans), depending on the size of the animal's head relative to the footprint of the jawphone. Hearing measurements in the water will require some degree of stabilization, generally by personnel supporting the position of the animal. If the animal is large, one person may need to raise themselves next to the animal to place the sensors, which may require the use of a ladder.

Mitigation Measures

Auditory evoked potential testing will not delay treatment, movement, or release of a stranded animal, increase handling time, nor will it interfere with rehabilitation activities. It is considered best practice to conduct AEP testing on cetacean release candidates to assess suitability for release, so in some cases this will be considered part of the diagnostic testing of the subject animal (i.e., enhancement) as well as scientific research. AEP testing will be stopped if an animal exhibits any adverse reaction, including abnormal respiration and locomotion, vocalization, vomiting, or other signs of distress. The suction-cups or needle electrodes can easily be removed if there is any difficulty with the procedure and all sensors will be removed as soon as tests are complete.

If needle electrodes are used, the insertion point will be treated with standard sterile prophylactic procedures to prevent infection including alternating scrubs of betadine and alcohol prior to needle insertion, and may include the application of a topical antibiotic (bacitracin 500 units/gram) following needle electrode removal. The optimal needle electrode length is less than the depth of the blubber but which gets the tip of the electrode close to the muscle/blubber interface. However, for mysticetes where needle electrodes longer than 2.5 centimeters (1 inch) will be expected to be needed, a portable ultrasound machine will be used to measure the depth of the blubber layer at the site of needle electrode insertion. Needle electrode breakage is unlikely, as the needle electrode will not penetrate the muscle/blubber interface, thus preventing the potential for any needles to bend or break because of differential movement of the blubber and muscle.

Evoked Potential Standards

In June 2018, the American National Standards Institute (ANSI) published standards entitled, *Procedure for Determining Audiograms in Toothed Whales through Evoked Potential Methods* (ANSI 2018). The purpose is to standardize methods such that the results of AEP hearing tests are comparable across laboratories and researchers. The new ANSI standard describes procedures for measuring AEP audiograms in odontocete cetaceans and provide recommendations in the areas of:

- General equipment requirements;
- Stimulus waveforms for measuring hearing thresholds;
- Acoustic stimulus waveform calibration;
- Threshold estimation methods;
- Results reporting formats;
- Modulation rate transfer function determination;
- Background noise considerations; and
- Testing arrangements, including types of electrodes and their placement.

The NMFS Permits and Conservation Division anticipate researchers will adopt the ANSI standard into their methods and in the future, and may require this as a standard method.

3.7.3.5 Remote Ultrasound

Researchers can measure cetacean blubber thickness using ultrasound remotely during vessel surveys. The acoustic system consists of an ultrasound transducer on a cantilevered carbon-fiber pole. The carbon-fiber pole is several meters in length and may vary depending on the size of target species. For example, a 12 meter (39.4 feet) long carbon-fiber pole was used to safely measure blubber thickness in North Atlantic right whales (Moore et al. 2001). To date, the NMFS Permits and Conservation Division has authorized remote ultrasound for medium and large cetacean species, but can permit this research method for small cetacean species if their behavior is conducive to obtaining measurements.

Remote ultrasound measurements are conducted upon close approach of an individual animal. Researchers safely maneuver the research vessel into position in the same manner as for conducting remote suction-cup tagging, slowly from behind and to the side of the surfacing target animal. Researchers may get within one to two body lengths of the target animal, just close enough for the carbon-fiber pole to make contact. Researchers may place the research vessel in neutral and wait for the target animal to approach under its own volition.

The remote ultrasound instrument will make contact with the back of the surfacing target animal to obtain the blubber thickness measurement. Contact duration of one second is all that is required for a good signal for blubber thickness measurement. Stereo video cameras may be mounted on a mast of the pivot point of the ultrasound transducer to record the location of the ultrasound readings on the target animals, allow time-coded video footage of the ultrasound take, and to assist the researchers in estimating the length of the animals (Moore et al. 2001).

3.7.4 Biological Sampling

Researchers may opportunistically conduct biopsy sampling, breath sampling, fecal sampling, prey sampling, sloughed skin sampling, and environmental DNA sampling during vessels surveys and aerial surveys. Biological samples are collected for various research objectives including diet, genetics, or to assess animal health.

Researchers typically observe cetaceans during vessel surveys at distances of 50 to 100 meters (164 to 328.1 feet) from small research vessels. Following the observation of biological samples in the water or evidence of a predation event, the researcher approaches the sampling area and collect biological samples using a small, fine mesh, long-handled dip net, or small containers for collection of water samples. The dip nets are cleaned and rinsed between collecting biological samples to prevent cross-contamination. Biological samples will initially be stored in a cooler until they can be divided and stored in cryovials or appropriate storage for the analysis, under refrigeration or frozen, for further analysis in a laboratory.

Researchers will not directly approach the animals during the collection of biological samples or water samples; however, in some cases animals may be approached within 10 to 30 meters (32.8 to 98.4 feet) or within the fluke-print of a diving animal for biological or water sample collection. In these cases, the approach will follow the same research methods as described above for close approach. Alternatively, biological samples are often observed and collected opportunistically during other vessel-based research activities such as photo-identification, focal follows, biological sampling, or tagging activities.

3.7.4.1 Biopsy Sampling

Biopsy sampling is a widely used method for obtaining skin and blubber tissue from cetaceans for use in studies on genetics, contaminants, disease, foraging ecology, reproduction, and other physiological and biological processes (reviewed in Noren and Mocklin 2012).

Researchers may conduct biopsy sampling on cetaceans during vessel surveys, often in conjunction with stock assessments, photo-identification, and tagging. Objectives that may require biopsy sampling include, but are not limited to:

- Genetic identification and cataloging;
- Population size and social structure;
- Diet and foraging studies with stable isotope analyses;
- Assessing contaminant loads, health, sex, and reproductive status; and
- Developing cell lines.

Based on their objectives, researchers may intentionally collect biopsy samples from known individuals multiple times throughout the course of a year for studies that involve analyzing tissue samples to provide information such as distribution and prey choices. Examples of studies involving repeated biopsy sampling of the same individuals across seasons or years include, but are not limited to:

- Movement of individuals between widely separated areas such as between feeding and breeding grounds, or between different feeding areas (as determined by genotyping);
- Monitoring the health of currently tagged or previously tagged animals;
- Studies of contaminant profiles, stable isotopes, or other markers to assess variation over time; and
- Assessing the reproductive status of females.

For example, individual animals may be sampled up to five times per year, over the course of several seasons. Alternatively, animals could be sampled more than once within the same day, depending on research objectives.

Biopsy sampling may be collected from any cetacean species, sex, or life stage. When possible, researchers collect detailed descriptive or photographic records of dorsal fins, flukes, or other distinctively marked body parts are maintained to reduce the likelihood of sampling the same individual cetacean more than once within a given survey, and aid in re-sampling individuals across vessel surveys during different times of the year or in different regions.

Because researchers conduct a variety of vessel surveys in many locations, biopsy sampling occurs from small to large research vessels (e.g., rigid-hull inflatable boats, NOAA ships, and charter vessels) depending on the target species. Researchers will approach target animals by the main research vessel during vessel surveys or by a small research vessel launched from a larger research vessel at a speed of 5.6 to 11.1 kilometers per hour (3 to 6 knots). The biopsy sampling will be collected remotely from animals within approximately 30 meters (98.4 feet) of the bow of the large or small research vessel depending on the target species (Palsboll and Larsen 1991). During any single encounter, as a term and condition of all permits, researchers may not attempt to sample an individual more than three times. Likewise, if researchers observe signs of repetitive, strong, adverse behavioral reactions, such as rapid changes in direction, prolonged diving, and evasion, from an individual or group of animals, they must discontinue biopsy sampling attempts for that individual or group of animals as a requirement of the permit. Biopsy sampling encounters can average 45 to 60 minutes, but may be shorter or longer depending on the target animal’s behavior and the type of research activities conducted in conjunction with biopsy sampling (e.g., photo-identification, tagging, or behavioral observation). See Section 19.3 for biopsy sampling terms and conditions in the permit template.

Biopsy sampling typically involves shooting a projectile dart with a hollow tip that collects a small plug of skin and blubber upon contact with the animal. No difference has been found between biopsy sampling delivery device types in their ability to collect a biopsy sample once the dart has made contact with the target animal (Noren and Mocklin 2012); therefore, a suite of delivery devices may be used depending on the research vessel or platform, species, and behavior. Higher-powered delivery devices, such as compound crossbows or the black-powder Larsen gun, are more likely to be used from large research vessels while targeting mysticetes at a distance over 20 meters (65.6 feet). Lower-powered delivery devices, such as recurve crossbows or adjustable-power guns, are more likely to be used at short ranges usually less than 20 meters (65.6 feet) from small research vessels or for bow-riding animals from larger research vessels (Barrett-Lennard et al. 1996; Chivers et al. 2010; Clapham and Mattila 1993; Cerchio et al. 2015; Kellar et al. 2013; Tezanos-Pinto and Baker 2012).

Alternatively, researchers may use a handheld pole with a dart tip on the end to manually collect a biopsy sample if the disposition and behavior of the target animal is conducive to a closer approach by the research vessel; this method does not involve a projectile delivery device. Rather, the research vessel will approach the target animal in closer proximity (e.g., within a body length) in a slow and cautious manner to quickly punch the pole into the dorsal back or flank of the animal. This can be an effective and less stressful method to collect biopsy samples for some species than using powered delivery devices from a greater distance because the main source of stress during biopsy sampling is often the close approach by the research vessel, not the biopsy sample collection itself or missed shots entering the water.

Researchers may also use a tethered pole to biopsy sample for bow-riding animals to aid retrieval of the dart. Researchers may use different configurations for tethering biopsy darts (Barrett-Lennard et al. 1996). For bow-riding animals, researchers tie a length a line to a handrail on the research vessel and the other end to the biopsy dart. The line is just long enough to go straight down from the research vessel to the water surface. Researchers will tie a metal washer to the lower end to keep the line somewhat taut in case of windy conditions. Another method is to attach a line to a 5.5 meter (18 feet) long pole-spear (Hawaiian sling). The pole-spear will be tethered to the research vessel and lowered to within 0.5 meters (1.6 feet) of the target animal, which allows researchers to target a specific location on the animal with a high degree of accuracy. Another alternative tethering method involves using spooled line with the spool attached to the crossbow and the other end of the line attached to the biopsy dart. Researchers may use this research method when sampling large cetaceans from a research vessel where biopsy dart retrieval is unfeasible. The line (e.g., nylon or paracord) is light enough that a large cetacean will easily snap it if it were to come into contact with the line. Thus, an entanglement is unlikely and has not been reported by researchers.

Researchers typically target the body posterior to the blowhole in the lateral area just below the dorsal fin for biopsy sampling. The target area provides sufficient assurance of avoiding the head of the animal, and coordinates well with attempts to simultaneously collect individual identification photographs of target animals (for most cetacean species). For large cetaceans, researchers may biopsy sample the area from the dorsal flank well behind the blowhole, and, sometimes the ventral side of the flukes is chosen as they “fluke-up” prior to a dive. As a term and condition of permits, researchers must avoid sensitive areas (e.g., eyes, blowhole, or mouth). When using a projectile delivery device, the biopsy dart hits the animal, bounces off, and floats at the water surface in the biopsy sample location. To aid recovery, researchers may toss a bright floating object in the vicinity of the biopsy dart or arrow as a visual location marker to help locate it (especially if maneuvering a large research vessel). Researchers will then retrieve the biopsy sample while the target animal continues its previous behavioral state, often moving away from the area.

Biopsy samples are very small in relation to the target animals. Biopsy dart tips are typically 25 millimeters (0.98 inches) long (up to 10 millimeters [0.4 inches] in diameter) for small cetaceans and 40 to 60 millimeters (1.6 to 2.4 inches) (up to 10 millimeters [0.4 inches] in diameter) for large cetaceans. The intention is for biopsy dart tips to be shallower than the target species' and age's average blubber thickness. Thus, the depth of the biopsy dart tip is controlled by a cushioned stop on the dart tip of neoprene vacuum hose encircling the dart head. Biopsy samples may be frozen, or stored in a medium, such as 70 percent ethanol, or saturated sodium chloride solution with 20 percent dimethylsulfide (Amos et al. 1991; Hoelzel 1988; Hoelzel and Amos 1988) or equivalent, for transport until analysis.

Sterilization Requirements

Biopsy dart tips will be sterilized before each use, following a veterinary or IACUC-approved protocol. Typically, sterilization is done by autoclave or gas sterilization using ethylene oxide or hydrogen peroxide or equivalent. Sterile biopsy dart tips are kept in air and watertight containers, or in sterilization pouches prior to use. Manipulation of the sterile biopsy tips before deployment will be performed with sterile surgical gloves or other sterilized equipment.

In the rare event that a sterile biopsy dart tip is not available, researchers may use disinfected tips following the IACUC or veterinary approved high-level disinfection protocol. This typically includes a 20-minute soak in a ten percent bleach solution or similar high-level disinfection solution (e.g., six percent hydrogen peroxide or two percent glutaraldehyde). For more details, see Section 19.3 for mitigation measures for biopsy sampling.

3.7.4.2 Breath Sampling

Researchers may sample a cetacean's exhaled breath (air), or blow, as a non-invasive tool to assess animal health (e.g., microbiomes, stress and reproductive hormones, etc.). Analysis of the exhaled breath from cetaceans can be used to assess reproductive and stress hormones (Hunt et al. 2014), genetics (Frere et al. 2010), disease (Acevedo-Whitehouse et al. 2010), health status (Apprill et al. 2017), and likely other aspects of cetacean biology (reviewed in Hunt et al. 2013). Researchers may conduct breath sampling from a research vessel or unmanned aircraft systems.

For vessel-based breath sampling, researchers track the target animal from a small research vessel. The research vessel will approach the target animal in a similar fashion as for photo-identification, in a slow converging course. When the researchers are close to the target animal (potentially within one body length), the research vessel is shifted to idle or a near idle speed and researchers collect a breath sample by holding a swiveling carbon-fiber pole (up to 10 meters [32.8 feet]) with a sterile collection device (e.g., PCR plates, petri dish, nylon fabric) on the end, as close to the blowhole as possible from the bow of the research vessel. The target animal is approached very gradually, and when the animal exhales, the researcher places the sample collector through the cloud of blow. The breath sample is retrieved from the carbon-fiber pole and stored on the research vessel.

Figure 10. Breath sampling exhaled air from a cetacean (from File No. 14233).

3.7.4.3 Fecal Sampling

Researchers may opportunistically collect fecal samples when an animal defecates. Fecal sampling is a well-established non-invasive sample collection method that can be used to assess reproductive hormones, stress, parasites, red tide effects, diet composition, energetics, and nutrition (reviewed in Hunt et al. 2013). In some cases, highly trained scent-detection dogs may be used to locate fecal material (e.g., Dr. Samuel Wasser). For this research method, the research vessel will be placed to the side or behind the animal and then, following detection of an animal defecating, move quickly into the wake of the animal for collection of the fecal sample. No direct approaches to animals or harassment is expected from the collection of biological or water samples; however, in some cases animals may be approached within 10 to 30 meters (32.8 to 98.4 feet) or within the fluke-print of a diving animal, for sample collection. In these cases the approach would follow the same methods as described above for close approach (see Section 3.7.2.4). Fecal samples will be collected with a small, fine mesh, long-handled dip net or small containers. Samples will initially be stored in a cooler until they can be divided and stored in cryovials or appropriate storage for the analysis, under refrigeration, and frozen for further analysis in a laboratory.

3.7.4.4 Prey Sampling

Researchers may collect prey samples following the display of behaviors suggestive of a predation event. The research vessel will reposition and approach the predation event location when the animal(s) has left the area and finished feeding. Researchers will approach the location of feeding, and collect prey samples that will then either be frozen or preserved in vials of dimethyl sulfoxide or ethanol for analyses. These parts or prey remains may include ESA-listed cetaceans, pinnipeds, and fish (e.g., salmon and steelhead).

3.7.4.5 Skin Sampling

Researchers may collect skin samples directly from cetaceans involving direct physical contact during vessel surveys, often paired with other research activities (e.g., stock assessments, photo-identification, tagging). The collection of skin samples is a non-injurious technique that is used to obtain samples of exfoliated skin for post-hoc molecular analysis (Harlin et al. 1999). Skin samples are collect for research objectives similar to those described above for biopsy sampling including genetic or sex identification, population structure, and development of cell lines.

The collection of skin samples is similar to the procedure for exhaled breath sampling using a pole, but skin sampling requires direct contact with the cetacean. Researchers track the target animal from a small research vessel and approach in a slow converging course (similar to photo-identification). Once close enough for direct contact with cetaceans, researchers collect a skin sample using a carbon-fiber pole (up to 10 meters [32.8 feet]) with a sterile swab or scrub pad (e.g., nylon or similar) affixed to the end and very briefly contacting the target animal’s skin along the back or side, posterior to the blowhole(s). Bowriding cetaceans may also be skin sampled using a carbon-fiber pole. The exfoliated skin samples obtained by researchers will be retrieved from the swab or pad on the pole and temporarily stored on the research vessel until processing. Samples may be frozen or stored in a medium, such as 70 percent ethanol, or saturated sodium chloride solution with 20 percent dimethylsulfide, or equivalent, for transport until analysis.

3.7.4.6 Sloughed Skin Sampling

Researchers may collect sloughed skin samples in the vicinity of cetaceans for genetic studies. Researchers may also collect sloughed skin remaining on tags following retrieval. Skin samples may be preserved in media such as 20 percent dimethyl sulfoxide salt-saturated solution. Although, recent research suggests that freezing skin samples from humpback whales is a more effective preservative than 90 percent ethanol (Hidalgo-Reza et al. 2019).

3.7.4.7 Environmental Deoxyribonucleic Acid Sampling

Researchers may collect water samples for environmental deoxyribonucleic acid (DNA) analysis to genetically detect the presence of a species, or taxonomic group, in a habitat. Collecting environmental DNA samples in the presence of a particular species can be used to validate the method and allows researchers to sample other areas where the species has not been observed or is known to occur. Collection of water samples will occur as described above and samples will be refrigerated and stored as appropriate for the analysis. The collection of water samples alone does not require a research and enhancement permit; however, animals may be potentially disturbed within the vicinity (approximately 91.4 meters [300 feet] for mysticetes and sperm whales, 45.7 meters [150 feet] for smaller cetacean species) of the research vessel. Once DNA or ribonucleic acid is extracted from the water samples, the genetic material is considered a marine mammal part and requires authorization for study, import, export, or receipt from others.

3.7.5 Tagging

Telemetry is a powerful tool to study cetaceans in the wild. Tagging provides a unique opportunity to remotely follow cetaceans to learn detailed information on movement, behavior, ecology, habitat use, and population structure. Recent advances in tagging technologies have provided unprecedented detail on cetacean biology, allowing researchers to better understand their physiology, foraging, ranging, diving, and sociality, and have improved efforts to protect and conserve these species (Nowacek et al. 2016). For example, tagging North Atlantic right whales has provided much needed information on foraging and diving behavior, improving our ability to assess the vulnerability of North Atlantic right whales to vessel strikes and entanglement (Nowacek et al. 2004; Parks et al. 2011c). Tagging calves is also important, as little is known about this age group's diving behavior and how it might influence their risk to anthropogenic threats. Given their under-developed diving capabilities, calves likely spend increased time at the surface and in shallower water, but currently few data exist on mysticete calf behavior (although see Stimpert et al. 2012; Tyson et al. 2012). Tagging studies can also be paired with other cetacean studies such as behavioral response studies to determine a cetacean's response to certain stressors. A variety of tag types and attachment mechanisms are used in cetacean telemetry research. Tag selection depends upon the specific objectives of the study, and cetacean species to be tagged. Certain tag types are commonly or exclusively used with a single attachment mechanism given the duration of attachment required or the size of the tag to be attached. Factors such as tag placement (see Section 3.7.5.1), number of receivers, and daily transmission allowance can be adjusted to minimize the number of data gaps returned from tags and maximize the amount of necessary data collected (Quick et al. 2019). There are four main tag types that will be authorized under the programmatic consultation: suction-cup tags, dart/barb tags, bolt/pin tags, and deep-implantable tags. Tag types are categorized by impacts to the target animals and the intended tag location and degree of invasiveness.

The NMFS Permits and Conservation Division has defined these four tag types for the purposes of the program for issuance of permits for research and enhancement activities on cetaceans based on their nature of attachment and invasiveness to adequately assess their impacts. In 2009, the Office of Naval Research workshop proposed a naming system based on the characteristics of the attachment elements (ONR 2009). In 2017, another more recent tagging workshop was held and a report summarizing the results of the workshop and best practices of tagging with a new proposed naming system is now available (ONR 2019). The final peer-review publication of this report and best practices is expected in late 2019. The tag nomenclature and descriptions for the purposes of the cetacean research permitting program may be modified in the future to be consistent with published literature and the scientific community and as tagging technology evolves, provided such naming conventions meet the Permit and Conservation Division's need to evaluate impacts from tagging.

3.7.5.1 Tag Attachment Types

Non-Invasive Suction-Cup Tagging

Tags are attached externally with suction-cups. There is no penetration into the animal's body. They are typically designed for shorter durations (hours to days). Most suction-cup tags archive the collected data to the tag, and the tag must be retrieved to access the data. Tag retrieval occurs once the tag has become detached from the animal and the tag is floating at the water's surface. Such tags generally include VHF, UHF, or satellite (Argos) transmitter to aid in recovery of the tag after it detaches from the animal (Figure 11). The instrument package may be attached directly to the suction-up or may be attached to the suction-cup by a hinge point, ball joint, universal joint, or flexible or elastical cables or straps, or may sit on a platform attached to one or more suction-cups. Archival tags may include contain passive acoustic sensors and/or animal-borne underwater cameras to collect photographs or video and often include other recording sensors including depth, temperature, and accelerometers (Figure 12). The video cameras (CritterCam or similar) is designed to videotape the area in front of the animal and is typically placed to the side and behind the blowhole. Some suction-cup tags are modified as "physiological tags" with an electrocardiogram electrode that attaches separately to the tagged animal to measure heart rate. Examples include the Customized Animal Tracking Solutions (CATS) tag, DTAGs, Acousonde, and the CritterCam. These tags are also called Type III tags (ONR 2009). Suction-cup tags that also include darts will be considered dart/barb tags (see below).

Suction-cup tags may also have active acoustic components to track and localize tagged animals, or locate the tag after release. Currently authorized examples include Vemco Tags with frequencies of 60 to 80 kiloHertz, pulse duration of 0.5 to 10 milliseconds, and a sound source level of up to 160 decibels re: 1 µPa at one meter. Other current examples of active acoustic tags include pingers with a frequency of 45 kiloHertz, pulse duration between 10 and 500 milliseconds, a duty cycle less than 50 percent, and a sound source level up to 180 decibels re: 1 µPa at one meter. The active acoustic tag components are typically outside of the hearing range of cetaceans and all active acoustic tag components will be evaluated in detail with the Office of Protected Resources bioacoustician, including a thorough evaluation of the suction-cup tag's acoustics and duration of attachment in line with NMFS revised marine mammal acoustic technical guidance to ensure that a PTS is not reasonably likely to occur for the tagged animal or others that could be in close proximity.

Figure 11. Example of a suction-cup tag with an acoustic recording instruments in hand (left) and attached to a beluga whale (right) from File No. 20556.

Figure 12. Example of a suction-cup tag by Customized Animal Tracking Solutions with two cameras, accelerometers, global positioning system, temperature and depth sensors, and a very high frequency transmitter from File No. 20430.

Suction-cups may be from 3 centimeters (1.2 inches) to 30 centimeters (11.8 inches) in diameter depending on the size of the instrument package. Two or more smaller suction-cups may also be used in place of a single large suction-cup. Typically, no more than eight suction-cups are used for a single tag. The instrument package generally does not exceed the dimensions of 30 by 15 by 10 centimeters (11.8 by 5.9 by 3.9 inches) with a mass of 400 grams (0.9 pounds) for standard tags. CATS and CritterCams will not exceed 1,100 grams (2.4 pounds). A flotation unit may be attached to the instrument to facilitate recovery. The instrument package, recovery beacon, and release device are all encased within or attached to a non-compressible foam or other floatation system. A typical housing is made out of a mixture of glass microspheres and polyethylene resin such that the whole tag package is durable, lightweight, and buoyant.

Suction-cup tags will be primarily deployed with carbon-fiber poles at ranges of 3 to 10 meters (9.8 to 32.8 feet). Suction-cup tags have been deployed using recently developed devices such as tag carriers with pneumatic rifles (e.g., ARTS) as an attempt to improve range and remotely deploy suction-cup tags on harder-to-approach species (e.g., minke and beluga whales) (Heide-Jørgensen 2001). Suction may be generated passively when the suction-cup contacts the animal; actively using a vacuum system or Venturi device; or actively by a system of one way valves as the animal dives and returns to the surface. The suction-cups may be lubricated with silicone grease or other non-reactive substance to improve the seal between suction-cup and skin.

For suction-cup tags with satellite or radio transmitters, the preferred location for tag placement or attachment is on the animal’s dorsal fin or dorsal surface, which is typically near the animal’s mid-line, and anterior of the dorsal fin. It is important to position suction-cup tags with transmitters high on the animal’s back to ensure the tag is above the water’s surface when the animal surfaces and has sufficient exposure for transmissions to reach the satellite or VHF receivers (Mul et al. 2019). Radio transmitters cannot transmit through salt water, so tags with these transmitters placed high on the back of the animal will give a longer signal for tracking. Other types of suction-cup tags such as active acoustic or CritterCam tags may be placed on other locations of the animal, but in such a way that the impairment of the animal is minimized. In particular, the area of the blowhole, eyes, genitals, flippers, and flukes will be avoided.

The expected duration of suction-cup tags ranges from a few hours up to several days (e.g., 72 hours), but is generally less than 24 hours. Suction-cup tags eventually break suction and fall of the animal on their own. A release device may be incorporated in certain suction-cup tag packages to ensure release from the animal and/or enable recovery. The most common usage of a release device is with multi-sensor suction-cup tags where the unit must be recovered to download the archival data that has been collected. The release device on the suction-cup tag may be active, or passive. Active release mechanisms include the use of a VHF radio signal or acoustic transmission to activate the release. A VHF radio signal activates the release device. The radio frequency will be determined by the manufacturer and meet Federal Commuication Commission regulations. Acoustic-activated release devices are similar but are activated by an acoustic signal emitted at a UHF beyond the hearing range of cetaceans. Passive release mechanisms include the use of corrodible magnesium links or other dissolving release devices (e.g., nuts) may be included as a primary or secondary release device to separate the suction-cups from the tag. A corrodible or dissolving cap, plug, or valve can also break suction with the cup. The suction-cup tag may also just lose suction naturally and release from the animal. The passive release devices can be calibrated for attachment periods from a few hours to several days. Once the suction-cup tag is released from its attachment, a recovery beacon is activated to indicate the location of the suction-cup tag. The recovery beacon may include one or more of a radio transmitter, acoustic device, and visual light. These suction-cup tags need to be recovered so the period for which the timed release device is set will depend on the time of day the suction-cup tag will be deployed, the expected daylight available (for tracking and recovery), and the likelihood the animal will move to areas where suction-cup tag recovery may be compromised.

The sensors included in suction-cup tags may include a combination of VHF radio transmitters, Fastloc GPS, accelerometers, magnetometers, and sensors to measure light levels, temperature, pressure, sound, and/or video. The suction-cup tag may also include a VHF radio transmitter, a satellite transmitter, or both, to facilitate tracking and recovery. Some physiological suction-cup tags also incorporate electrocardiogram electrodes to measure heart rate.

Invasive Dart/Barb Tagging

Tags are attached with the intent that one or more dart/barbs (anchors) penetrate the animal's skin and anchors into dense connective tissue (i.e., dorsal fin or ridge or body behind the pectoral fin and above the lateral vertebral processes), blubber, and/or cartilage but not muscle. Tags result in an entry wound, and exit wound if placed in the fin. The tag's electronics package is typically designed to be placed outside of the body and can be recoverable. Most dart/barb tags transmit collected data to a received (e.g., satellite, shore-based or hand-held receiver), though some may also be recoverable. Transmitting dart/barb tags generally include sensors to determine an animal's geographic location (e.g., Argos or GPS), and may also include other sensors, such as depth, temperature, or light level. Attachment duration ranges from a week to several months. Examples include Smart Position and Temperature (SPOT) tags (Wildlife Computers) deployed in the Low Impact Minimally Percutaneous Electronic Transmitter (LIMPET) configuration and the Whale Lander. These tags are also called Type II tags or Type A (ONR 2019).

Dart/barb tags are small, lightweight, and held in place on the dorsal fin or body using two or more barbed darts. Dart shafts and petals are often constructed from titanium or stainless steel, but may also be constructed from a biocompatible polymer, such as silicone, nylon, or Delrin. The tag and dart/barb dimensions may vary depending on the target species and electronic sensor chosen. Dart/barb tags are typically smaller, lighter, and less invasive (shallower penetration of attachment systems) than deep-implantable tags, but with a shorter duration of attachment. They were originally designed for remote-deployment onto the dorsal fins of medium-sized cetaceans, but they have also been deployed onto dorsal body surfaces with the darts implanted into blubber (Andrews et al. 2015). Commercially available dart/barb tags currently include SPOT5 and SPOT6, SPLASH10/Mk10-A, and SPLASH10-F (Wildlife Computers) models.

One of the most common dart/barb tags are SPOT or SPLASH tags deployed in the LIMPET models (Figure 13). LIMPET tags are called "barnacle-style" tags because the configuration resembles a barnacle, with the barnacle body external to the animal and its footplates inserted into the animal's integument. The LIMPET tag has a dart/barb that is the attachment element, which consists of a central shaft that is constructed of a biocompatible metal or polymer, with backwards facing barbs meant to engage with tissue to slow the outmigration of the dart. The dart/barb is designed to implant at an entry site that remains percutaneous until the complete dart/barb tag is lost by out-migration. In some cases the dart/bar tag may be fully-piercing, with entry and exit wounds (e.g., through the dorsal fin).

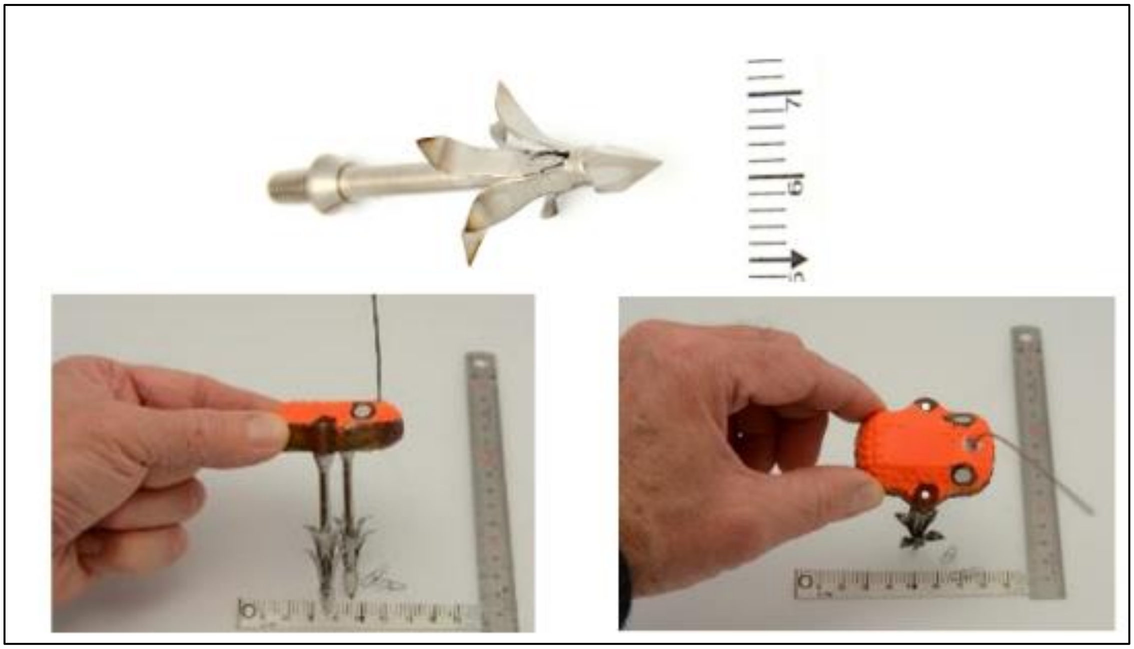


Figure 13. Example of a standard Low Impact Minimally Percutaneous Electronic Transmitter dart/barb tag with two rows of backwards facing petals attached to a shaft that penetrates 6.7 centimeters (top) and SPOT6 location-only Low Impact Minimally Percutaneous Electronic Transmitter dart/barb tag (Bottom left and right) from File No. 20556.

Another example of the current designs for a recoverable multi-sensor dart/barb tag is the Whale Lander, which is teacup shaped and attaches to the animal with three dart/barbs (Figure 14). The Whale Lander dart/barb tag is 8.9 centimeters (3.5 inches) in diameter and 6.5 centimeters (2.6 inches) tall and includes an Argos transmitter, Fastloc GPS receiver, three-axis accelerometer and magnetometer, light-level, temperature and depth sensors, and is attached with three barbed titanium LIMPET-type dart/barbs. After the dart/barb tag is shed from the animal, it floats at the water's surface is tracked for recovery by using the Argos-transmitted GPS data. This model of dart/barb tag may also carry an underwater camera, which can be jettisoned by a remote-release function. Other examples of dart/barb tags include dermally attached tags (Figure 15), and combination suction-cup and dart/barb tags, with a dart/barb embedded in the suction-cup for longer attachment duration.

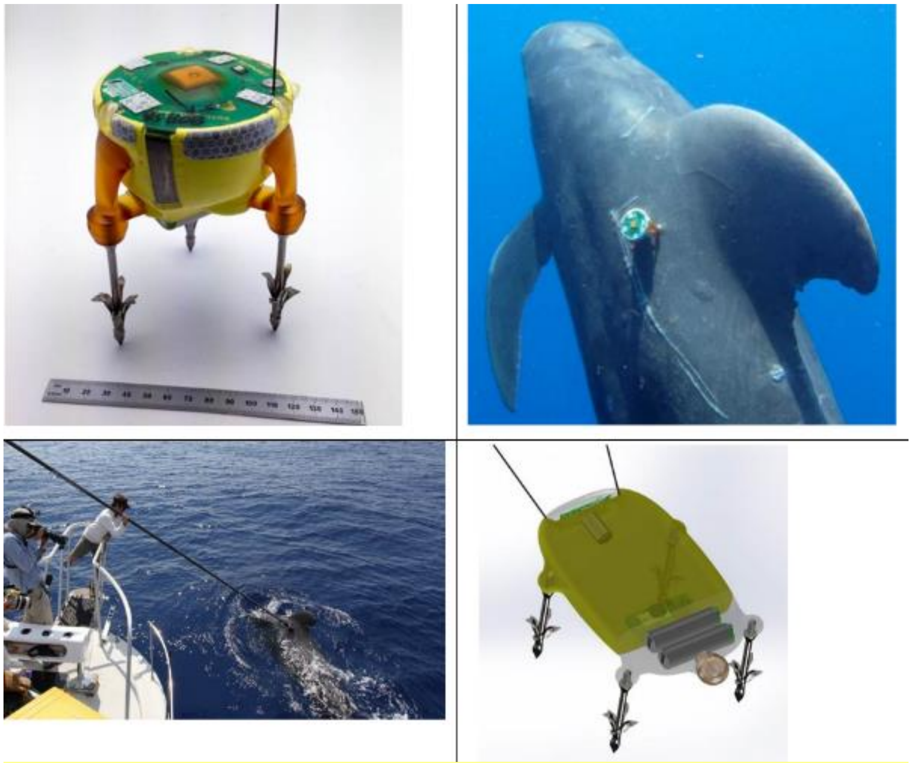


Figure 14. Example of a standard Low Impact Minimally Percutaneous Electronic Transmitter dart/barb tag with two rows of backwards facing petals attached to a shaft that penetrates 6.7 centimeters (top) and SPOT6 location-only Low Impact Minimally Percutaneous Electronic Transmitter dart/barb tag (bottom left and right) from File No. 20556. An alternate design for a multi-sensor, multi dart/barb tags with four Low Impact Minimally Percutaneous Electronic Transmitter-style dart/barbs (bottom right) from File No. 20556.

Figure 15. Example of a dermally attached dart/barb tag from application from File No. 20465.

The length of dart/barbs to attach dart/barb tags typically measure 6.5 to 10 centimeters (2.6 to 3.9 inches) in length. The retention barbs are typically between 0.5 to 3 centimeters (0.2 to 1.2 inches) long. Dart/barb tags typically include one to four darts. The LIMPET-style dart/barb tag typically measures 5.5 by 4.8 by 2.1 centimeters (2.2 by 1.9 by 0.8 inches). The total weight of the dart/barb tag usually does not exceed 90 grams (0.2 pounds) depending on the type of electronics and the attachment system used. Other dive-location dart/barb tags (e.g., TRD-10, Wildlife Computers) can be attached to foam housing for floatation to aid in retrieval. This dart/barb tag package can be up to 15 by 30 by 2.5 centimeters (5.9 by 11.8 by 1 inches) and weight up to 700 grams (1.5 pounds) (Figure 16).

Figure 16. Example of a dive-location dart/barb tag with a TDR 10-F (Wildlife Computers) Very High Frequency transmitter and floatation from File No. 20430.

Research vessels will typically closely approach animals to conduct dart/barb tagging similarly to photo-identification or biopsy sampling, except the distance will vary depending on the tag type and deployment method. In general, the approach distance for attaching dart/barb tags ranges from 3 to 25 meters (9.8 to 82 feet). Dart/barb tags may be deployed via crossbows, pneumatic rifles and black-powder guns such as the Dan Inject rifle (powered by compressed carbon dioxide) or Larsen gun (powered by black-powder), Air-Rocket Transmitter System, handheld pole, spear gun, or jab stick. For remote deployment, the dart/barb tag is placed in a tag holder at the tip of a bolt, which slides into the flight groove of the crossbow or the barrel of the rifles prior to firing. On contact with the animal, the bolt will fall away and be retrieved, leaving only the transmitter attached to the animal.

For dart/barb tags with satellite transmitters and radio transmitters, the preferred location for dart/barb tag placement is on the animal’s dorsal surface of in the dorsal fin or dorsal surface to pierce the skin and anchor into the blubber, connective tissue, and/or cartilage but not muscle (for dart/barb tags intended to penetrate muscle, see section on deep-implantable tags below. It is important to position dart/barb tags with satellite or radio transmitters high on the animal’s back to ensure the dart/barb tag is above the water’s surface when the animal surfaces and has sufficient exposure for transmissions to reach the satellites or radio receivers (Mul et al. 2019). Radio and satellite transmitters cannot transmit through salt water so dart/barb tags with these transmitters placed high on the back of an animal will give a longer signal for tracking. In particular, the area of the blowhole, eyes, mouth, genitals, flippers, and flukes will be avoided. Dart/barb tags with acoustic sensors are also attached on the dorsal surface of the animal, behind the blowhole.

Dart/barb tags are designed to provide durations generally ranging from a week to several months. Dart/barb tags may have release functions including an active device that use VHF or UHF signals to trigger release remotely, or passive releases including corrodible links or nuts, or corrodible or dissolving caps. For active release, the dart/barb tag may contain a triggerable, or remote-release function, so that when a tagged animal is in good location for dart/barb tag recovery, a signal can be sent and make the floating archival package release from the tagged individual, leaving a baseplate behind that is attached to one or multiple attachment darts or other type of implanted anchor. For either release method, once the dart/barb tag is released from its attachment, it floats to the sea surface and a recovery beacon on the dart/barb tag is activated to indicate the location of the dart/barb tag. The recovery beacon may include one or more combinations of a radio transmitter (VHF or UHF, maximum power of 500 megaWatts) or a light-emitting diode light (maximum intensity of 250 lumens). The anchored baseplate remains embedded in the animal, often for weeks, until it is expelled by a combination of the animal's natural response to a foreign body and drag forces.

Dart/barb tags may include a combination of sensors such as time-depth recorders, acoustic time-depth recorders, cameras, accelerometers, three-dimensional movement, and physiological parameters such as body temperature via a thermistor contained within a dart shaft, along with an Argos satellite transmitter. Multi-sensor dart-barb tags may also include Fastloc GPS receiver that will allow more accurate positioning of the animal and of the dart/barb tags when it releases from the animal, thereby facilitating recovery of the dart/barb tag. Dart/barb tags may also include an active acoustic component.

Invasive Bolt/Pin Tagging

Tags are attached with a penetrating bolt or pin that pierces the skin fastened on each end at the entry and exit wound and anchored through connective tissue, blubber, and cartilage, but not muscle. The tag's electronic package is typically outside of the body. Most bolt/pin tags transmit collected data to a receiver (e.g., satellite, shore-based, or hand-held receiver), though some may also be recoverable. Transmitting tags generally include sensors to determine the animals geographic location (e.g., Argos, GPS), and may also include other sensors, such as depth, temperature, or light level. Attachment duration ranges from a week to several months. Examples includes fin-mounted tags, fully-piercing tags, and tethered units fully outside of the body. These tags are also called Type II tags or Type B (ONR 2019).

Bolt/pin tags are small, lightweight tags that are held in place on the dorsal fin, or dorsal surface of the body by one or more bolts or pins. The bolt/pin tag and anchor dimensions may vary depending on the target species and electronic sensor suite chosen by researchers. Examples include fin-mounted tags, fully-piercing tags, and tethered units with electronics placed outside of body (e.g., spider tags). The bolt/pin tags were originally designed for attachment to small cetaceans during captures, such as the spider tag for beluga whales, and fin-mounted tags for bottlenose dolphins (*Tursiops truncatus*). As technology has improved over time, researchers are developing procedures to attach bolt/pin tags remotely to animals. The bolt/pin tags can be remotely attached to the dorsal fin or on the dorsal body surface with the bolt/pin anchoring through the blubber. The bolts or pins for tag attachment are often composed of a biocompatible polymer, such as Delrin, silicone, or nylon, but are sometimes stainless steel or titanium. The bolt/pin tags are attached to cetaceans remotely, typically using a pole. Examples of bolt/pin tags that can be attached with bolts or pins include SPOT and SPLASH tags (Wildlife Computers), VHF bullet tags (Figure 17), and LIMPET tags.

Figure 17. Example of a bolt/pin tag (Very High Frequency bullet tag) attached to a bottlenose dolphin during capture from File No. 20455.

Bolt/ping tags may also be attached to free-swimming animals via piercing anchors with entry and exit wounds through the tissue (Figure 18). The fully-piercing anchor extends pas the body or dorsal fin at the entry and exit sites, and this is where another element of the bolt/pin tag connects the fully-piercing anchor to the external tag package. Bolt/pin tags have been authorized for remote deployment on non-ESA-listed cetaceans but are not yet authorized for ESA-listed cetaceans. Researchers have shown interest in deployments on ESA-listed cetaceans pending successful deployments on non-ESA-listed cetaceans. See Section 3.16.3 for a description of the NMFS Permits and Conservation Division's phased-in approach that was developed with researchers, NMFS ESA Interagency Cooperation Division, and Office of Protected Resources veterinary medical officer. This type of phased-in approach may be utilized for new novel tag types under this programmatic consultation as long as the impacts are the same based on the best available science as those described here.

The length of the bolts, pins, or anchors are quite variable. The bolt or pin for attachment into dorsal fins is typically 3 to 10 centimeters (1.2 to 3.9 inches) in length, which is slightly longer than the thickness of the dorsal fin of the targeted animal. The fully-piercing bolt/pin tag anchors designed for large cetaceans (e.g., mysticetes or sperm whales) can be up to 30 centimeters (11.8 inches) in length, and have a diameter up to 3 centimeters (1.2 inches). The external package for bolt/pin tags is often the same size and weight as described above for dart/barb tags. The LIMPET-style dart/barb tag typically measures 5.5 by 4.8 by 2.1 centimeters (2.2 by 1.9 by 0.8 inches). The fin-mounted bolt/pin tags typically measures 17 by 4 by 2 centimeters (6.7 by 1.6 by 0.8 inches). The total tag weight for bolt/pin tags usually do not exceed 90 grams (0.2 pounds), which depends on the type of electronics and the attachment system used. The bolts or pins are typically made of Delrin, stainless steel, or titanium.

Research vessels will conduct approaches for bolt/pin tag attachment similarly as described for photo-identification or biopsy sampling except the distance for close approach will vary depending on the deployment method. Remote deployment of bolt/pin tags requires close approach with a pole and must make contact with the target animal for attachment. In general, approach distance for attaching bolt/pin tags ranges from one to five meters (3.3 to 16.4 feet). Fully-piercing bolt/pin tag anchors are attached via pneumatic device on the end of a hand-held pole. Bolt/pin tags may also be attached to bow-riding animals via pneumatic device on a pole (Figure 18). In the future as technology improves, the remote deployment of bolt/pin tags may include other remote devices described above for dart/barb tags including crossbows, pneumatic rifles and black-powder guns, compressed carbon dioxide rifles (Dan Inject), black powder rifles (Larsen gun), and the Air Rocket Transmitter System.

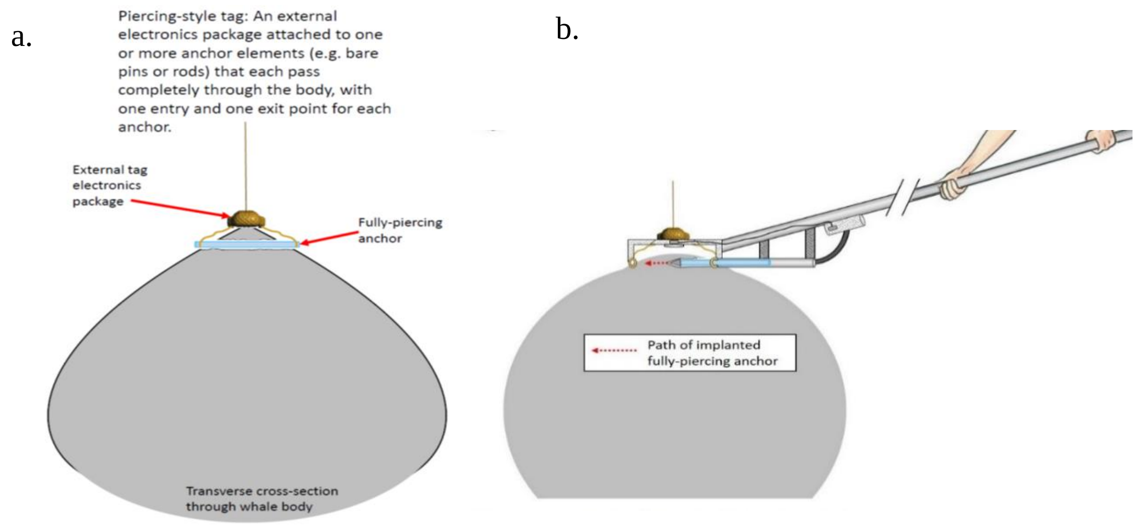


Figure 18. Example of a bolt/pin tag. (a) Fully-piercing bolt/pin tag attached to a cetacean. (b) Schematic of a pneumatic device for applying tags with fully-piercing anchors using a pole from application in File No. 20556.

Note: This bolt/pin tag attachment method has not yet been approved in a scientific research and enhancement permit, but did undergo Endangered Species Act section 7 consultation for File No. 20556.

Some bolt/pin tags are designed for attachment to the trailing edge of the dorsal fin of small to medium-sized cetaceans. It is important to position radio/satellite tags high on the animal's back or dorsal fin to ensure the bolt/pin tag is above the water when the animal surfaces and has sufficient exposure for transmissions to reach the satellites or radio receivers. Radio and satellite transmitters cannot transmit through salt water so bolt/pin tags with these transmitters place high on the back or dorsal fin will give a longer signal for tracking. In particular, the area of the blowholes, eyes, mouth, genitals, flippers, and flukes will be avoided.

Bolt/pin tags are designed to provide durations ranging from a week to several months. The attachment duration for bolt/pin tags has been reported up to 260 days for tags attached during capture. Bolt/pin tags may contain a trigger, or remote-release function, as described above for dart/barb tags, so that when a tagged animal is in a good location for tag recovery, a signal can be sent and make the floating archival package fall off the animal. Bolt/pin tag release may be an active device that use VHF or UHF signals to trigger release remotely, or passive releases including corrodible links or nuts or corrodible or dissolving caps. Once the bolt/pin tag is released from its attachment, a recovery beacon on the bolt/pin tag is activated to indicate the location of the bolt/pin tag. The recovery beacon may include one or more combinations of a radio transmitter (VHF or UHF, maximum power of 500 megaWatts) or a light-emitting diode light (maximum intensity of 250 lumens). The bolts or pins naturally work their way out of the animal's body with movement over time (likely days) depending on their location and size (shorter bolts and pins will fall out faster).

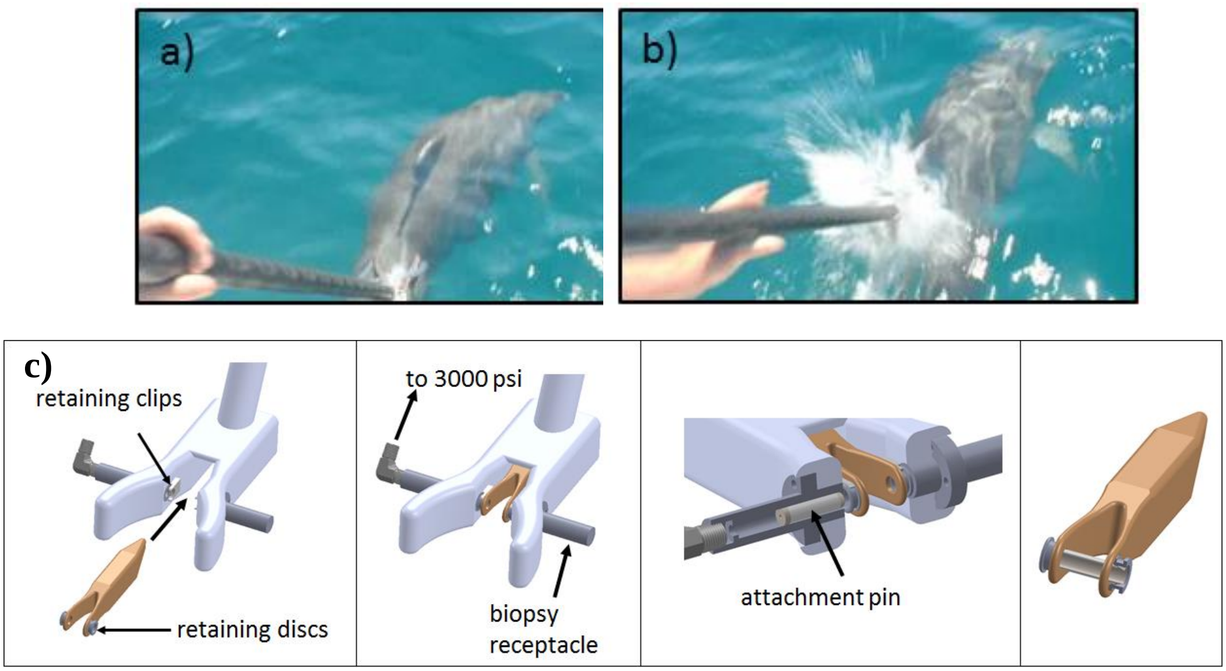


Figure 19. Example of a remote deployment of dorsal mounted bolt/pin tags on a bow-riding animal. (a) Positioning tool behind the dorsal fin; (b) Placing tool in proper position at the base of the trailing edge of the dorsal fin; and (c) Schematic of the tag deployment tool design, from File No. 20455.

As with dart/barb tags, bolt/pin tag sensors may include a combination of time-depth-recorders, acoustic time-depth-recorders, cameras, acceleration, three-dimensional movement, and physiological parameters such as body temperature via a thermistor contained within a dart shaft, along with an Argos satellite transmitter. Multi-sensor bolt/pin tags may also include a Fastloc GPS receiver that will allow more accurate positioning of the animal and of the bolt/pin tag when it releases from the animal, thereby facilitating recovery of the unit. Bolt/pin tags may also include an acoustic component.

Invasive Deep-Implantable Tagging

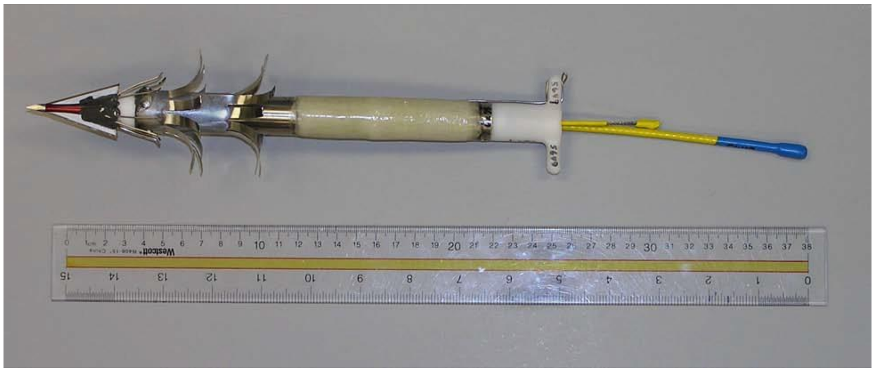
Tags are attached using a penetrating unit that pierces the skin and is implanted into the body of the animal via blubber, connective tissue, and muscle. Deep-implantable tags are implanted deeper into the body of the animal compared to dart/barb tags. These tags are designed to fully impact into the body of the animals and to anchor in the fascia between muscle and blubber layers (at the variable muscle and connective tissue matrix that underlies the blubber) (Mate et al. 2007; Gales et al. 2009). In some cases, the deep-implantable tag may be embedded in the muscle layer. The electronics package is typically internal with the antenna remaining external, but may include external tag packages (e.g., recoverable tags) with long anchors/darts that penetrate muscle tissue. Deep-implantable tags are generally used for long-duration movement studies, though may also include other sensors such as temperature, depth, light sensors, and acoustic dosimeters. Attachment duration ranges from months to more than one year. Examples include SPOT and SPLASH tags (Wildlife Computers) deployed in a fully-implantable configuration, and Dive Monitoring tag (Telonics). Deep-implantable tags are often referred to as "fully-implantable" tags or Type I tags (ONR 2009) or Type C or Type A tags (ONR 2019). In addition, some external tags (LIMPET or dart/barb or Type A tags) with longer anchors or attachment darts (e.g., up to 30 centimeters [11.8 inches] long) may be considered deep-implantable tags if the anchor is designed to penetrate into the blubber-muscle interface or muscle later of the target animal (Mate et al. 2007; Heide-Jorgensen et al. 2015; Mate et al. 2016).

Deep-implantable tags can be divided into two major components: the transmitter and the attachment system. The transmitter corresponds to the body of the tag, being the component that carries all the electronics and the battery and the attachment system corresponds to the portion of the deep-implantable tag responsible for providing subdermal anchoring of the transmitter to the animal's body (Figure 20). Deep-implantable tag transmitters are usually equipped with a single attachment dart. The dart is composed by a cylindrical or rectangular rod with needle or arrow-shaped (bladed) tips and multiple sets of retention barbs or toggles. The housing of deep-implantable tag transmitters can be equipped with stoppers to prevent full penetration of the tag upon deployment, or post-deployment migration of the deep-implantable tag inside the animal. Stoppers are particularly important when deep-implantable tags are deployed with rifles or pneumatic delivery systems. The battery and electronic components deep-implantable transmitters are generally case with epoxy inside a stainless steel housing (in the shape of a tube or box), which cover the whole extension of the electronic package. The posterior end of the deep-implantable tag, where the salt water switch (conductivity) is located, is not implanted and remains exposed after deployment. Deep-implantable and external transmitters will be coupled with attachment systems made with stainless steel, titanium, or plastic for sub-dermal attachment. Coupling is provided by connecting the anchor to the transmitter via an interface containing a screw or pin or, in more recent designs, via a welding point. One or more sets of outwardly-curved metal strips are wrapped around the distal end of the housing to prevent outward migration of the tag. Thin, outwardly-curved wires or actively deployed retention blades can be mounted forward of these strips, closer to the deep-implantable tag tip, for initial additional anchorage.

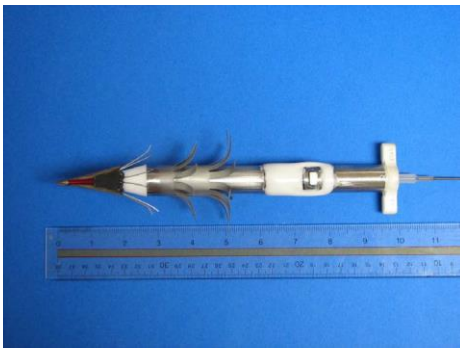
In some cases, the deep-implantable tag transmitter can be external (Figure 20). The cylindrical portion of the deep-implantable tag housing is designed for implantation beneath the animal's skin (with a penetration depth of 19.8 centimeters [7.8 inches]) while the plate and syntactic foam GPS receive sit atop the animal's back. The deep-implantable tag has a large, buoyant, external component that is subject to significant hydrodynamic drag. Thus, penetration beyond the blubber/muscle interface is necessary for longer attachment beyond the durations of dart/barb or bolt-pin style tags. After a pre-determined, programmable time, an electrical current is activated within the tag, oxidizing the corrodible wire, whereupon the deep-implantable tag is ejected from the housing and floats to the water surface for recovery (Mate et al. 2017). Current examples of deep-implantable tags include Wildlife Computers SPOT and SPLASH tag deployed in a fully-implantable configuration, Telonics ST-15 or ST-27 (RDW-640), and Dive Monitoring (RDW-665).

Dimensions of deep-implantable tags and tag anchors vary, but anchors are generally 10 to 30 centimeters (3.9 to 11.8 inches) in length (Mate 1999; Mate et al. 1999; Heide-Jorgensen et al. 2006; Mate et al. 2007; Mate 2008; Mate and Best 2008; Gales et al. 2009; Robbins et al. 2013). The maximum weight of deep-implantable tags ranges from 300 to 350 grams (0.7 to 0.8 pounds) for fully-integrated tags, and up to 620 grams (1.4 pounds) for recoverable deep-implantable tags with external components. The diameter of the anchor varies according to the placement, size, and shape of the tips and retention barbs, but usually ranges from 0.8 to 2.4 centimeters (0.3 to 0.9 inches). The number of barb/toggle sets varies, but typically ranges from one (shorter attachment systems) to three (longer attachment systems) and the length of the barbs used to date range from 3.5 to 7 centimeters (1.4 to 2.8 inches). Barbs and toggles deploy immediately after the deep-implantable tag is attached to the body of the animal by opening outwards and anchoring in the adjacent tissue. Material used to produce these attachment systems includes stainless steel and titanium and can be coated with other bio-compatible material.

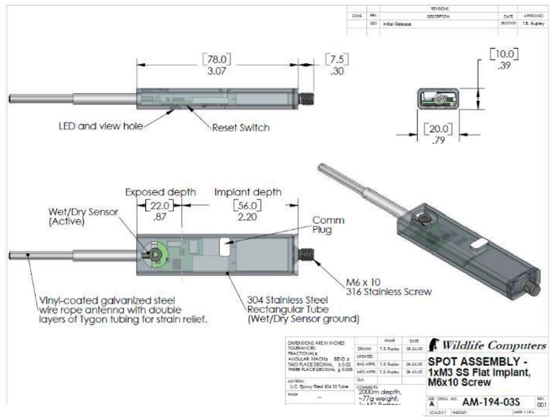
a)

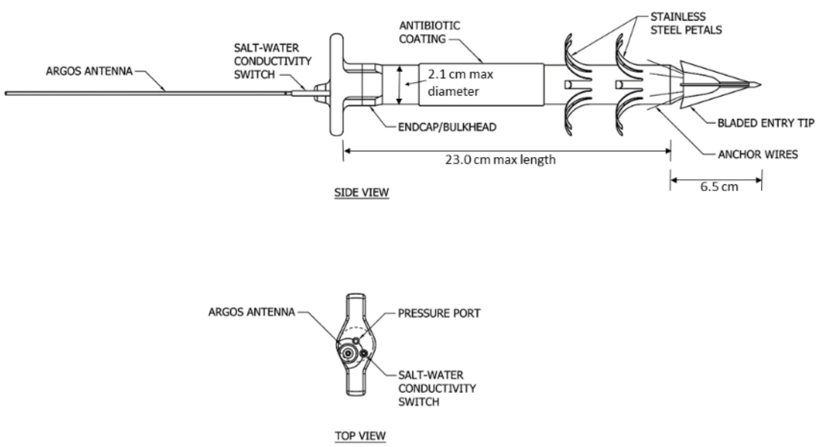


b)



c)



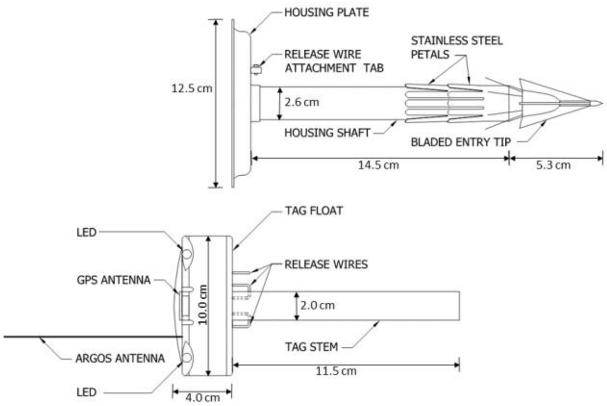


d)

Figure 20. (a) Example of a Telonics ST-15. (b) Example of a Wildlife Computers SPOT5 location-only satellite tag from File No. 14856. (c) Flat deep-implantable tag schematics from File No. 20465. (d) Schematic diagram of the Telonics non-recoverable tag (ST-27 transmitter) showing the main body, the distal end with

antenna and saltwater conductivity switch endcap, as well as the penetrating trip and anchoring system from File No. 21585.

a)



b)

Figure 21. (a) Example of a retrievable deep-implantable tag from File No. 14856. (b) Example of a schematic diagram of the Wildlife Computers recoverable deep-implantable tag, with the Oregon State University-designed housing. The housing shaft is designed for implantation beneath the animal's skin while the plate and tag float sit atop the animal's back from File No. 21585.

The deep-implantable tag will ultimately be shed from the animals due to hydrodynamic drag and the natural migration (rejection) of foreign objects out of the tissue. The timing of this shedding will vary depending on the species and season. Based on past deployments, attachment durations range from approximately 30 days to a maximum of 600 days (average 185 days for sperm whales, 100 days for right whales, and 39 to 75 days for humpback whales) (Mate and Baumgartner 2001; Zerbini et al. 2016). Electronic life expectancy of the transmitters is approximately six to 24 months, depending on how deep-implantable tags are programmed. Recoverable deep-implantable tags with external tag transmitters typically stay attached for approximately two months.

Animals are typically approached for tagging in small research vessels (usually 8 meters [26.2 feet]), either rigid-hull inflatable boats or fiberglass hulls. Animals may be approached as closely as 1 meter (3.3 feet) for deep-implantable tagging. Close approaches usually occur from behind and to one side of the animal. Target animals will not intentionally be approached head on. During deep-implantable tag deployment, the speed of the research vessel will be slightly greater than the animal's speed in order to catch up to the animal and deploy the tag. Deployment methods may include carbon-fiber poles, crossbows, Larsen guns, and air-powered projects (e.g., Air-Rocket Transmitter System, modified line throwers, and Dan-Inject rifles). The choice of the deployment technique is often tag and species-specific. A buoyant tag carrier fits into the applicator barrel and holds the deep-implantable tag. The carrier separates from the deep-implantable tag after attachment and is usually recovered.

Deep-implantable tags will be placed on the dorsal surface of the animals, up to approximately 5 meters (16.4 feet) in front of the dorsal fin/ridge/hump, and behind the blowhole. For implantable units with only an external antenna, the placement becomes important to allow the tag to break the water surface during surfacing events to allow transmission of data.

In addition to providing transmissions for location calculation, the deep-implantable tag can report a data, such as the cumulative number of surfacings an animal makes, the percentage of time at the surface, and the percentage of time in user-specified temperature ranges. Life expectancy of the electronics is adjustable depending on the transmission duty cycle.

3.7.5.2 Targeting Animals for Tagging

For most permits for research and enhancement activities on cetaceans, individuals targeted for tagging by researchers will include adults, subadults, and juveniles older than one year of age. For some permits, non-neonate calves may also be tagged depending on research objectives, target species, and tag size and type. For example, blue whale calves over 10 meters (32.8 feet) long may be authorized for tagging and non-neonate North Atlantic right whale calves may receive suction-cup tags in the cetacean research permitting program. Obviously pregnant females and mothers with neonates will not be tagged in most cases, unless explicitly justified in the application and authorized through the permit process (Table 4). Generally, researchers will not closely approach mothers with neonate calves, and will not come between or separate mother-calf pairs. The permits also contain additional conditions for minimizing impacts to mother-calf pairs. Characteristics of neonates vary by species, but typically are one month old or less and include features such as its small size relative to the mother, presence of fetal folds, flaccid flukes or fins, uncoordinated behaviors, and pigmentation.

Prior to tagging attempts, a visual assessment of health condition of target individuals will be conducted by researchers, and required by permit terms and conditions. As a requirement of permits under this programmatic consultation, researchers must avoid deploying any invasive tag (e.g., dart/barb tags, bolt/pin tags, deep-implantable tags) on animals that are obviously emaciated, those with generalized skin conditions likely indicative of poor health (e.g., skin "pox" or large-scale skin discoloration, unnatural skin color, unusual wounds (e.g., large numbers of fresh cookie-cutter shark bite wounds, large recent shark bit wounds, extensive fresh tooth rakes), large aggregations of cyamids in unusual locations on the main body, or apparently severe injuries. Individuals whose behavior suggests compromised health (e.g., difficulty surfacing, listing to one side) will be avoided. Obviously pregnant females will be avoided in most cases, except as described above for those research activities and species where tagging of pregnant females is justified in the application for conservation and management purposes and explicitly authorized.

Researchers will approach animals carefully and terminate close approaches if the target animal(s) show significant avoidance to research vessels prior to tag deployment. Researchers will not approach mothers with neonate calves in most cases unless justified in the application and explicitly authorized, and will not come between or separate mother-calf pairs.

3.7.5.3 Tag Sterilization

Permit terms and conditions will require all equipment inserted into the body of an animal (i.e., implantable tags, tag anchors) must be sterilized (CDC 2008) following an IACUC or veterinary-approved protocol. Sterilization will destroy or eliminate all forms of microbial life and is carried out by physical or chemical methods. Disinfection will eliminate many or all pathogenic microorganisms, except bacterial spores, on inanimate objects usually by liquid chemicals. Sterilization typically occurs by autoclave or gas sterilization using ethylene oxide or hydrogen peroxide or equivalent. Other chemical sterilization methods may be used, such as cold sterilization solutions (e.g., glutaralhyde, hydrogen peroxide, peracetic acid) at the appropriate concentrations, temperature, and contact times for sterilization (not disinfection) (FDA 2015). Sterilization methods and requirements may be updated in the future based on the best available science for accepted sterilization methods. Sterile tag anchors and deep-implantable tags will be kept in air and watertight containers, or in the sterilization and before deployment should be performed with sterile surgical gloves or other sterilized equipment. In general, prior to deployment, it is possible to leave the sterilization pouch on the tag anchors while attachment systems that penetrate the skin will be sterilized and sealed in a transport package before use in the field.

3.7.5.4 Tag Antibiotics

Researchers may use topical or integrated slow-release antibiotics on tags that penetrate the skin prior to deployment. Coating the tag in antibiotics follows the research method proposed by Dr. Bruce Mate (Mate et al. 2007), which uses a broad-spectrum antibiotic (e.g., 2.5 grams [0.01 pounds] of gentamycin sulphate) mixed in acetone with a long dispersant methacrylate powder. However, more effective antibiotics may be used when they become available, with IACUC or veterinary approval.

3.7.5.5 Tagging Frequency

In most cases, individual animals will not knowingly be tagged more than once in a given year, but may be tagged in subsequent years provided it is no longer carrying an invasive or deep-implantable tag. In some cases, researchers may request to tag the same animal more than once per year depending on their study objectives.

3.7.5.6 Tagging Combinations

Based on historical tagging data, animals will be tagged with one tag type for the majority of tagging takes requested by researchers. The NMFS Permits and Conservation Division expect a portion of takes authorized will allow for two or three tags per individual. Typically this will include a suction-cup tag and one invasive tag (dart/barb tag, bolt/pin tag, or deep-implantable tag); however, some researchers request authorization to tag animals with a dart/barb tag and deep-implantable tag, or with two deep-implantable tags to ground truth tag types and collect different forms of tag data (e.g., location-only versus dive behavior). A much smaller percentage of researchers may deploy three tags on an animal, one of each type. In general, no tagged animal will receive more than six darts acting as anchors among the combination of total tags received. In the case of two or three tags being deployed on the same individual per year, multiple tags may be deployed at the same time, or on subsequent surfacings, or perhaps even on subsequent days.

3.7.5.7 Tag Refinement, Modifications, and Evolution

The dimensions and weights of tags described are examples of the variety used or designed to date by the research community; as tag technology improves over time, tags with different shapes and sizes may be used. Tagging instruments are constantly being improved and researchers will utilize the most appropriate tagging instruments and research methods available at the time of tagging. The NMFS Permits and Conservation Division will carefully review and evaluate an applicant’s research objective and proposed research methods before authorizing any tag package and deployment system to ensure that researchers are likely to achieve their objectives and goals with the fewest impacts on tagged animals, in line with their permit issuance criteria under the ESA and MMPA.

As the needs of researchers evolves, tagging instruments deployed on animals may include new components and sensors. Although the exact size and shape of a new or enhanced tag cannot be predetermined, the size and weight should not be substantially larger than that described above for the current examples. If a researcher’s tag unit changes such that its specifications greatly exceed those permitted or require invasive techniques other than those described, the NMFS Permits and Conservation Division will consult with the NMFS ESA Interagency Cooperation Division on the necessary steps (i.e., informal or formal consultation) to evaluate the potential impact of the tag design and their inclusion under this programmatic consultation.

Tag anchors, darts, barbs, bolts, and pins are currently constructed from stainless steel, titanium, or plastic (e.g., Delrin). In the future, as technology improves, the tag anchors may be constructed from other biocompatible, or bio-absorbable materials, including polyglycolic acid, polylactic acid, or hydrogels. These materials will be reviewed by the NMFS Permits and Conservation Division, tagging experts, IACUC, and veterinarians to ensure they are safe for animals before approval for use in research and enhancement permits, and the NMFS Permits and Conservation Division will consult with the NMFS ESA Interagency Cooperation Division on the necessary steps to include such attachment materials under the programmatic consultation.

3.7.5.8 Tag Tracking and Post-Tag Monitoring

To the maximum extent feasible, researchers will conduct short-term (e.g., during the same day) and long-term (e.g., weeks or months over the life of the attachment) tracking and post-tag monitoring of animals. Immediately after tagging animals, the researchers (tagging team) will capture a suite of photographs at approximately 20 meters (65.6 feet) distance to fully document the initial placement and condition of the tag implant site. Whenever possible, the researchers will also track or conduct a focal follow of the tagged animal at a distance of approximately 100 meters (328.1 feet) to assess the response of the animal to the tagging event. After the initial day of tagging, the animal's movements can be tracked remotely using the satellite systems. Researchers will attempt to resight, photograph, and conduct follow-up observations on tagged animals. In many cases, resightings of tagged animals are opportunistic; however, researchers using invasive tag methods will be required to conduct post-tag monitoring to the maximum extent possible (see Section 19.4).

The main goals of post-tag monitoring are to quantify the tissue response to the implanted anchors and generally assess whether the tagging had any adverse effects (e.g., abnormal behavior or wounds) on cetaceans. During post-tag monitoring, the tag site is evaluated to determine whether a swelling or depression or other type of lesion is apparent in the tissue, and if so, its magnitude, by noting the approximate size (height, diameter), appearance, and shape (e.g., if uniform, then round or elliptical, otherwise irregular shapes are described). Skin color and texture are also described and compared with surrounding tissue, along with an assessment of whether the skin at the tagging site is intact. Any fluid discharge or tissue extrusion will be described and quantified to the extent possible, as well as ectoparasites at the tagging site and elsewhere on the cetacean. This evaluation should include photo-documentation of the animal and tag site whenever possible.

For some tag types (e.g., suction-cup tags), animals will be tracked by research vessel for monitoring and tag retrieval (e.g., hours to days). The tagged animals will be tracked and followed as described in the focal follow and behavioral observation procedures (see Section 3.7.2.7).

3.7.6 Import/Export and Salvage of Carcass, Parts, or Tissues

Significant research on cetaceans is conducted on parts collected, imported, exported, and received under research and enhancement permits. The NMFS Marine Mammal Health and Stranding Response Program responds to as many incidents as they can for dead-stranded cetaceans and collects or salvages samples; however, in some limited cases, the NMFS Marine Mammal Health and Stranding Response Program allows for permit holder to collect or salvage parts from dead cetaceans opportunistically encountered during permitted research activities (not as a result of permitted research activities). These cases most often include research and enhancement activities that occur in remote locations where the NMFS Marine Mammal Health and Stranding Response Program cannot respond to the stranding event and the loss of samples will be a detriment to research on cetaceans.

For permit holders authorized to collect and salvage parts from cetaceans under this programmatic consultation, the researchers will collect parts from dead cetaceans encountered during other research and enhancement activities. Specimens will generally be acquired opportunistically; therefore, specific numbers and kinds of specimens cannot be predetermined; however, the researchers generally collect or salvage parts from cetacean species for which they are permitted take of live animals. Researchers will use appropriate personal protective equipment including gloves, masks, and lab coat or apron to collect samples from carcasses of cetaceans. Samples will be collected with forceps and put into individually labeled sample collection tubes or bags. Collected samples will be placed on ice or frozen as soon as possible after collection. Researchers may collect any sample including, but not limited to: baleen, eyes, muscle, skin, blubber, internal organs and tissues, reproductive organs, teeth, mammary glands, milk or colostrum, serum or plasma, urine, tears, blood, bile, fetuses, internal and external parasites, stomach or intestines and their contents, feces, earplugs, tympanic bullae, ear ossicles, fins, flukes, bone, head and skull, and whole carcasses.

3.7.7 Captive Studies

Research and enhancement activities (e.g., performing a hearing test) may occur on a non-releasable rehabilitated animal in captivity taken under MMPA Section 109(h) and ESA Section 10(a)(1)(a). In most cases, these research and enhancement activities will be authorized under the Marine Mammal Health and Stranding Response Program permit, but in limited circumstances, at the discretion of the Director of the Office of Protected Resources, these activities may be authorized in individual research permits and are limited to the research and enhancement activities described in this consultation.

Captive killer whales at APHIS-approved facilities may have ancestry from the Southern Resident DPS of killer whales, but they are not considered ESA-listed. The captive female killer whale “Lolita” is recognized as the only known member of the Southern Resident DPS of killer whales who was captured in 1970 and resides at the Miami Seaquarium in Miami, Florida. A final rule was published in February 10, 2015 (80 FR 7380) that does not exclude “Lolita” from the Southern Resident DPS of killer whales due to her captive status. NMFS determined that captive members of the Southern Resident population should be included in the ESA-listed Southern Resident DPS of killer whales.

3.8 Conservation Measures

Conservation, minimization, or mitigation measures can be found in the permit template for cetacean research in Section 19.3. These measures reflect the best available science on the species and additional steps will be taken by the NMFS Permits and Conservation Division to limit impacts of invasive tagging by species, age class, and animal condition. Mitigation measures in Section 19.3 were updated in consultation with the Office of Protected Resources' veterinary medical officer for cetaceans, and other cetacean experts and veterinarians. In addition, the NMFS Permits and Conservation Division requires researchers to address the mitigation measures that will be implemented to minimize potential impacts to their research and enhancement activities within each permit application.

Any time a serious injury or mortality of an animal has been reported during research and enhancement activities or new information indicates that impacts of a specific research method or procedure may greater than anticipated, the NMFS Permits and Conservation Division will consider whether research protocols or standard mitigation measures need revision.

3.9 Proposed Limits for Cetacean Research Permitting Program

The intent of the NMFS Permits and Conservation Division's cetacean research permitting program is to not authorize research methods that will lead to any fitness-level impacts to ESA-listed cetacean species or DPSs. The number of animals that may be taken during research activities that are not expected to result in fitness level impacts in NMFS Permits and Conservation Division's cetacean research permitting program as a whole will be unlimited. This includes all research activities on wild and captive animals, except deep-implantable tags. Biopsy sampling and dart/barb tagging will have unlimited takes, but species and age-class restrictions will apply.

Permits for research activities on captive animals in rehabilitation or public display facilities may be unlimited. Permits for research activities on parts alone, such as for cell line development, will not authorize the take of live animals, and the numbers of parts can be unlimited. This section discusses the NMFS Permits and Conservation Division's proposed approach for authorizing non-lethal take for research activities on live animals in the wild.

The NMFS Permits and Conservation Division will limit some research methods by age-class or based on an animal's apparent physical condition. In doing so, the conservation measures will serve as a safeguard to avoid serious injury, mortality, or other fitness-related impacts (e.g., reproductive success) to the target species and populations. NMFS Permits and Conservation Division propose to limit the species that may receive deep-implantable tags and the number of takes authorized for these species annually. If new information becomes available indicating that other research methods can have fitness-level impacts that cannot be mitigated or avoided and that the NMFS Permits and Conservation Division values permitting, they will take a similar approach to finding a way to limit the magnitude of effort and therefore impact to the target species and populations. This will be evaluated on a case-by-case basis in discussion with us.

While the NMFS Permits and Conservation Division will not limit take numbers overall for the cetacean research permitting program for individual research methods except for deep-implantable tags, they do not anticipate the number of applicants significantly changing in the foreseeable future. Also, past authorized take numbers were much higher than reportedly used on an annual basis (see Section 10.10). The NMFS Permits and Conservation Division does not expect the overall magnitude of cumulative authorized take numbers for cetaceans in the program to significantly increase. Rather, the NMFS Permits and Conservation Division will have applicants renewing their permit improve the justification for requested take numbers to be more in line with the numbers they have reported if the nature and scope of their research activities is not substantially changing. This effort has begun in their revised application instructions (Section 19.1). Also, NMFS Permits and Conservation Division's revised guidance for counting and reporting takes is expected to result in lower authorized and reported take numbers, although the actual level of research effort is not expected to change substantially. Hence, future authorized take numbers are expected to be more in line with the annual reported take data, with potential modest growth in reported takes annually, dependent on resources (e.g., funding), and advances in emerging fields (e.g., unmanned aircraft systems and active acoustics).

3.9.1 Proposed Limits for Deep-Implantable Tags

For this programmatic consultation, the NMFS Permits and Conservation Division is taking a conservative approach and proposing limits on the number of deep-implantable tags authorized annually for cetaceans based on empirical data from the program for the issuance of permits for research and enhancement activities on cetaceans and the best available information on the potential risk of fitness-level impacts on tagged animals. The NMFS Permits and Conservation Division will closely monitor reports of invasive tags, including issues such as tag breakage. This is to ensure their assessment of potential impacts remains valid and can make timely adjustments to their program's protocol and permit terms and conditions as warranted. Examples of such adjustments include revised permit terms and conditions for invasive tagging in Section 19.3.

In 2016, L95, a member of the Southern Resident DPS of killer whales, was determined upon expert review to have died as a result of a fungal infection secondary to dart/barb tagging. Several factors suspected to have contributed to the death of the animal including the immunosuppressed state of animals in this population, the location of tag attachment, and improper field sterilization of the tag unit after a missed tag attempt. As a result of this incident, permit terms and conditions related to dart/barb tagging for all cetacean species has been revised and improved based to minimize the chance of a future such occurrence. The revised terms and conditions for permits include a requirement that tags are sterilized prior to and between uses. In addition, no animals in poor health or that are immunocompromised may be tagged.

The NMFS Permits and Conservation Division revised their standard permit terms and conditions for invasive tags to improve their ability to minimize impacts from such tags. It is now standard practice in research and enhancement permits to require that researchers sterilize any part of a tag that penetrates the skin (see Section 19.3 for details). The sterilization protocols must be approved by a researcher's IACUC or may have veterinary approval for researchers that do not have an IACUC. If a tag is contaminated in the field (e.g., missed tagging attempt, or if the tag is dropped onto the research vessel or in the water), researchers must re-sterilize or use a new sterile tag, or cease tagging efforts until a new sterile tag is available.

For the majority of research methods proposed, NMFS Permits and Conservation Division believe that the permit conditions and minimization measures that researchers will be required to follow will mitigate the risk of fitness-level impacts. However, NMFS Permits and Conservation Division recognize these minimization measures may not entirely eliminate all risk of fitness level impacts from the use of deep-implantable tags on ESA-listed cetaceans. Therefore, due to the potential for fitness-level impacts, NMFS Permits and Conservation Division will be cautious in the authorization of deep-implantable tags (i.e., tags designed to anchor in the fascia between muscle and blubber layers) for ESA-listed cetaceans under this programmatic consultation. NMFS Permits and Conservation will not authorize deep-implantable tags for some species or age-classes, and will limit the number of deep-implantable tags for those species and populations that may be tagged. NMFS Permits and Conservation Division propose to authorize deep-implantable tags annually to no more than ten percent of the best available abundance estimate at the species, DPS, or population level. However, the number of deep-implantable tags authorized annually almost never translates to that many cetaceans actually being tagged each year; therefore, they expect that the number of deployed and reported tags will not exceed five percent of the species, DPS, or population level annually. The proposed limits will be evaluated annually and may need to be adjusted as new information becomes available. Funding agencies require applicants to be permitted in order to apply for funds. It is the inherent nature of the NMFS Permits and Conservation Division's cetacean research permitting program that researchers have a need to request a certain number of takes in order to be eligible and competitive for funding. Having adequate resources and eligibility for funding is a regulatory requirement for permit applicants. In larger populations, the five or ten percent is a relatively large number and not likely to occur (e.g., greater than 800 tags). In very small populations, the five or ten percent is a small number and it is more difficult to manage takes depending on the number of permitted researchers. The ten percent authorized limit is most applicable to managing the very small populations. The NMFS Permits and Conservation Division will need flexibility in authorizing take with the understanding that actual and authorized take will rarely match.

The NMFS Permits and Conservation Division propose to limit deep-implantable tagging of ESA-listed cetaceans in the following ways:

- Limit the species, DPS, or population that may be tagged (see Table 1);
- Limits based on the age-class and status of animals that may be tagged (see Table 1); and
- Limit the number of deep-implantable tags authorized annually by species, DPS, or population (see Table 1).

In addition to these limits, NMFS Permits and Conservation Division will include permit conditions related to sterilization and post-tag monitoring, and develop species specific permit requirements in conjunction with NMFS regional recovery coordinators (see Section 19.3).

3.9.1.1 Proposed Limits on the Species that may Receive Deep-Implantable Tags

NMFS Permits and Conservation Division proposes to limit the species, DPS, or population to limit the species that may be tagged with deep-implantable tags as identified in Table 1 and as modified in the future as appropriate. NMFS Permits and Conservation Division developed a decision matrix of criteria when considering whether to allow deep-implantable tags for each species, DPS, or population as follows:

- Blubber thickness;
- Population size;
- Population trend;
- Baseline status (e.g., health, unusual mortality events, human impacts); and
- Data needs for conservation (e.g., as identified in species' recovery plans or status reviews or in consultation with NMFS regional recovery coordinators).

Table 1. Endangered Species Act-listed Species and distinct population segments authorized by the cetacean research permitting program for invasive tagging to evaluate and mitigate impacts.

Species	Dart/Barb or Bolt/Pin Tags[1,2]	Deep-Implantable Tags[1,2]	Tag Combinations
Beluga Whale – Cook Inlet DPS	Yes	No[a,b,c,d]	SC, D/B
Bryde's Whale – Gulf of Mexico Subspecies	Yes[3]	No[a,b,c,d]	SC, D/B
False Killer Whale – Main Hawaiian Islands Insular DPS	Yes	No[a,b,c,d]	SC, D/B
Gray Whale – Western North Pacific Population	Yes	Yes	SC, D/B, DI[5]
Killer Whale – Southern Resident DPS	No[4]	No[a,b,c,d]	SC, D/B
North Atlantic Right Whale	Yes	No[a,b,c,d]	SC, D/B
North Pacific Right Whale	Yes	Yes[e]	SC, D/B, DI[5]
Sei Whale	Yes	No[a,b,c,d]	SC, D/B
All Other ESA-listed Species (Blue Whale, Bowhead Whale, Fin Whale, Humpback Whale – Multiple ESA-	Yes	Yes	SC, D/B, DI[5]

listed DPSs, Southern Right Whale, and Sperm Whale)			

DPS=distinct population segment
SC=suction-cup tag
D/B=dart/barb tag
DI=deep-implantable tag
[1] Multiple tags may be authorized unless otherwise noted.
[2] Decision matrix for invasive tags: a – blubber thickness, b – population size, c – population trend, d – baseline (e.g., UME, health, human impacts), and e – data needs for conservation purposes (see recovery plans).
[3] Limited to no more than one tag per year.
[4] The dart/barb tagging program for Southern Resident DPS of killer whales has ceased and is not anticipated in the near future. If dart/barb tagging is proposed in the future, NMFS Permits and Conservation Division will either reinitiate programmatic consultation or conduct a separate consultation.
[5] Only one tag may be deep-implantable tag, unless expressly authorized (then maximum of two).

The decision criteria for deep-implantable tags includes:

Blubber Thickness – The blubber thickness of cetaceans targeted for deep-implantable tags is part of NMFS Permits and Conservation Division's decision matrix due to the penetration depth of deep-implantable tags. The anchors of deep-implantable tags may be up to 30 centimeters (11.8 inches) in length, and for species with thinner blubber layers, the tag anchor may penetrate deeply into muscle tissue, if authorized. Based on a review of available literature and stranding data, the reported blubber thickness for each ESA-listed species is found in Table 2. For some species with thinner blubber layers (e.g., Cook Inlet DPS of beluga whale, Gulf of Mexico subspecies of Bryde's whale, North Atlantic right whale, Main Hawaiian Islands DPS of killer whale, and Southern Resident DPS of killer whale), the deep-implantable tags will be at least two to four times longer than the reported blubber thickness and thus, will not be authorized under this programmatic consultation.

Table 2. Reported blubber thickness for Endangered Species Act-listed cetaceans from publications and unpublished stranding records.

Species	Blubber Thickness (cm)		Details	Source
	Mean	Range		
Beluga Whale – Cook Inlet DPS	9.6 4.8	3 to 27.9 2.1 to 9.5	Adults (n=33) Juveniles (n=10)	(Burek-Huntington et al. 2015; Alaska stranding records, unpublished)
Blue Whale	8.2 8.8	5.5 to 11 5.4 to 10.8	Adult Female (n=3) Juvenile Male (n=2)	(TMMC stranding records, unpublished)
Bowhead Whale	22.7	13 to 38.5	Neonates to Adults (n=61)	(George 2009)

Bryde's Whale – Gulf of Mexico Subspecies [1]	4.5 5.9 6.3	2.6 to 6.9 3.6 to 9.3 3 to 8	Mature Males (n=85) Pregnant Females 10 to 14 meter Animals (n=4)	(Konishi et al. 2009; D. Tormosov unpublished)
False Killer Whale – Main Hawaiian Islands Insular DPS	2.9	2.6 to 3.4	Adult (n=1)	(NMFS Pacific Islands Fisheries Science Center stranding records unpublished)
Fin Whale	9.9 7.1	4 to 20 3.5 to 13	Adult and Juvenile Females (n=15) Adult and Juvenile Males (n=12)	(Lockyer 1984; Lockyer et al. 1985)
Gray Whale – Western North Pacific Population [2]	14.3 12.9	9.5 to 20 9.5 to 17.5	Adult and Juvenile Females (n=146) Adult and Juvenile Males (n=152)	(Rice and Wolman 1971)
Humpback Whale – Multiple ESA-listed DPSs	15	12 to 18	Unknown	(Slijper 1954)
Killer Whale – Southern Resident DPS	4.5 4	3 to 7 3.7 to 4.5	Adult (n=4) Subadult (n=1)	(NMFS Northwest Fisheries Science Center stranding records unpublished)
North Atlantic Right Whale	12.2 12.1	7.9 to 22.3 2.75 to 27	Ultrasound of animals aged 8 months to 8 years old (n=172) Necropsy reports for adults, juveniles, and calves (n=30)	(Miller et al. 2011; Moore et al. 2004)
North Pacific Right Whale	25.3	23 to 27.5	14 meter Female (n=2)	(George 2009)
Sei Whale	7.5 7.5	4 to 13 4 to 11	Adult Females (n=7) Adult and Juvenile Males (n=5)	(Lockyer et al. 1985)
Southern Right Whale	6.2 10.9	1.5 to 17.2 1.5 to 21.2	Calves (n=38)	(Reeb et al. 2007)

			Adult Females (n=22)	
Sperm Whale	10.8 18.8 13.3	8 to 17 11 to 25 10.6 to 16	Adult and Juvenile Females (n=10) Adult Males (n=9) Adult Males (n=7)	(Lockyer 1991; Jauniaux et al. 1998)

cm=centimeter
DPS=distinct population segment
TMMC=The Marine Mammal Center
[1] Not Gulf of Mexico subspecies of Bryde's whale, data is from Bryde's whales from Japan and Russia.
[2] Animals sampled in California, stock unknown.

Deep-implantable tags that are much longer than the blubber layer of the target species have the potential to penetrate deeply into the muscle layer and potentially into the body cavity. Even if the body cavity is not penetrated, deep-implantable tags embedded deeply in muscle tissue can cause trauma due to shearing forces (Moore and Zerbini 2017). The effects of deep-implantable tags that are longer than necessary can result in more severe impacts such as serious injury to a vital organ, increased risk of tag breakage, swelling, and an increased risk of infection in more vascularized tissues. Therefore, NMFS Permits and Conservation Division prohibit deep-implantable tagging such cases to avoid serious injury or other unintended impacts based on an evaluation of the best available information on blubber thickness for each tagging request.

Population Size – The population size criteria was selected due to the very small abundance estimates for some ESA-listed cetacean species. NMFS Permits and Conservation Division propose for the purposes of this programmatic consultation will consider a very small population, which will therefore warrant a closer examination of impacts of deep-implantable tagging, to be those that are less than approximately 500 individuals. NMFS Permits and Conservation Division base this on NMFS's conservative approach for managing small populations in U.S. waters such as Cook Inlet DPS of beluga whales, Gulf of Mexico subspecies of Bryde's whales, Southern Resident DPS of killer whales, North Atlantic right whales, and North Pacific right whales. All of these populations are generally given higher scrutiny in agency decision-making because of their critical status, and all are estimated to less than 500 individuals.

The current best available estimates of population sizes for the U.S. stocks or DPSs of ESA-listed cetaceans are found in the NMFS stock assessment reports (see Table 3). The best available estimates for non-U.S. stocks or DPSs are from the literature, International Whaling Commission, or International Union of Conservation of Nature (see Table 3). Because there is the potential for fitness-level impacts may be associated for species or DPSs with very small population numbers. ESA-listed species or DPSs with small population sizes include Cook Inlet DPS of beluga whales, Gulf of Mexico subspecies of Bryde's whales, Main Hawaiian Islands insular DPS of false killer whale, Southern Resident DPS of killer whales, and North Atlantic right whales. Therefore, NMFS Permits and Conservation Division will not authorize deep-implantable tags for these small populations; however, this list may change as new information becomes available and will be evaluated on a case-by-case basis. Determining whether a population is at risk will be informed by reviewing NMFS stock assessment reports and five-year status reviews, any other new information and publications on the species or DPS, and in consultation with experts in NMFS Office of Protected Resource's Marine Mammal and Sea Turtle Conservation Division including the Marine Mammal Health and Stranding Response Program, Endangered Species Division, ESA Interagency Cooperation Division, and NMFS regional and science center experts. More information on the status of species likely to be adversely affected can be found in Section 9.

Population Trend – NMFS Permits and Conservation Division evaluated the current population trend for determining deep-implantable tag limits in their decision matrix (Table 4). For the Cook Inlet DPS of beluga whale, Southern Resident DPS of killer whale, and North Atlantic right whale, current population trends show that these populations are decreasing. The blue, bowhead, fin, Western North Pacific Population of gray whale, and Southern right whales all show evidence of population increases, and the rest of the ESA-listed species population trends are unknown. For ESA-listed species with declining population trends, the potential for fitness-level impacts can have more significant effects on these populations, and conservatively, NMFS Permits and Conservation Division will not authorize deep-implantable tags for these species or DPSs.

Current Baseline Status – NMFS Permits and Conservation Division used the current baseline status (e.g., health, unusual mortality events, human impacts) to evaluate whether species may receive deep-implantable tags. The current health status of a species or DPS plays heavily into the decision making process to determine if the application of deep-implantable tags is warranted. For example, an unusual mortality event was declared in 2017 for North Atlantic right whales. Given the current unusual mortality event, additional impacts of deep-implantable tags may cause further impacts to this vulnerable species.

Data Needs for Conservation Purposes – The final criteria used by NMFS Permits and Conservation Division to make decision of the use of deep-implantable tags are data needs for conservation purposes. The recovery plans (or status review), outline the current data needs for each species or DPS. For some species or DPS the potential risk of deep-implantable tags are outweighed by the data needs for species with unknown population sizes or distributions. For example, the North Pacific right whale is estimated to be less than 1,000 individuals in the North Pacific Ocean; however, the recovery plan for this species includes a priority to "use satellite tagging to assess range, distribution, movements, feeding ground use and to identify wintering areas" (NMFS 2013a).

3.9.1.2 Proposed Limits on the Age-Class and Status of Animals that may Receive Deep-Implantable Tags

NMFS Permits and Conservation Division propose to limit the age-class and status of animals that may receive tags of any type (Table 1). No neonates or compromised animals may be tagged. Conditions that can indicate a compromised condition may include:

- Noticeable reductions in body mass in the post-cranial region (i.e., exhibiting a nuchal fat pad depression);
- Prominent vertebral column;
- Visible ribs;
- Excessive skin lesions, parasites, or cyamids;
- Behaving abnormally; or
- Otherwise compromised individuals.

For deep-implantable tags, NMFS Permits and Conservation Division will further restrict researchers so that obviously pregnant females and mothers with neonate calves may not be tagged with deep-implantable tags in most cases, unless justified in the application and explicitly authorized. In some cases, non-neonate calves may receive deep-implantable tags (e.g., blue whale calves over 10 meters [32.8 feet].

Table 3. Current population abundance estimates, potential biological removal, and population trend for Endangered Species Act-listed cetaceans based on National Marine Fisheries Service stock assessment reports except where noted.

Species	Stock or DPS	Population Estimates		Potential Biological Removal	Population Trend
		Best	Minimum		
Beluga Whale	Cook Inlet DPS	312	287	0.57	Decreasing 1.3% Per Year
Blue Whale	Western North Atlantic Stock	Unknown	440	0.9	Unknown
	Eastern North Pacific Stock	1,647	1,551	2.3	Increasing 3% Per Year
	Central North Pacific Stock	133	63	0.1	Unknown
Bowhead Whale	Western Arctic Stock	16,892	16,100	161	Increasing 3% Per Year
	Spitsbergen Stock (East Greenland/Svalbard/Barents Sea)	50 to 250[2]	-- --	NA	Decreasing
	Sea of Okhotsk	200[2]	-- --	NA	Decreasing
Bryde's Whale	Gulf of Mexico Subspecies	33	16	0.06	Unknown
False Killer Whale	Main Hawaiian Islands Insular DPS	167	149	0.3	Unknown
Fin Whale	Western North Atlantic Stock	1,618	1,234	2.5	Unknown

	Northeast Pacific Stock	3,168	2,554	2.65	Increasing 4.8% Per Year
	California/Oregon/Washington Stock	9,029	8,127	81	Stable
	Hawaii Stock	154	75	0.1	Unknown
Gray Whale	Western North Pacific Stock	140	135	0.06	Increasing 3.3% Per Year
Hector's Dolphin	South Island	14,849[3]	-- --	-- --	Decreasing 0.5% Per Year
Humpback Whale [1]	Arabian Sea DPS	-- --	82	Unknown	Unknown
	Cape Verde Islands/Northwest Africa DPS	-- --	Less than 100[7] 171 to 260[8]	Unknown	Unknown
	Central America DPS	-- --	411	Unknown	Unknown
	Mexico DPS	-- --	3,264	Unknown	Unknown
	Western North Pacific DPS	-- --	1,059	Unknown	Unknown
Killer Whale	Southern Resident DPS	83 or 75[4]	83	0.14	Decreasing
North Atlantic Right Whale	Rangewide	458	455	1.4	Decreasing
North Pacific Right Whale	Eastern North Pacific Stock	31	26	0.05	Unknown
	Western North Pacific Stock	500 to 922[5]	-	NA	Unknown
Sei Whale	Nova Scotia Stock	357	236	0.5	Unknown
	Eastern North Pacific Stock	519	374	0.75	Unknown
	Hawaii Stock	391	204	0.4	Unknown
Southern Right Whale	Chile-Peru Stock	1 to 49[2]	-- --	NA	Decreasing
	All Other Stocks Worldwide	15,000[6]	-- --	NA	Increasing 5 to 7% Per Year
Sperm Whale	North Atlantic Stock	2,288	1,815	3.6	Unknown
	Gulf of Mexico Stock	763	560	1.1	Unknown
	North Pacific Stock	NA	NA	NA	Unknown

	California/Oregon/Washington Stock	1,997	1,270	2.5	Unknown
	Hawaii Stock	4,559	3,478	13.9	Unknown

DPS=distinct population segment
NA=not available
[1] Humpback whale population estimates are from the ESA-listing final rule (81 FR 62259)
[2] (Cooke and Reeves 2018)
[3] (MacKenzie and Clement 2016)
[4] Center for Whale Research 2018 census data
[5] (IWC 2001; Thomas et al. 2016)
[6] (NMFS 2015a)
[7] 88 individuals (Wenzel et al. 2009)
[8] (Ryan et al. 2014)

3.9.1.3 Deep-Implantable Tag Numbers

Based on the NMFS Permits and Conservation Division's analysis of current and historical take data (Section 10.10), including the level of effort reported to tag cetaceans with deep-implantable tags and the status of each species, NMFS Permits and Conservation Division propose the following deep-implantable tag limits (in terms of annual take numbers). NMFS Permits and Conservation Division will limit the total number of authorized deep-implantable tags in any one year by species, DPS, or population level, as appropriate, using the best estimate of the population size (Table 3).

In order to ensure the research and enhancement activities are not likely to jeopardize ESA-listed cetaceans, the approach used to establish authorized levels of takes by deep-implantable tags must be adaptive to incorporate new information regarding changes in the status of ESA-listed cetaceans over time. Beyond assuring the research and enhancement activities is not likely to jeopardize ESA-listed cetaceans, the NMFS Permits and Conservation Division will reduce the level of authorized takes by deep-implantable tags to the maximum extent possible while also ensuring researchers can collect information necessary for conservation and recovery.

NMFS Permits and Conservation Division are proposing to authorize deep-implantable tags at the level of ten percent of the species, DPS, or population level, as appropriate. However, they do not expect the deployed and reported deep-implantable tag numbers to exceed five percent of the species, DPS, or population level (see Table 3). The limits for the permitted deep-implantable tags are based on current best estimates of the population numbers using the best available information at this time, while recognizing that these numbers may need to be adjusted as new information becomes available. The proposed deep-implantable tag limits take into account the historical data reported by researchers as well as the current species abundance and trends in U.S. waters (except for the Western North Pacific stock of North Pacific right whale and the Southern right whale). NMFS Permits and Conservation Division has chosen to quantify their limits using the estimates available for U.S. stocks or DPSs, but doing so does not take into account the fact that some species may include additional animals that do not enter U.S. waters but can be encountered and tagged by researchers on the high seas (International Waters). For this reason, for some species like blue whales, the ten percent authorized limit is very conservative because the worldwide abundance estimate may be much higher than U.S. waters. These limits exceed potential biological removal for each stock or DPS; however, NMFS Permits and Conservation Division believe the deep-implantable tagging (if performed according to the proposed mitigation measures) only has the potential for fitness-level effects (and even those are not expected due to the required mitigation measures).

The limits are calculated at the combined species (stock or DPS) levels with the exception of the bowhead whale, North Pacific right whale, and Southern right whale. The North Pacific right whale has two separate stocks that appear to be biologically meaningful populations (Clapham et al. 2004; Marques et al. 2011; NMFS 2013a; Thomas et al. 2016; Muto et al. 2018), and as a result, NMFS Permits and Conservation Division will authorize deep-implantable tag limits at the stock level for this species. Deep-implantable tag limits will also be considered at the stock level for the Spitsbergen stock and Sea of Okhotsk stock of bowhead whales and the Chile-Peru stock of Southern right whales. For all other species, because the individual stocks are not known to be biologically meaningful and the fact that permit holders often need takes allocated rangewide for a species (e.g., throughout an ocean basin), the limits are quantified and managed at the species level.

Humpback whales, within their multiple DPSs that overlap in space and time, will be handled differently from other species. In most cases, researchers will not know which DPS an animal belongs to when they attach a deep-implantable tag. Data from photo-identification or genetic analyses may be able to assign an animal to a DPS, but those data may not be available until long after the tag has been applied.

Due to these complexities, NMFS Permits and Conservation Division will limit authorized deep-implantable tags at ten percent at the species level (or DPS level, depending on location, as some DPS's may mix) for humpback whales. If a researcher proposed to conduct tagging in a limited area where only DPSs with small numbers will occur, they will verify that those research activities will not exceed the ten percent limit for each DPS, and work with the applicant to lower the requested take numbers if necessary. At the end of the year, NMFS Permits and Conservation Division will analyze the reporting data to verify that no single DPS received more deep-implantable tags than the five percent level. Given that only five of the 14 humpback whale DPS are ESA-listed, in most areas researchers are more likely to tag non-ESA-listed humpbacks during research than the ESA-listed DPSs. NMFS Permits an Cooperation Division acknowledge that the ten percent authorized limit for some of the DPSs is small (e.g., Cape Verde Islands/Northwest Africa or Arabian Sea DPSs of humpback whales); however, based on the location of where most research and enhancement activities occur, the chance that any one DPS will have these limits exceed in any one year is not reasonably likely to occur.

NMFS Permits and Conservation Division will evaluate the reported takes of each DPS of humpback whale based on location and assign them to each DPS based on the best available scientific information. If NMFS Permits and Conservation Division find that the reported deep-implantable tag numbers exceeded the five percent limits, they will consult with us and can modify their approach to issuing deep-implantable tags as needed.

For example, NMFS Permits and Conservation Division may issue a permit that authorizes a researcher to put 25 deep-implantable tags on humpback whales in the Pacific Ocean, off California, Oregon, Washington, and Alaska annually. There are individuals from multiple DPSs in this region. When the permit is issued, NMFS Permits and Conservation Division and the researcher may not know where the majority of those research activities may occur within the action area. Furthermore, it is unlikely that the researcher will know which DPS they are tagging at the time. While the permit authorizes 25 deep-implantable tags annually, the researcher applies 12 deep-implantable tags during the year. As part of the researcher's annual report, NMFS Permits and Conservation Division will request information on where they tagged the 12 humpback whales. Based on those locations and using available guidance, they will assign those humpback whales to a specific DPS. If the NMFS Permits and Conservation Division find that more than five percent of any DPS of humpback whale received deep-implantable tags, they will consult with us and modify their approach.

NMFS Permits and Conservation Division propose to authorize up to ten percent of current abundance estimates for deep-implantable tagging of ESA-listed cetaceans; however, this limit can change over time. Each year they will evaluate the annual reports from researchers and any new information on the effects of deep-implantable tags to ensure they are not having fitness-level impacts at the authorized level for each species, stock, or DPS. For example, if new information from the research community conducting deep-implantable tagging or in annual reports indicates that deep-implantable tags are not having fitness-level impacts, NMFS Permits and Conservation Division may increase the annual limits not to exceed the ten percent maximum of the species, DPS or population level. Conversely, if the data indicates that fitness-level impacts are occurring, NMFS Permits and Conservation Division may then lower the annual limits for deep-implantable tags. NMFS Permits and Conservation Division may also opt to increase or decrease the ten percent authorized limit for a given species or DPS based on an evaluation of the health of that population, population size, and the decision matrix criteria. In all these scenarios, NMFS Permits and Conservation Division will inform us prior to implementing any changes to the number of deep-implantable tags authorized annually to ensure that the percent change is still within the scope of this programmatic consultation (i.e., although the percent may change, they do not anticipate a change in the effects to the population).

Table 4. Abundance of Endangered Species Act-listed species and distinct population segments and proposed deep-implantable tag limits for National Marine Fisheries Service Permits and Conservation Division's cetacean research permitting program (except Western North Pacific stock of North Pacific right whales and Southern right whales).

Species	Stock or DPS	Combined Abundance Estimate (Best)[1]	Number of Deep-Implantable Tags Authorized (10% of Best)	Number of Deep-Implantable Tags Reported (5% of Best)	Historical Annual Deep-Implantable Tags Reported [2]	Historical Annual Deep-Implantable Tags Authorized[1]
Blue Whale	Western North Atlantic, Eastern North Pacific, and Central North Pacific Stocks	2,220	222	111	12.4 ± 13.6 (0 to 29)	227.5 ± 104.0 (75 to 375)
Bowhead Whale	Western Arctic Stock	16,892	1,689	845	31. ± 2.4 (0 to 7)	270.6 ± 86.2 (130 to 415)
	Spitsbergen Stock	250	25	13		
	Sea of Okhotsk Stock	200	20	10		
Fin Whale	Western North Atlantic, Northeast Pacific, California/Oregon/Washington, and Hawaii Stocks	13,969	1,396	698	5.9 ± 6.2 (0 to 14)	33.4 ± 178.1 (75 to 572)
Gray Whale – Western North Pacific Stock	Western North Pacific Stock	140	14	7	0	18.0 ± 19.2 (0 to 36)
	All DPSs Combined	5,076	508	254		

Humpback Whale	Arabian Sea DPS	82	8	4	13.8 15.9 (0 to 46)	380.6 ± 198.3 (150 to 625)
	Cape Verde Islands/Northwest Africa DPS	260	26	13		
	Central America DPS	411	41	21		
	Mexico DPS	3,264	326	163		
	Western North Pacific DPS	1,059	106	53		
North Pacific Right Whale	Eastern North Pacific Stock	31	3	2	0.5 [3] (0 to 3)	50.6 ± 30.1 (14 to 84)
	Western North Pacific Stock	500	50	25		
Southern Right Whale	Worldwide (excluding Chile-Peru Stock)	15,000	1,500	750	0	78.8 ± 84.8 (0 to 180)
	Chile-Peru Stock	49	5	3		
Sperm Whale	North Atlantic, Gulf of Mexico, North Pacific, California/Oregon/Washington, and Hawaii Stocks	9,607	961	480	12.6 ± 12.3 (0 to 31)	449.4 ± 214.4 (230 to 765)

[1] N_{min} was used when N_{best} was unavailable. Stocks of animals with unknown N_{best} or N_{min} were not included in the combined total

[2] Historical data from 2009 through 2017. Annual average ± standard deviation (range).

[3] Four North Pacific right whales were tagged in 2009 through 2010 under an annual report not included in this dataset, but are included here for historical purposes.

Note: The historical numbers of authorized and reported deep-implantable tags from 2009 through 2017 are included for reference.

3.10 Authorizing Deep-Implantable Tags

Scientific research and enhancement permits for cetaceans issued under the program will promote conservation and recovery and ultimately, result in a net benefit to ESA-listed cetaceans. However, the potential exists for some adverse effects on individual cetaceans as a result of research and enhancement activities. As a condition of a permit, researchers will be required to follow specific protocols to avoid, minimize, and mitigate the unintended adverse effects that may result from research including deep-implantable tagging. The research protocols for avoiding, minimizing, and mitigating adverse effects on individual cetaceans are discussed in Section 3.8 and permit terms and conditions are described in Section 19.3. In addition to these standard methods, researchers are required to consider and describe additional precautionary measures they can take to further minimize potential impacts of their research on individual cetaceans.

The NMFS Permits and Conservation Division's proposed approach for authorizing monitoring and managing deep-implantable tagging on cetaceans is described further below and in detail in the NMFS Permits and Conservation Division's biological assessment (NMFS 2019).

3.10.1 Limiting Deep-Implantable Tags

The NMFS Permits and Conservation Division propose to cap the number of deep-implantable tags authorized annually for ESA-listed cetaceans to no more than ten percent of a species and/or DPS' population best estimate based on the best available science. The authorized number of deep-implantable tags is based on empirical data to develop limits for the cetacean research permitting program. Each ESA-listed species authorized for deep-implantable tagging will have a capped number of tags authorized annually (Table 4). The limit on take numbers may adaptively change as new information becomes available for a species or population. For example, if the species' abundance declines, the NMFS Permits and Conservation Division will consider whether the ten percent authorized limit is still appropriate or needs to be reduced. Likewise, the alternative may occur if the species' abundance substantially increases.

3.10.2 Management of Authorized Deep-Implantable Tags

The limits for deep-implantable tags in Table 4 represents the maximum number of individual cetaceans that may be authorized for the cetacean research permitting program. This section describes the NMFS Permits and Conservation Division's proposed approach for:

1. Allocating authorized deep-implantable tags among permits;
2. Tracking and monitoring cetaceans instrumented with deep-implantable tags based on information obtained from researchers; and
3. Addressing scenarios if fitness-level impacts are observed.

3.10.2.1 Allocating Authorized Take Among Research and Enhancement Permits

As part of the NMFS Permits and Conservation Division's cetacean research permitting program, they will establish an annual permit cycle for processing new applications and major modifications. The annual permit cycle will allow staff to review and evaluate all requests for directed take of cetaceans for the upcoming year at one time. Applicants are required to specify the ESA-listed cetacean (species, stock, or DPS), number, life stage (i.e., adult or juvenile), research method (e.g., aerial or vessel survey, biopsy sampling, or tagging), and location.

Once the annual window for submitting new application or major modifications is closed, the NMFS Permits and Conservation Division can estimate the number of takes of deep-implantable tags that are anticipated in the upcoming year for purposes of comparison with the annual caps for deep-implantable tags established for each species.

3.10.2.2 Requested Takes for Deep-Implantable Tags

Based on current data, takes for deep-implantable tagging are authorized in 12 percent of current permits (five of 41) for research and enhancement activities that will fall under the scope of this programmatic consultation. Provided that the number of deep-implantable tag takes requested by all applicants for the year's annual permit cycle are within the take limits for each species (Table 4) takes will be authorized as requested. This assumes that all applications and proposed take numbers are deemed *bona fide* and are recommended for issuance.

If an applicant's requested number of takes for deep-implantable tags is greater than numbers historically reported by the applicant and the applicant has not fully justified the need for the take numbers, the NMFS Permits and Conservation Division will work with the researcher to determine the justification for the requested number of takes for deep-implantable tagging. The NMFS Permits and Conservation Division will only authorize takes for deep-implantable tagging if the researcher can justify the numbers and demonstrate that research methodologies are warranted for the conservation and recovery of the ESA-listed species. If the requested take numbers are not justified, the applicant's request for deep-implantable tags may be lowered or the application may be denied. Any requests that cannot meet the ESA and MMPA issuance criteria will be returned, withdrawn, or denied; thus, these requests will be removed from the pool of applicants for deep-implantable tagging takes analysis. All requested take numbers for deep-implantable tagging that the NMFS Permits and Conservation Division proposes to authorize within an application and permit cycle will be tallied and compared to the annual limits.

3.10.2.3 Accounting for Authorized Deep-Implantable Tags from Active Research and Enhancement Permits Issued in Previous Years

Because not all active research and enhancement permits are on the same issuance cycle, only a few of the permits in the program for the issuance of permits for research and enhancement activities on cetaceans will fall under the programmatic consultation and deep-implantable tagging limits in 2019. In general, in any given year the pool of active research and enhancement permits may include both newly issued permits, and permits issued in previous application cycles once the programmatic consultation is in effect. To ensure the cumulative level of take from all active permits remains with the limits for each species, the NMFS Permits and Conservation

Division will consider all authorized takes for deep-implantable tagging under the programmatic consultation on an annual basis. The NMFS Permits and Conservation Division will use the same approach and tally all authorized takes for deep-implantable tagging from existing active permits issued under the programmatic consultation combined with requested deep-implantable tags for new applications for the upcoming year. Because takes will be authorized and managed on an annual basis, each permit holder's take numbers will reset each year against the ten percent authorized limit for the ESA-listed species or DPS.

If the pool of requests in a given year's permit cycle exceed the takes for deep-implantable tagging limits for a species or DPS, the NMFS Permits and Conservation Division will contact affected researchers to discuss options for reducing the anticipated takes for deep-implantable tagging so as not to exceed the annual take limits. The NMFS Permits and Conservation Division will contact new applicants in a given permit cycle to reduce the anticipated number of deep-implantable tags for a given species or DPS to the annual limits. Researchers with permits issued in previous years may also be contacted to assess their flexibility in reducing their authorized take for the upcoming year.

3.10.3 Monitoring Takes for Deep-Implantable Tags

The NMFS Permits and Conservation Division will continue to monitor and track takes for deep-implantable tagging, as information from researchers is reported throughout the year and in annual reports. As a condition of each permit, the NMFS Permits and Conservation Division must be notified if the permit holder exceeds their annual take limits. If a permit holder reaches or exceed their limit of takes for deep-implantable tagging specified in their permit, they also must stop their research and enhancement activities.

The NMFS Permits and Conservation Division will monitor the reported numbers of deep-implantable tags closely to ensure that the limits are not exceeded each year. The NMFS Permits and Conservation Division has developed the limits on deep-implantable tags based on empirical data over the eight years of research anticipated future permit activity. They believe that the deep-implantable tagging limits are not likely to be exceeded as proposed, and will consult with the NMFS ESA Interagency Cooperation Division if the annual limits for the program for the issuance of permits for research and enhancement activities on cetaceans are unintentionally exceeded in any year.

The NMFS Permits and Conservation Division's decision-making matrix (Section 3.10.2) will also be reviewed on an annual basis, and may modify the species that may receive deep-implantable tags, or change the authorized take numbers of deep-implantable tags annually not to exceed ten percent of the species, DPS, or population level. The NMFS Permits and Conservation Division will also coordinate with NMFS recovery coordinators, NMFS Marine Mammal and Sea Turtle Division, and species experts in the future to make the decisions about changes to authorized limits for deep-implantable tags and will be conservative when in doubt.

3.11 Fitness-Level Impacts

The NMFS Permits and Conservation Division cannot conclude with absolute certainty that deep-implantable tags do not have the potential for fitness-level impacts at the individual or population level. However, they are mitigating these potential impacts by requiring certain terms and conditions in permits, in addition to conservatively placing a limit on the number of deep-implantable tags authorized to ten percent of the best available abundance estimate for each species, population, or DPS based on the best available science. Due to these conservative limits, the NMFS Permits and Conservation Division do not expect deep-implantable tags to translate to individual, population, or species level impacts. Previous biological opinions with no jeopardy have supported this conclusion for individual permits authorizing takes for deep-implantable tags. No mortalities have been reported because of deep-implantable tagging. The death of L95 may have been in part due to a dart/barb tag; however, as discussed above, many other factors appear to have contributed in this case and the revised sterilization requirements should alleviate the concerns raised by this case. In addition, no invasive tags will be authorized for Southern Resident DPS of killer whales (see Table 1).

Currently ESA-listed cetaceans face many threats that may result in fitness-level impacts or mortality including vessel strike, entanglement, whaling, and long-term impacts due to climate change and pollution. Placing a limit on the number of deep-implantable tags on animals annually is a low percentage of the population, with an unlikely potential for fitness-level impacts. In addition, the allowable deep-implantable tag limit of ten percent of the population may be modified going forward, after discussion with the NMFS ESA Interagency Cooperation Division, under this programmatic consultation should new information (e.g., change in a species or DPS' status, or evidence of fitness-level impacts from annual reports) indicate that this limit needs re-evaluation. Therefore, the NMFS Permits and Conservation Division believes that the allowance of deep-implantable tags, when considering other external threats that may impact the species and result in fitness-level impacts, is unlikely to reduce the viability of or jeopardize the continued existence of any ESA-listed cetacean species or population.

3.12 Internal Program Review

The NMFS Permits and Conservation Division will conduct an internal review of the program for the issuance of permits for research and enhancement activities on cetaceans after completion of one full annual permit cycle, including submission of annual reports, has been completed under the programmatic consultation. The internal review will evaluate program operations to determine whether resources (time, staff, expertise, etc.) need adjustment, identify challenges or problems that arose and lessons learned, and identify ways to improve how the program for the issuance of permits for research and enhancement activities on cetaceans functions. Specific aspects that will be assessed include:

- Permit cycle – Are the majority of the applicants submitting requests on time? Is the volume of requests in a cycle manageable in addition to other workload? Is the six-month processing window adequate?

- Take allocation – Are the levels of deep-implantable tags requested and authorized in line with what was expected based on past data? Are the deep-implantable tag take limits sufficient or over-estimated?
- Reporting schedule – Are permit holders submitting annual and incident reports on time? Is NMFS getting the details needed to assess the program for the issuance of permits for research and enhancement activities on cetaceans?
- Lessons learned – What other challenges or problems arose and how were they resolved? Does the process need revision?
- Future issues – Are there issues on the horizon based on funding announcements, trending research interests, species status, new information/papers, etc. that will require reinitiation?

The NMFS Permits and Conservation Division will continue to conduct internal reviews of the cetacean research permitting program on a regular basis (approximately every 12 to 16 months), as other taxa/species programmatic consultations are completed, or more frequently as needed (e.g., staffing, other NMFS Permits and Conservation Division or Office of Protected Resources tasks and projects, changes in ESA-listings, etc.) that may affect how the NMFS Permits and Conservation Division processes and manages permits.

3.13 Monitoring the Effects of the Permits for Research and Enhancement Activities

The NMFS Permits and Conservation Division assess 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 cetaceans;
- Adaptive management of authorized research and enhancement activities and take levels;
- Monitoring the status of authorized ESA-listed cetacean species; and
- Internal program reviews.

Permit holders are required to notify the NMFS Permits and Conservation Division if their activities result in exceeding authorized take, serious injury, or mortality of a protected species. 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 NMFS Permits and Conservation Division, and submit an incident report. Review of the report and the authorized methods and protocols allow NMFS Permits and Conservation 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 NMFS Permits and Conservation 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 NMFS Permits and Conservation 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 19.4.

If any report indicates that the research and enhancement activities are exceeding the original assessment of impacts, the NMFS Permits and Conservation 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 NMFS Permits and Conservation 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 NMFS Permits and Conservation Division to review how the permit holder has used the number of takes authorized each year. To facilitate the NMFS Permits and Conservation Division's ability to monitor the reported use of takes by permit holders across the program, they are establishing a fixed reporting schedule.

3.14 Monitoring the Status of Endangered Species Act-Listed Species

The NMFS Permits and Conservation 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 NMFS Permits and Conservation Division will remain apprised of species status reviews and stock assessment reports in coordination with the NMFS Marine Mammal and Sea Turtle Conservation Division and NMFS Endangered Species Division, of the target species on an annual basis to ensure that the NMFS Permits and Conservation Division does not authorize take to a degree that will result in greater impacts to any cetacean species. The NMFS Permits and Conservation 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 beyond the action area, or evidence that fitness level impacts are occurring as a result of the research methods, although 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.

3.15 Standard Reporting Schedule

Similar to the annual permit cycle for allocating takes, the NMFS Permits and Conservation Division will have a fixed reporting schedule so that all permit reports are due at the same time of year. Permit holders will have 60 days to submit their report after the end of each permit year. The NMFS Permits and Conservation Division will then have 30 days to review the reports and ask permit holders for additional information if needed. The NMFS Permits and Conservation 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 NMFS Permits and Conservation Division. After the reports have been reviewed, the NMFS Permits and Conservation Division will have another 30 days to compile all data for annual reporting to the NMFS ESA Interagency Cooperation Division.

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 5. Example of the timeline and actions during the standard reporting schedule for research and enhancement permits.

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

Because reporting is vital to effectively monitor the takes used by permit holders and ultimately, monitoring of impacts to the species, the NMFS Permits and Conservation 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 NMFS Permits and Conservation 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.

3.16 Adaptive Management

Adaptive management will be an integral component of the cetacean research permitting program. Any aspect (e.g., species, take umbers, methods, mitigation measures, etc.) of a permit can be modified at any time as a result of new information that informs the NMFS Permits and Conservation Division's assessment of potential impacts to species or habitat and knowledge of the species (e.g., status, threats, habitat, range, etc.). New information comes not only from submitted permit reports but by the NMFS Permits and Conservation Division remaining apprised of new publications, presentations, and monitoring common listservers used by the research community. This allows the NMFS Permits and Conservation Division to ensure the program satisfies their statutory mandates and regulatory requirements and promote conservation and recovery of the species while minimizing impacts.

Adaptive management is built into the NMFS Permits and Conservation Division's reporting requirements to continually monitor impacts, as well as in their permit application process. When reviewing applications, the NMFS Permits and Conservation Division will ensure take numbers are justified and will also encourage researchers to coordinate fieldwork as practical to reduce the chance that the limits on take numbers for deep-implantable tags are reached. The NMFS Permits and Conservation Division also will monitor available information regarding the status of each species and DPS to ensure that the basis for concluding low/negligible risk to the species remains valid. New information (e.g., status review, published abundance estimates, etc.) for each species or DPS that informs this approach will be reviewed and considered and applied to the management of the invasive tagging limits as it becomes available. For example, a report is now available on the outcomes of a 2017 tagging workshop sponsored by the International Whaling Commission, Office of Naval Research, and Office of Protected Resources where international experts evaluated the current state of invasive tagging methods and protocols, such as sterilization requirements (ONR 2019). The NMFS Permits and Conservation Division have reviewed and will consider the recommendations in that report as it relates to authorizing all invasive tag methods (e.g., dart/barb, bolt/pin, and deep-implantable tags) in research and enhancement permits and the mitigation measures those permits require. The final peer-reviewed publication of this report and best practices is expected in late 2019 and once final, NMFS Permits and Conservation Division may include report recommendations as permit terms and conditions. Any updates will be provided to us with annual reports.

3.16.1 Standard Methods

Another example of adaptive management for issuance of permits for research and enhancement activities on cetaceans is the development of standard methods to reduce processing time by developing pre-approved methods for standard marine mammal research and enhancement activities using the best available science. The goals of developing standard methods are to:

- Streamline the ESA/MMPA application submission and review;
- Minimize question and answer periods on applications; and
- Promote consistency and quality in methodologies across researchers.

The NMFS Permits and Conservation Division, in collaboration with the NMFS Office of Science and Technology, is developing standard methods for research on marine mammals. A standard method is a research procedure that is routine and not likely to substantially change, other than improvements based on best available science, and implemented regularly with known impacts. Once the standard methods are approved by NMFS and external reviewers (such as subject matter experts and the Marine Mammal Commission), they will be published on the NMFS Permits and Conservation Division's website for use by researchers. If those standard methods are cited in a permit application, they will not require review by NMFS because they will have been pre-approved. Any new or novel methods or methods not used frequently are subject to standard review during the permit process.

Currently, no standard methods have been finalized; however, drafts of the standard methods are in progress and are expected to align with the methods described in this programmatic consultation. The NMFS Permits and Conservation Division is in the process of working with the NMFS science centers and regional offices, IACUC, NMFS ESA Interagency Cooperation Division, Marine Mammal Commission, and the scientific research community for review and development of these standard methods. As the standard methods are finalized, the procedures described here in this programmatic consultations will be updated to use the standard method provided the method will not result in greater impacts than those described for the procedure. Any future methods or procedures that become standard methods will undergo the same process for development and review, and will be incorporated into this programmatic consultation. The NMFS Permits and Conservation Division will discuss reinitiation with the NMFS ESA Interagency Cooperation Division if new standard methods or procedures are warranted.

Beyond standard methods, as new or novel technologies or methods are developed in the research community over the course of research and enhancement activities on cetaceans under this programmatic consultation, the NMFS Permits and Conservation will evaluate these methods or procedures on a case-by-case basis. If the effects of the new method or procedure are the same as those currently authorized, then these methods may be incorporated into the programmatic consultation. The criteria the NMFS Permits and Conservation Division may use to determine if a new procedure or method is safe may include results of testing on a non-ESA-listed surrogate species, IACUC approval, and review by veterinarians or experts in the appropriate field. If a method or procedure has unknown effects or known effects that were not previously considered under this programmatic consultation, the NMFS Permits and Conservation Division may reinitiate consultation with the NMFS ESA Interagency Cooperation Division about requirements for the new method, if necessary.

3.16.2 Species-Specific Requirements in Conjunction with National Marine Fisheries Service Regional Recovery Coordinators

As part of the adaptive management process, the NMFS Permits and Conservation Division will also work with the NMFS recovery coordinators for ESA-listed species to minimize impacts to vulnerable species as laid out in the following example for the Gulf of Mexico subspecies of Bryde's whales. The NMFS Permits and Conservation Division will use this framework for the Gulf of Mexico subspecies of Bryde's whale as an example, and may develop similar plans for other ESA-listed species (e.g., North Pacific right whale or Western North Pacific population of gray whale) in the future as warranted in consultation with the NMFS recovery coordinators.

In 2018, the NMFS Permits and Conservation Division developed an adaptive management plan to provide a framework for coordinating and monitoring annual take of the Gulf of Mexico subspecies of Bryde's whale under multiple scientific research and enhancement permits in consultation with the NMFS Southeast Regional Office and the NMFS ESA Interagency Cooperation Division. This adaptive management framework was necessary because the Gulf of Mexico subspecies of Bryde's whale is the only year-round resident mysticete in the Gulf of Mexico and its current population is less than 100 individuals and may only contain 33 animals (81 FR 88639) (Hayes et al. 2017). Note that deep-implantable tags were not authorized for Gulf of Mexico subspecies of Bryde's whales under this framework, and no deep-implantable tags will be authorized on this species under this programmatic consultation at this time. However, the framework provides an appropriate example that may be followed with other ESA-listed species where deep-implantable tags are authorized.

3.16.2.1 Gulf of Mexico Subspecies of Bryde's Whale Adaptive Management Framework

Under the adaptive management plan, the NMFS Permits and Conservation Division conditionally authorized takes of Gulf of Mexico subspecies of Bryde's whales to limit research and enhancement activities that may result in MMPA Level A harassment (biopsy sampling and tagging) across all permits combined to ensure that no more than the entire population may be intentionally taken twice annually by these research and enhancement activities. In order to invoke the takes authorized in each permit in any given year, the permit holder is required to receive written authorization from the NMFS Permits and Conservation Division before conducting any research activity involving take of the Gulf of Mexico subspecies of Bryde's whale and follow special, additional reporting requirements. Take numbers may be authorized as originally requested (e.g., if only one researcher is proposing to work) or reallocated among permit holders on an annual or other specified basis (e.g., for the next two years), based on the number of requests and after evaluating the status of the species, management needs, researcher's plans and funding levels, and reported takes by permit holders during the prior year. Permit holders are required to coordinate their research activities, including timing and location with NMFS Southeast Regional Office, NMFS Permits and Conservation Division, and other permit holders to avoid the potential for the same animals to be taken by more than one permit holder on the same day. Any future applicants that request takes of Gulf of Mexico subspecies of Bryde's whales will be incorporated into this adaptive management framework, and any issued permits will contain the same conditions.

3.16.2.2 Mitigation Measures for Gulf of Mexico Subspecies of Bryde's Whales

In addition to the standards mitigation measures (see Section 19.3), the following applies to Gulf of Mexico subspecies of Bryde's whale:

- No biopsy sampling or tagging of animals in poor health or compromised animals;
- Only using sterile biopsy sampling and tagging equipment; and
- Limiting ESA harm (MMPA Level A harassment) procedures to three attempts per day per method (not including active acoustic playbacks).

Permit holders have additional mitigation measures for the Gulf of Mexico subspecies of Bryde's whale including:

- Limiting the total number of ESA harm (MMPA Level A harassment) procedures (biopsy sampling and dart/barb tagging) so that no more than the entire population is taken more than twice each year; and
- Researchers must take reasonable measures to prevent unintentional repeated sampling of known individuals.

3.16.2.3 Monitoring and Reporting for Gulf of Mexico Subspecies of Bryde's Whales

Permit holders with takes for Gulf of Mexico subspecies of Bryde's whales are required to coordinate research under the standard permit conditions including a requirement to notify the appropriate NMFS regional office of planned research and enhancement activities so these offices can coordinate field activities and monitor take for species among all permit holders working in their region. In addition, the NMFS Permits and Conservation Division have additional requirements to allow for a higher level of monitoring and coordination with other researchers, the NMFS Southeast Regional Office, and the NMFS Permits and Conservation Division to minimize impacts to the Gulf of Mexico subspecies of Bryde's whale. Permit holders will be required to coordinate their research and enhancement activities, including timing and location with the NMFS Southeast Regional Office, NMFS Permits and Conservation Division, and other permit holders to avoid the potential for the same animals to be taken by more than one permit holder on the same day.

3.16.2.4 Reports and Data Sharing

In addition to the standard annual report due for all permitted research and enhancement activities, each permit holder is required to submit a second, separate annual report specific to research and enhancement activities on Gulf of Mexico subspecies of Bryde's whales that will be due at the end of each calendar year. These reports will allow the NMFS Southeast Regional Office and NMFS Permits and Conservation Division to monitor Gulf of Mexico subspecies of Bryde's whale takes annually to minimize impacts to the subspecies on a population level. For data sharing, each permit holder is required to submit tissues and photo-identification data to a shared database to develop catalogs to genetically and photographically identify individuals in the population.

3.16.2.5 Annual Coordination Meetings

Each permit holder proposing research and enhancement activities on Gulf of Mexico subspecies of Bryde's whales for a given year is required to attend a coordination meeting held by the NMFS Permits and Coordination Division along with NMFS Southeast Regional Office, funding agencies, and the NMFS ESA Interagency Cooperation Division prior to the start of field seasons (e.g., in January each year). The purpose of these coordination meetings is to discuss the current status and knowledge of the Gulf of Mexico subspecies of Bryde's whale population, results from the previous year's research activities, and plans for the upcoming year's research activities. Takes will be re-authorized on an annual basis each year following submission of annual reports and these coordination meetings. Research coordination meetings will occur on an annual basis so that research for the upcoming year can be planned among all permit holders. NMFS will use the information in the reports and at the coordination meeting to determine the appropriate research to meet recovery objectives and appropriate level of takes to minimize impacts for that year.

3.16.2.6 Annual Reauthorization

All permitted researchers are required to receive written authorization from the NMFS Permits and Conservation Division each year to continue research specific to Gulf of Mexico subspecies of Bryde's whales. Permit holders not submitting their annual reports on time or otherwise not meeting criteria to continue research on Gulf of Mexico subspecies of Bryde's whales as determined by NMFS may be denied continued research and enhancement activities on this subspecies for that year.

3.16.3 Phased-In Approach for Novel Tag Types

As part of the adaptive management process, the NMFS Permits and Conservation Division may use phased-in approaches to authorize novel or modified tag types (e.g., bolt/pin tags) if the effects of these tags are the same as those currently authorized. In 2017, the NMFS Permits and Conservation Division worked with a researcher, NMFS ESA Interagency Coordination Division, and the Office of Protected Resources' veterinary medical officer to develop a phased-in approach to test a novel bolt/pin tag called a fully-piercing tag on an ESA-listed cetacean. This type of tag is not yet approved in the permit, but did undergo section 7 consultation.

Example phased-in approach:

1. Show the tagging mechanism including the anchors and deployment device works on tissue surrogates.
2. Conduct testing of the tag on cetacean carcasses. This will include intentional off-angle deployments and misfires to account for movement of the cetacean in the field.
3. Non-ESA-listed surrogate species deployments: the tag will be deployed on at least three non-ESA-listed cetacean species. A report summarizing steps one to three will be submitted to the NMFS Permits and Conservation Division.
4. Limited deployment on ESA-listed species in Year 1: If steps one to three are successful, deploy the tag on up to three male or non-reproductive female ESA-listed cetaceans.

- Pre-tagging health assessment will be conducted prior to tagging to ensure the cetacean is in good health.
- Post-tagging monitoring will be conducted to document tag retention and tissue response. Additional images will be obtained if cetacean are relocated and photographed subsequent to tag loss. A report will be provided to the NMFS Permits and Conservation Division for review.

5. ESA-listed species deployments in Year 2: If step four is successful, deploy the tag on up to ten male or non-reproductive females, conduct post-tagging monitoring and provide a report to the NMFS Permits and Conservation Division for review.
6. ESA-listed species deployments in Year 3 to 5: If the first two years of tag deployments are successful and no adverse effects are noted, deploy a maximum of 15 tags on adult or juvenile ESA-listed cetaceans of either sex, including suspected pregnant females and females with non-neonate calves.

3.17 Annual Reporting to the National Marine Fisheries Service Endangered Species Act Interagency Cooperation Division

Continued close collaboration and an on-going dialogue between the NMFS Permits and Conservation Division and the NMFS ESA Interagency Cooperation Division will be an important component of the adaptive approach to managing the cetacean research permitting program. The NMFS Permits and Conservation Division will review, summarize, and compile information from the annual reports submitted by permit holders for the prior year into an annual report provided to the NMFS ESA Interagency Cooperation Division (in a format mirroring the annual report form in Section 19.4). The annual report to the NMFS ESA Interagency Cooperation Division will synthesize data such as the number and percentage of takes used for ESA harassment and harm (MMPA Level A and Level B harassment) research activities, the frequency of observed effects of research activities, and the number and kinds of unauthorized non-target species incidentally taken. These data will be used by the NMFS Permits and Conservation Division as part of its internal program review to improve implementation of the program for the issuance of permits for research and enhancement activities on cetaceans over time; one way this may occur is by evaluating the percentage of takes used annually on average by the permit holders and determining whether future requested take numbers for a given activity or objective need reconsideration or closer review in the next permit cycle.

Annual reports will also include notifying the NMFS ESA Interagency Cooperation Division if new information becomes available indicating that the adverse effects of authorized research methods, such as deep-implantable 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 NMFS Permits and Conservation Division will consult (either formally or informally) with the NMFS ESA Interagency Cooperation Division 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 NMFS Permits and Conservation Division and the NMFS ESA Interagency Cooperation Division to confer on such matters before the next year's permit cycle begins. The NMFS Permits and Conservation Division will also continue to work closely with the NMFS ESA Interagency Cooperation Division during the life of the programmatic consultation to routinely check-in (e.g., every five years or more frequently as needed) on how the program for the issuance of permits for research and enhancement activities on cetaceans and programmatic consultation is functioning overall, and to determine whether new information indicates that the NMFS Permits and Conservation Division should request reinitiation of this programmatic consultation. The NMFS Permits and Conservation Division foresee regular reporting and periodic check-ins with the NMFS ESA Interagency Cooperation Division as an ongoing dialogue as part of the adaptive management of the program for the issuance of permits for research and enhancement activities on cetaceans using the best available information.

3.18 Funding and Carrying Out Cetacean Research and Enhancement Activities

Each federal agency has an independent responsibility to consult in order to insure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of an ESA-listed species or result in the adverse modification of critical habitat (16 U.S.C. §1536(a)(2)). Action agencies have potential section 7 liability if they rely on a biological opinion issued to another action agency because they have not actually undertaken the consultation required of them by section 7(a)(2) of the ESA.

In addition to the issuance of research permits by the NMFS Permits and Conservation Division, scientific research on ESA-listed cetaceans is often carried out by NMFS through its various science centers, and funded both by NMFS as well as other federal agencies. Based on the Marine Mammal Commission's Survey of Federally-Funded Marine Mammal Research and Conservation (2017) for fiscal year 2015, agencies within the Department of Commerce, Department of the Interior, Department of Defense, Department of Homeland Security, Department of Energy, and Department of Health and Human Services, as well as four independent agencies reported a combined total of $144.2 million for marine mammal research and conservation, much of which may have funded research on ESA-listed cetaceans. The federal agencies included the NMFS, Department of the Navy, U.S. Fish and Wildlife Service, U.S. Geological Survey, Bureau of Ocean Energy Management, Marine Mammal Commission, U.S. Coast Guard, National Ocean Service, National Science Foundation, National Park Service, Environmental Research Program (ESTCP/SERDP), Department of the Army, Office of Energy Efficiency and Renewable Energy, National Institutes of Health, Smithsonian Institution, Department of the Air Force, Bureau of Safety and Environmental Enforcement, and National Aeronautics and Space Administration. Additional federal agencies (e.g., NOAA's Office of Oceanic and Atmospheric Research) have reported funding projects in other fiscal years. The funds included direct expenditures associated with hundreds of projects, direct expenditures for other marine mammal non-project activities, and indirect costs associated with direct expenditures. The direct expenditures included projects that focused on population dynamics and stock assessment; studies of marine mammal biology and ecology; conservation, management, and policy; and impacts of human activities such as sound, military activities, fishing, pollution, and tourism. Federal agencies also directed funding to technology development, animal health, communications, and outreach and meetings. These direct expenditures focused on one or more of 130 individual marine mammal species. Of the direct project expenditures associated with particular species, agencies directed $49.5 million toward 29 species listed as threatened or endangered under the ESA, or designated as depleted or categorized strategic under the MMPA (MMC 2017).

Federal agencies funding cetacean research activities will be covered by this programmatic consultation. The reason for this is that the NMFS Permits and Conservation Division's proposed implementation of a program for the issuance of permits for research and enhancement activities on cetaceans has permitting authority for ESA-listed cetaceans under the ESA and MMPA; other federal agencies such as those noted above, that provide funding for research activities or those such as NMFS science centers that carry out research and enhancement activities on ESA-listed cetaceans may desire coverage from ESA liability that is covered by this consultation on the proposed implementation of a program for the issuance of permits for research and enhancement activities on cetaceans. While the NMFS Permits and Conservation Division has requested consultation with the NMFS ESA Interagency Cooperation Division on their cetacean research permitting program, other federal agencies funding the underlying research activities and NMFS entities that perform such have not requested consultation before or during (or following completion) the consultation. Because action agencies are responsible for consulting with the NMFS under section 7(a)(2), NMFS is not legally obligated to seek out action agencies, especially in the absence of a request for consultation. If the consultation is completed with the NMFS Permits and Conservation Division and federal agencies funding or carrying out the research activities then later request ESA coverage, then the NMFS ESA Interagency Cooperation Division would likely need to initiate a new consultation; this is not a reinitiation and the new biological opinion would not replace the one already issued to the NMFS Permits and Conservation Division for their proposed implementation of a program for the issuance of permits for research and enhancement activities on cetaceans. The new biological opinion would likely incorporate by reference the biological opinion issued to the NMFS Permits and

Conservation Division, and add information specific to the federal agencies funding the research activities. In order to avoid this situation, the federal agencies funding the research activities will be covered by this consultation.

The effects of the research and enhancement activities on ESA-listed species and designated critical habitat would be the same irrespective of whether the proposed action is the permitting action (i.e., issuance of scientific research permits for ESA-listed cetaceans) of one agency or the funding or carrying out of the action of another agency since all such research would require a permit from the NMFS Permits and Conservation Division consistent with its cetacean research permitting program, as evaluated here. The current and ongoing consultation contains the analysis relevant to the federal agencies funding and carrying out research and enhancement activities on ESA-listed cetaceans and insured against jeopardy and adverse modification. Thus, we will not need to re-analyze the effects of the action (i.e., federal agencies funding or carrying out research and enhancement activities on ESA-listed cetaceans) on ESA-listed species and designated critical habitat.

A recent example in the *Biological and Conference Opinion on the Issuance of Permit Nos. 14550, 14856, 16239, 17312, and 18636, for Research on Gulf of Mexico Bryde's Whales, and Activities to be Conducted under the Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies (RESTORE) Act Grant* considered the National Centers for Coastal Science's action to fund research activities on the Gulf of Mexico subspecies of Bryde's whale, and the NMFS Permits and Conservation Division's authorization of permit amendments to permit holders to allow takes of Gulf of Mexico subspecies whales for the purposes of scientific research. The National Centers for Coastal Ocean Science's funding will be applied to the NMFS Southeast Fisheries Science Center's research activities under Permit No. 14450, one of the permits proposed for authorization by the NMFS Permits and Conservation Division's action. The National Centers for Coastal Ocean Science RESTORE Act funded grant *Trophic Interactions and Habitat Requirements of Gulf of Mexico Bryde's Whales* was awarded to the NMFS Southeast Fisheries Science Center. The recipient would conduct research that aims to develop a comprehensive ecological understanding of Gulf of Mexico subspecies of Bryde's whales and their prey items through vessel-based surveys to assess their habitat, spatial distribution, and foraging ecology. The research activities will include work on the physical, oceanographic, and biological features that may define critical habitat. A multi-faceted approach will be used that integrates visual and acoustic monitoring, environmental sampling, trawling, biopsy sampling for genetic, stable isotope, and pollutant analyses, and deployment of animal-borne tags sampling at fine and course scales. Models will be developed from the resulting data that will identify key trophic interactions, improve characterization of Gulf of Mexico subspecies of Bryde's whale habitat, and provide information to managers that will inform restoration and population recovery activities.

4 Interrelated and Interdependent Actions

Interrelated actions are those that are part of a larger action and depend on that action for their justification. *Interdependent* actions are those that do not have independent utility apart from the action under consideration. For this consultation, we consider all vessel transit associated with research and enhancement activities as interdependent. Thus, we evaluate the effects of vessel transit on ESA-listed species and so include all waters traversed during such transits as part of the action area.

5 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 C.F.R. §402.02). The NMFS Permits and Conservation Division proposes to issue MMPA Section 104 and ESA Section 10(a)(1)(A) permits for scientific research and enhancement activities on cetaceans within all U.S., International, and foreign waters of the Arctic, Atlantic, Indian, Pacific, and Southern Oceans. The majority of research and enhancement activities will occur in U.S. waters within the Exclusive Economic Zone (EEZ); however, a limited number of researchers may conduct research and enhancement activities in International and foreign waters (within the EEZ of foreign countries) worldwide. In the U.S. waters of the Atlantic Ocean, this includes the East Coast (Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, and Florida), Gulf of Mexico (Texas, Louisiana, Mississippi, Alabama, and Florida), and Puerto Rico. In the U.S. waters of the Pacific Ocean, this includes the West Coast (Washington, Oregon, and California), Alaska, Hawaii, and Pacific island territories. The NMFS Permits and Conservation Division can only authorize take and permit research and enhancement activities under NMFS jurisdiction, which excludes the territorial sea of foreign countries (typically 22.2 kilometers [12 nautical miles] from shore). The research and enhancement activities within the action area will occur throughout the year, weather permitting and when logistically feasible, for the duration of the permits. The action area also includes U.S. Department of Agriculture Animal and Plant Health Inspection Service (APHIS)-approved facilities with currently captive ESA-listed cetaceans (e.g., “Lolita” from the Southern Resident DPS of killer whales at the Miami Seaquarium and “Tyonek” from the Cook Inlet DPS of beluga whales at SeaWorld San Diego). In limited circumstances under this programmatic consultation, the NMFS Permits and Conservation may authorize research methods described in the *Authorized Research and Enhancement Activities* (Section 3.7) used on cetacean populations in the wild on cetaceans in captive or rehabilitation facilities for research or enhancement purposes, depending on the nature and objectives of the proposed research activities. Captive animals may change over time as APHIS-approved facilities shift their focus and animals are moved to other locations, or additional ESA-listed cetacean species are held in the future. For the purposes of this programmatic consultation, we will not limit the action area to the APHIS-approved facilities currently holding captive ESA-listed cetaceans, but will be flexible in the addition of new APHIS-approved facilities on a case-by-case basis. Any APHIS-approved facility will be included as part of the action area for this programmatic consultation.

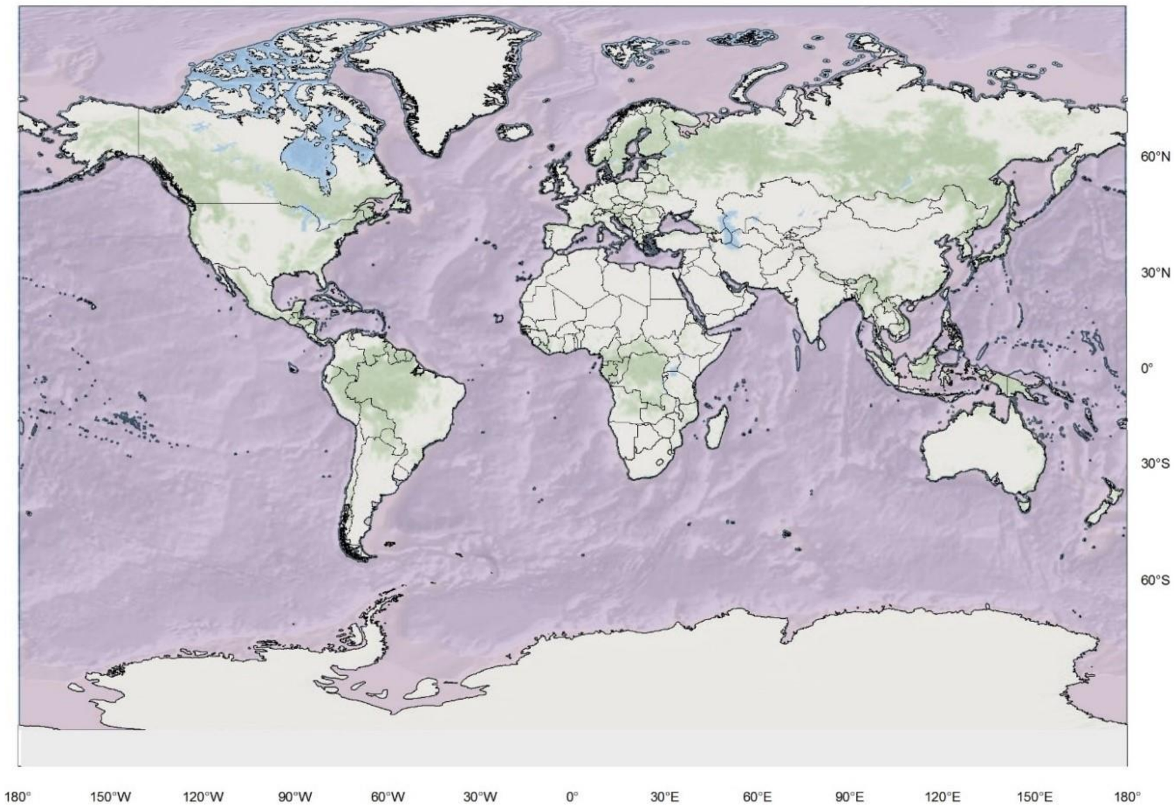


Figure 22. Map of the National Marine Fisheries Service's Permits and Conservation Division's program for the issuance of permits for research and enhancement activities on cetaceans in the Arctic, Atlantic, Indian, Pacific, and Southern Oceans action area for this consultation.

Note: The EEZ extends no more than 370.4 kilometers (200 nautical miles) from the territorial sea baseline and is adjacent to the territorial sea, typically 22.2 kilometers (12 nautical miles). In the United States this includes the Commonwealth of Puerto Rico, Guam, American Samoa, the United States Virgin Islands, the Commonwealth of the Northern Mariana Islands, and any other territory or possession over which the United States exercises sovereignty.

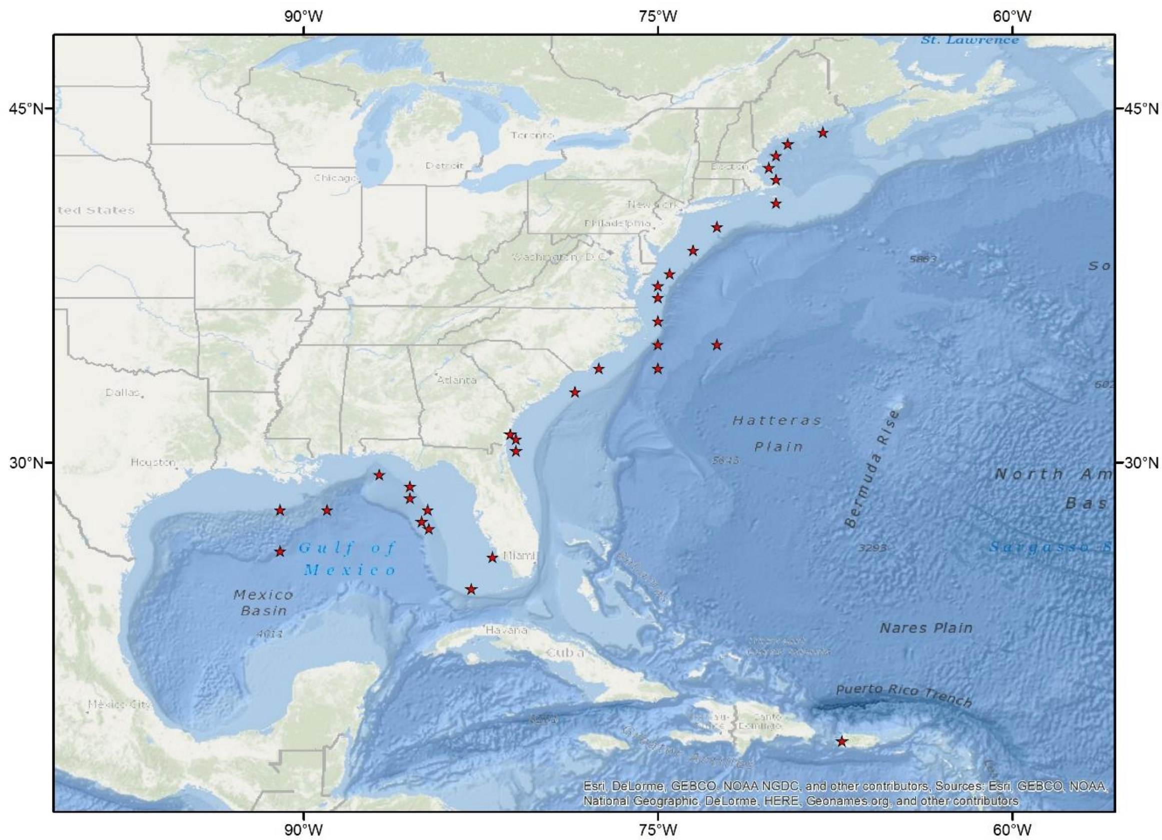


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Figure 23. Map of the active research permits (denoted by red stars) for cetaceans in the Atlantic Ocean (as of June 18, 2018) for this consultation.

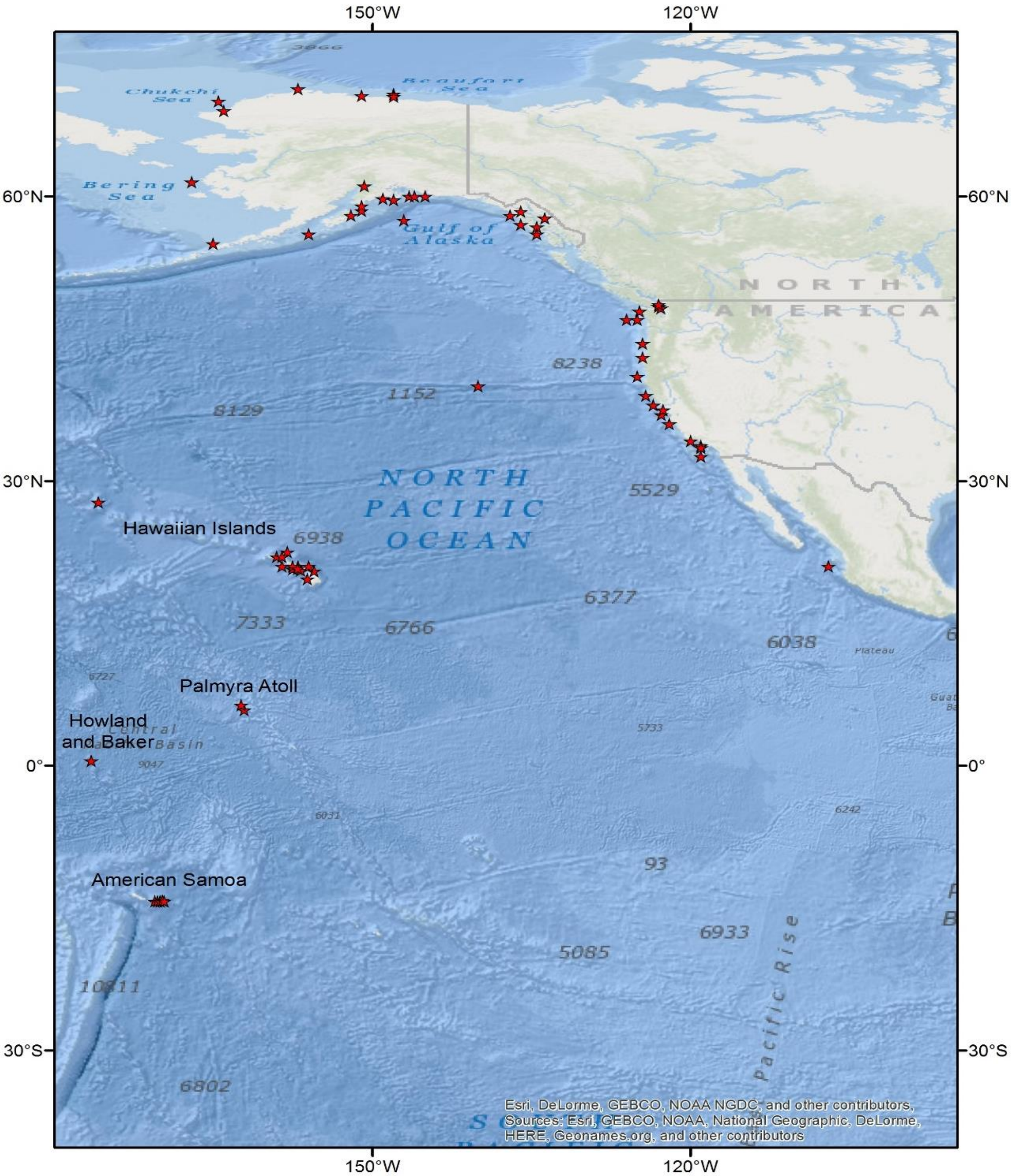

Figure 24. Map of the active research permits (denoted by red stars) for cetaceans in the Eastern Pacific Ocean (as of June 18, 2018) for this consultation.

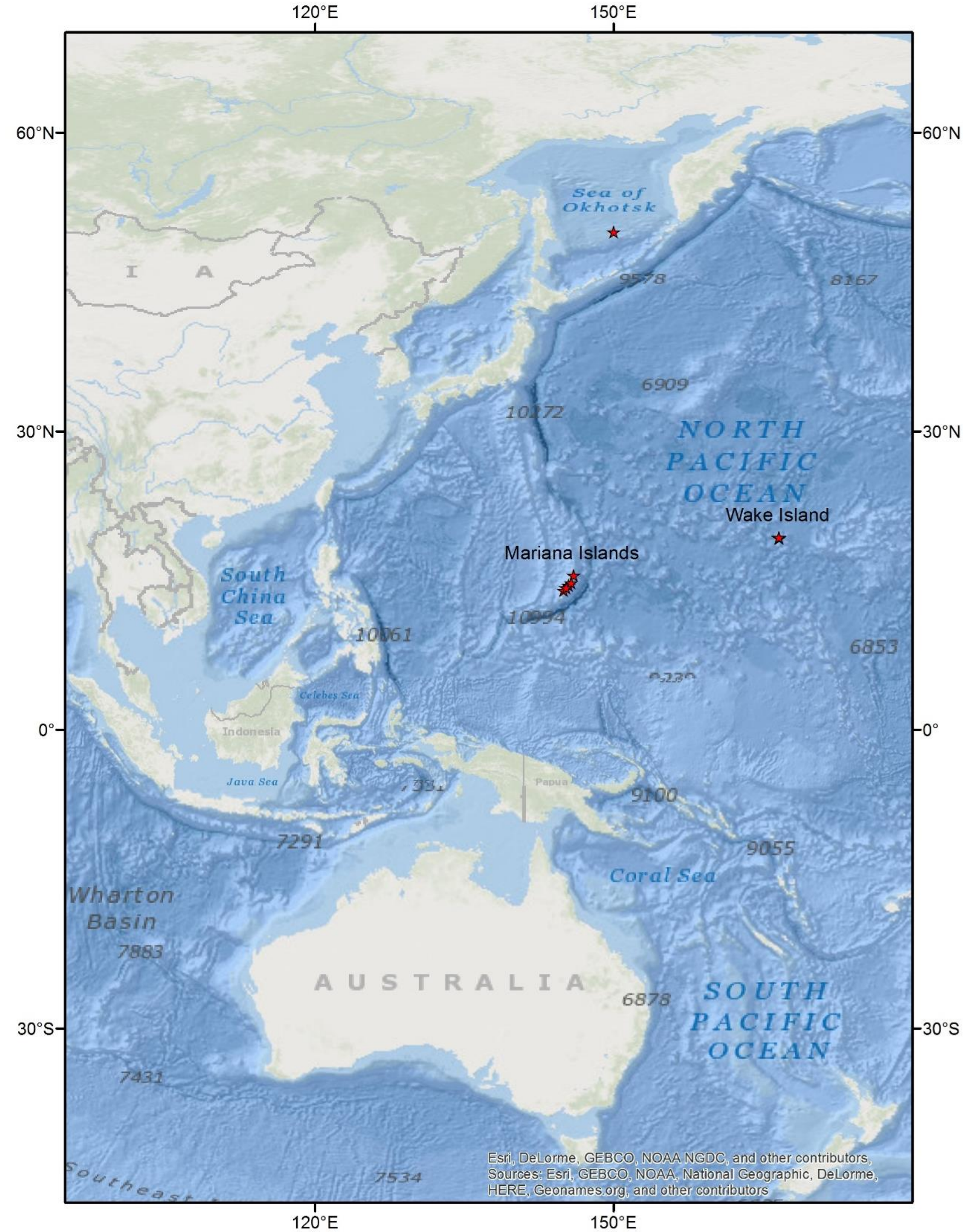

Figure 25. Map of the active research permits (denoted by red stars) for cetaceans in the Western Pacific Ocean (as of June 18, 2018) for this consultation.

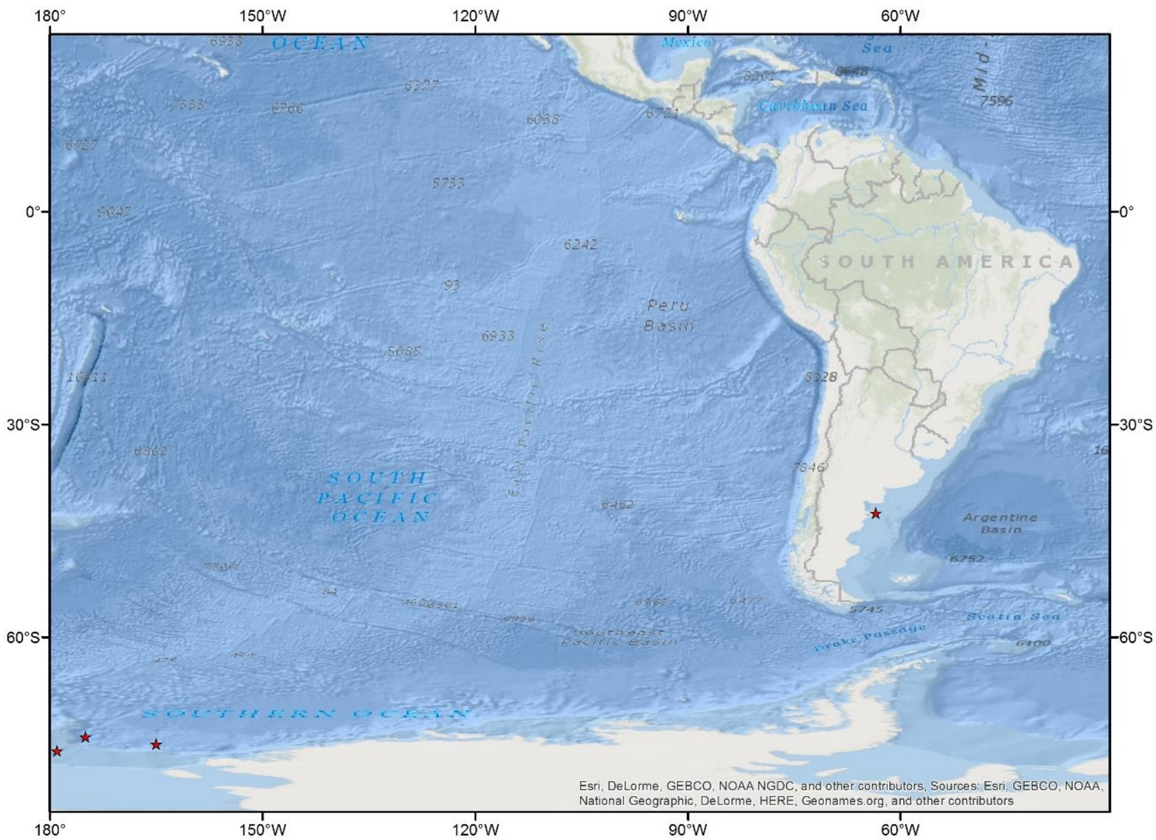

Figure 26. Map of the active research permits (denoted by red stars) for cetaceans in the Southern Ocean (as of June 18, 2018) for this consultation.

Research will not be conducted continuously in all locations within the action area; however, NMFS Permits and Conservation Division anticipates research and enhancement activities can occur in any sector of the action area in the foreseeable future as funding or valid research objectives arise.

6 Potential Stressors

The proposed action involves multiple research and enhancement activities, each of which can create potential stressors. Stressors are any physical, chemical, or biological entity that may directly or indirectly induce an adverse response either in an ESA-listed species or their designated critical habitat. During consultation, we identify stressors that are reasonably certain to result from the proposed action. These can be categorized as pollution (e.g., fuel, oil, trash), aerial surveys, vessel surveys (close approaches, vessel strikes, vessel noise, behavioral observations, visual disturbance, gear entanglement, photography and videography), lasers from photography and videography, passive acoustic monitoring, active acoustics (i.e., playbacks, prey mapping, AEP tests, and remote ultrasound), biological sampling (i.e., breath sampling, environmental DNA sampling, fecal sampling, sloughed skin sampling, skin sampling, and prey sampling), and tagging. These stressors were evaluated independently to assess the effect each may have on the ESA-listed species. Those stressors which may affect but we conclude are not likely to adversely affect ESA-listed species are discussed below (Section 6) and are not carried forward in this consultation. Those stressors determined to likely adversely affect ESA-listed species are evaluated in detail in Section 11. Furthermore, the proposed action includes several conservation measures and conservation recommendations described in Section 3.8 and Section 16 that are designed to minimize effects that may result from these potential stressors. While we consider all of these conservation measures important and expect them to be effective in minimizing the effects of potential stressors, they do not completely eliminate the identified stressors. Nevertheless, we treat them as part of the proposed action and fully consider them when evaluating the effects of the proposed action (Section 11).

6.1 Stressors Not Likely to Adversely Affect Endangered Species Act-listed Species and Critical Habitat

If the effects of an action are determined to be wholly beneficial, insignificant, or discountable we conclude that the action is not likely to adversely affect ESA-listed species or designated critical habitat. This same decision model applies to individual stressors associated with the proposed action, such that some stressors may be determined to be not likely to adversely affect ESA-listed species or critical habitat because any effects associated with the stressors will not rise to the level of take under the ESA. As further detailed below, we find that the stressors of pollution, aerial surveys (visual and/or auditory disturbance), vessel surveys (visual and/or auditory disturbance), vessel strike, gear entanglement, active acoustics, biological sampling, tagging (initial contact and tag attachment), import/export and salvage of carcass, and captive studies are not likely to adversely affect ESA-listed species because their effects are insignificant and/or discountable.

6.1.1 Pollution

The operation of the research vessels permitted under the cetacean research permitting program may result in pollution from exhaust, fuel, oil, trash, and other debris. Air and water quality are the basis of a healthy environment for all species. Emissions pollute the air, which could be harmful to air-breathing organisms and lead to ocean pollution (Chance et al. 2015; Duce et al. 1991). Emissions also cause increased greenhouse gases (carbon dioxide, methane, nitrous oxide, and other fluorinated gases) that can deplete the ozone, affect natural earth cycles, and ultimately contribute to climate change (see https://www.epa.gov/ghgemissions/overview-greenhouse-gases for additional information). The release of marine debris such as paper, plastic, wood, glass, and metal associated with vessel operations can also have adverse effects on marine species most commonly through entanglement or ingestion (Gall and Thompson 2015). While lethal and non-lethal effects to air breathing marine animals such marine mammals, sea turtles, and birds are well documented, marine debris also adversely affects marine fish (Gall and Thompson 2015).

Many of the research vessels permitted as a result of the proposed action have spill-prevention plans, which will allow a rapid response to a spill in the event one occurred. Discharges from research vessels in the form of leakages of fuel or oil are possible, though effects of any spills to

ESA-listed species (i.e., cetaceans, pinnipeds, marine reptiles, fishes, marine invertebrates, and marine plants) will be minimal, if they occur at all. The potential for fuel or oil leakages is extremely unlikely. To our knowledge, none of these leakages have occurred during cetacean research and enhancement activities. An oil or fuel leak could pose a significant risk to the vessel and its crew and actions to correct a leak should occur immediately to the extent possible. In the event that a leak should occur, the amount of fuel and oil onboard the research vessels is unlikely to cause widespread, high dose contamination (excluding the remote possibility of severe damage to the research vessel) that will impact ESA-listed species directly or pose hazards to their food sources. During vessel surveys, NOAA research vessels conform to requirements of 33 C.F.R. §151, the Federal Water Pollution Control Act, International Maritime Organization ballast water guidelines, and MOC Environmental Guideline ENV 09. Given the experience of the researchers and vessel operators in conducting research and enhancement activities and maintaining research vessels in the action areas, it is unlikely that spills or discharges will occur. If a discharge does occur, the amounts of leakage will be small, and would be expected to disperse quickly in the water and not affect ESA-listed species directly. Therefore, we conclude that the effects on ESA-listed species that may result from this stressor (discharge) are discountable and thus vessel discharges may affect but are not likely to adversely affect, and will not be carried forward in this consultation.

Furthermore, because the potential for oil or fuel leakage is extremely unlikely to occur, we find that the risk from this potential stressor is discountable. Therefore, we conclude that pollution by oil or fuel leakage is not likely to adversely affect ESA-listed species, and will not be carried forward in this consultation.

6.1.2 Aerial Surveys

Aerial surveys conducted under the proposed action can include various types of manned and unmanned platforms. Details of the aerial survey platforms vary by permit and potential stressors (visual disturbance and/or auditory disturbance) of these platforms are discussed below.

6.1.2.1 Manned Aerial Surveys

Responses to aerial surveys consist only of behavioral responses, which vary by species and aircraft type. As outlined below, behavioral responses to manned aerial surveys are likely more pronounced than to unmanned aerial surveys.

Manned aerial surveys that will be authorized under the proposed action may cause visual disturbance and/or auditory disturbance (i.e., noise) that may affect ESA-listed cetaceans, pinnipeds, marine reptiles, fishes, and marine invertebrates within the action area. Species 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). The underwater and sound intensity from aircraft is less than produced by vessels and visually, aircraft are more difficult for cetaceans to locate since they are not in the water and move rapidly (Richter et al. 2006). However, when aircraft fly below certain altitudes (about 500 meters [1,640.4 feet]), they have caused cetaceans to exhibit behavioral responses that might constitute a significant disruption of their normal behavioral patterns (Patenaude et al. 2002). 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. 1998). Sperm whales have been observed to respond to a fixed-wing aircraft circling at altitudes of 245 to 335 meters (803.8 to 1,099.1 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). About 14 percent of bowhead whales approached during aerial surveys exhibited short-term behavioral reactions (Patenaude et al. 2002). While all ESA-listed cetacean species exposed to aerial surveys may exhibit short-term behavioral reactions, data from the NMFS science centers, academic institutions, and other organizations from past permits indicated only mild behavioral responses, if any. It is expected the aerial surveys using manned aircraft conducted during the proposed research activities will result in no reaction or only mild short-term behavioral reactions and not any long-term behavioral changes or reduction in fitness. The effects that may result from potential stressors from manned aerial surveys on ESA-listed cetaceans are considered insignificant.

Aerial surveys directed at cetaceans may also unintentionally disturb ESA-listed pinnipeds. However, as a condition in the permit, researchers will not be authorized to conducted flights over pinniped haul-outs and rookeries, and thus any unintentional disturbance will likely occur over water, or occur over one or a few individuals on land or sea ice. Potential responses to aircraft overflights by pinnipeds 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 (six percent) entered the water in response to a low-flying (150 meters [492.1 feet] altitude) twin-engine plane. In Baffin Bay, Alaska, 44 bearded seals did not react to a twin-engine turboprop airplane flying at 100 to 200 meters (328,1 to 656.2 feet) altitude (Finley and Renaud 1980). Burns and Frost (1979) report that bearded seals raise their heads but usually remain on ice unless an airplane 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 (639.8 to 820.2 feet), but no Steller sea lions left the beach or stampeded (Snyder et al. 2001; Wilson et al. 2012). From past research and enhancement activities, ESA-listed pinnipeds appear to show minimal response to aerial surveys (NMFS 2016c). The NMFS Marine Mammal Laboratory has observed no response to aerial surveys by Western DPS of Steller sea lions, and only four and 13 percent of Beringia DPS of bearded seal and Arctic DPS of ringed seals exhibited behavioral responses. In summary, we expect ESA-listed pinnipeds to either exhibit no response to aerial surveys or exhibit mild short-term behavioral reactions but do not expect any long-term behavioral changes or reduction in fitness. The effects that may result from potential stressors from manned aerial survey on ESA-listed pinnipeds are considered insignificant.

Aerial surveys have the potential to disturb sea turtles if they are in the vicinity of researchers targeting cetaceans. Researchers will not purposely approach sea turtles and thus, disturbance is expected to be minimal. Researchers will constantly be scanning for cetaceans and thus be able to spot sea turtles from aircraft 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 (Hazel et al. 2007). Further, if a sea turtle were spotted, normally the researchers will exercise caution and remain a safe distance from the animal(s), as described in the conditions of each permit. Precautionary steps may include stopping research and enhancement activities, moving to another area (or higher altitude), or waiting until the sea turtle has left the area. In the event a sea turtle is exposed to aerial surveys it will likely be brief and temporary and result in short-term behavioral reactions, such as swimming away from the aircraft, which are not expected to have fitness consequences. The effects that may result from potential stressors from manned aerial surveys on ESA-listed marine reptiles are considered insignificant and/or discountable.

The potential of manned aerial surveys to disturb ESA-listed marine reptiles, fishes, and marine invertebrates is extremely unlikely to occur, and therefore is insignificant and/ordiscountable. Therefore, we conclude that this stressor (manned aerial surveys) may affect, but is not likely to adversely affect ESA-listed cetaceans, pinnipeds, marine reptiles, fishes, and marine invertebrates, and will not carried forward in this consultation.

6.1.2.2 Unmanned Aerial Surveys

Unmanned aerial surveys that will be authorized under the proposed action may also cause visual and/or auditory disturbances to ESA-listed cetaceans, pinnipeds, marine reptiles, fishes, and marine invertebrates. Despite being conducted at much lower altitudes than manned aerial surveys, the aircraft used to conduct unmanned aerial surveys will be much smaller and quieter, so less of a behavioral response might be expected. While the use of unmanned aerial systems to study marine mammals is in its infancy, current data support the notion that there is less disturbance and indicate that cetaceans exhibit no behavioral response to unmanned aerial systems when they are flown at certain altitudes. For example Acevedo-Whitehouse et al. (2010) used unmanned aircraft systems at 13 meters (42.7 feet) over blue, gray, humpback, and sperm whales, and observed no avoidance behaviors. Koski et al. (2015) used unmanned aircraft systems over bowhead whales at 120 meters (393.7 feet) with no behavioral responses noted. NMFS's Southwest Fisheries Science Center used unmanned aerial systems over killer whales and found that at 35 meters (114.8 feet), there were no behavioral reactions (Durban et al. 2015). Three recent reviews covering the potential impacts of unmanned aerial systems on marine mammals found no data to indicate that ESA-listed cetaceans behaviorally respond to unmanned aircraft systems (Christie et al. 2016; Marine Mammal Commission 2016; Smith et al. 2016). However, in a recent report submitted to NMFS for Permit No. 18636, researchers documented behavioral responses by large cetaceans when unmanned aircraft systems were flown at a height of approximately 3.7 meters (12 feet) over the animals (NMFS 2017f). These responses consisted of mild, short-term changes in behavior such as cetaceans rolling over to view the unmanned aircraft systems, or "bucking" before returning to pre-exposure behavior.

Fettermann et al. (2019) documented behavioral changes in bottlenose dolphins during exposure to an unmanned aircraft system, including reorientations of the pod, chin slaps, tail slaps, side floats, and spy hops. However, these behaviors were observed only when the unmanned aircraft system was flown at an altitude of 10 meters (32.8 feet) above the animals. Flying the unmanned aircraft system at altitudes of 25 meters (82 feet) or higher had no significant effect on the animals' behavior.

Based on the available information, we anticipate that in most cases, there will be no response to unmanned aircraft systems, but in some cases, mild short-term behavioral responses can occur. We do not anticipate any effects to the fitness of individuals. Given the nature of these responses, we do not expect they will significantly disrupt the normal behavioral patterns of ESA-listed species including cetaceans, pinnipeds, marine reptiles, fishes, and marine invertebrates. The effects that may result from potential stressors from unmanned aerial surveys are considered insignificant. Therefore, we conclude that this stressor (unmanned aerial surveys) may affect, but is not likely to adversely affect ESA-listed cetaceans, pinnipeds, marine reptiles, fishes, and marine invertebrates, and will not be carried forward in this consultation.

6.1.3 Vessel Surveys, Close Approaches, and Documentation

Vessel surveys and close approaches conducted under the proposed action will expose ESA-listed cetaceans, pinnipeds, marine reptiles, fishes, marine invertebrates, and marine plants within the action area to vessel traffic and visual and/or auditory disturbances. As noted previously, most documentation does not present any stressors outside of those associated with vessel surveys and close approaches. The purpose of vessel surveys and close approaches is to allow researchers to conduct other research and enhancement activities (i.e., behavioral observations, photography and videography, passive acoustic monitoring, active acoustic playbacks, active acoustic prey mapping, remote ultrasound, biopsy sampling, breath sampling, fecal sampling, prey sampling, sloughed skin sampling, skin sampling, environmental DNA sampling, and tagging), responses to which are described in the subsections below.

Vessel surveys necessarily involve transit within the marine environment, and the transit of any research vessel in waters inhabited by cetaceans carries the risk of striking an animal. Responses to a vessel strike can involve death, serious injury, or minor, non-lethal injuries. The probability of a vessel collision and the associated response depends, in part, on the size and speed of the vessel. The majority of vessel strikes of large cetaceans occur when vessels are traveling at speeds greater than approximately 18.5 kilometers per hour (10 knots), with vessels traveling faster, especially large vessels (80 meters [262.5 feet] or greater), being more likely to cause serious injury or death (Conn and Silber 2013; Jensen and Silber 2004; Laist et al. 2001; Vanderlaan and Taggart 2007).

The research vessels will be traveling at generally slow speeds, reducing the amount of noise produced by the propulsion system and the probability of vessel strikes (Kite-Powell et al. 2007; Vanderlaan and Taggart 2007). While vessel strikes during research and enhancement activities are possible, we are aware of only two instances of a research vessel striking a large cetacean in thousands of hours at sea (Wiley et al. 2016). One of these vessel strikes occurred within the action area for Permit No. 21371 and involved the NOAA research vessel (R/V) *Auk*. While transiting to port on April 9, 2009 in Massachusetts Bay, the R/V *Auk* struck a North Atlantic right whale (Wiley et al. 2016). A captain and mate each of whom had logged many hours of ship time during marine mammal research activities operated the vessel. The vessel was traveling at 10.6 kilometers per hour (19.7 knots), which, while not required for a vessel of its size (15 meters [49.2 feet]), is well above the 18.5 kilometers per hour (10 knots) restrictions that were active at the time within the area for larger vessels (greater than 19.8 meters [65 feet]). Winds were 37 to 42.6 kilometers per hour (20 to 23 knots) out of the northeast, and wave heights were approximately 1.3 meters (4.3 feet), not ideal conditions for spotting marine mammals. Six marine mammal observers were on the lookout when the mate spotted a large cetacean approximately 9 meters (29.5 feet) in front of the vessel, which was subsequently seen by a marine mammal observer when the animal's fluke was directly in front of the vessel. There was not time to notify the captain, nor adjust course and speed; the North Atlantic right whale was struck. The North Atlantic right whale exhibited minor bleeding from seven to eight lacerations on the tip of its left tail fluke, which follow up photographs show eventually healed with the tip of the fluke falling off. After assessing the animal's condition, the R/V *Auk* departed approximately one hour following the initial strike, because at that point the animal appeared to be behaving normally. Since the event, the North Atlantic right whale has been seen at least 46 times, with the injury being fully healed by day 719 after the vessel strike and the animal appearing to be healthy (Wiley et al. 2016).

The R/V *Auk* vessel strike incident is an important reminder that even with well-trained marine mammal observers and vessel operators, all vessels, even research vessels, have the potential to strike cetaceans. In this particular instance, there were six dedicated marine mammal observers, but no indication of the animal's presence prior to the initial sighting within 9 meters (29.5 feet) of the vessel by the mate. We consider this event extremely rare given that only two instances of research vessel strikes (See Section 6.1.3.1 for second incident) have ever been reported over the years of cetacean research and enhancement activities similar to the proposed action under ESA/MMPA permits, neither of which appear to have been lethal (Wiley et al. 2016).

We generally expect the movement of ESA-listed species including marine mammals to be away from or parallel to the research vessels, as well as the generally slow movement of the research vessels during most of its travels. Also, the researchers have not documented any vessel strikes on ESA-listed marine mammals during research and enhancement activities. Given the rarity of vessel strikes of large cetaceans during research and enhancement activities from historical data, the extensive experience of researchers at the NMFS science centers, academic institutions, and other organizations have in spotting cetaceans at sea and the fact that the researchers have not struck a large cetacean during past research and enhancement activities, and the slow speeds (generally 18 kilometers per hour [10 knots]) at which they will operate when near animals, we believe the likelihood of a vessel strike from research vessel transits is extremely unlikely. As such, the potential for vessel strike from the research vessels is highly improbable. Therefore, we conclude that the effects on ESA-listed cetaceans that may result from this stressor (vessel strike) are discountable.

Close approaches by research vessels may cause visual or auditory disturbances to cetaceans and more generally disrupt their behavior, which may negatively influence essential functions such as breeding, feeding, and sheltering. Cetaceans react in a variety of ways to close vessel approaches. Responses range from little to no observable change in behavior to momentary changes in swimming speed and orientation, diving, surface, and foraging behavior, and respiratory patterns (Au and Green 2000; Baker et al. 1983; Baumgartner and Mate 2003; Hall 1982; Isojunno and Miller 2015; Jahoda et al. 2003; Koehler 2006; Malme et al. 1983; Richardson et al. 1985; Scheidat et al. 2006; Watkins et al. 1981). Changes in cetacean behavior can correspond to vessel speed, size, and distance from the animal, as well as the number and frequency of vessel approaches (Baker et al. 1988; Beale and Monaghan 2004). Characteristics of the individual and/or the context of the approach, including age, sex, the presence of offspring, whether or not habituation to vessels has occurred, individual differences in reactions to stressors, and the behavioral state of the cetaceans can also influence the responses to close vessel approaches (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. 1998). Observations of large cetaceans indicate that cow-calf pairs, smaller groups, and groups with calves appear to be more responsive to close vessel approaches (Bauer 1986; Bauer and Herman 1986; Clapham and Mattila 1993; Hall 1982; Williamson et al. 2016). Cetaceans may become sensitized or habituated to vessels as the result of multiple approaches (Constantine 2001), which can increase or decrease stress levels associated with additional approaches and or research and enhancement activities following an approach. Reactions to vessel noise by bowhead and gray whales have been observed when engines are started at distances of 914.4 meters (3,000 feet) (Malme et al. 1983; Richardson et al. 1985) from the animals, suggesting that some level of disturbance may result even if the vessel does not closely approach. It should be noted that human observations of a large cetacean’s behavioral response may not reflect a cetacean’s actual experience; thus, our use of behavioral observations as indicators of a cetacean’s response to research and enhancement activities may or may not be correct (Clapham and Mattila 1993).

We expect that the research vessels will not add significantly to the local noise environment in their operating area due to the propulsion and other noise characteristics of the vessel’s machinery. Any contribution is likely small in the overall environment of regional ambient sound levels. A research vessel’s transit past a marine mammal will be brief and is not likely to impact any individual’s ability to feed, reproduce, or avoid predators. Brief interruptions in communication via masking are possible, but unlikely given the habits of marine mammals to move away from the research vessels, either as a result of engine noise, the physical presence of the research vessel, or both (Lusseau 2006). In addition, the research vessels will be traveling at relatively slow speeds, reducing the amount of noise produced by the propulsion system. The source levels of sounds that will be generated by research vessels (i.e., vessel noise) are below that which could cause physical injury or temporary hearing threshold shifts, and they are unlikely to mask cetaceans ability to hear mates and other conspecifics for any significant amount of time (Hildebrand 2009a; NOAA 2018b). Because the potential acoustic interference from engine noise will be undetectable or so minor that it could not be meaningfully be evaluated, we find that the effects to ESA-listed cetaceans from this potential stressor are insignificant.

Despite the varied observed responses to vessel approaches documented in the literature, and the multitude of factors that may affect an individual whale's response, we expect the effects of close approaches by research vessels that will be authorized under scientific research permits, with the exception of close approaches for tagging, to be minimal for several reasons. Researchers at the NMFS science centers, academic institutions, and other organizations have years of experience approaching cetaceans in a way that is designed to minimize disturbance and associated responses. Researchers will be constantly watching for marine mammals, and thus, if non-target ESA-listed cetaceans and pinnipeds are spotted, researchers will be able to avoid closely approaching them. Nonetheless, a close approach to these species can occur if researchers are unable to identify the cetacean and pinniped species or DPS from a distance. The source level of sounds that will be generated by research vessels are below that which can cause physical injury or temporary hearing threshold shifts, and they are unlikely to negatively affect cetacean's ability to hear mates and other conspecifics (Hildebrand 2009a; NOAA 2018b). No long-term effects on behavior or fitness from disturbances caused by close approaches by research vessels have been documented by researchers at the NMFS science centers, academic institutions, and other organizations and more generally in the literature. Based on accounts from past research and enhancement activities, responses documented in the literature, and the proposed research method for closely approaching cetaceans using a research vessel that incorporates measures to minimize impacts, we expect the proposed close approaches may produce short- to mid-term behavioral and stress responses, but would not significantly disrupt the normal behavioral patterns of cetaceans to an extent that would create the likelihood of injury or impact fitness. As a result, we do not expect close approaches, with the exception of those required for tagging, to have fitness consequences for individual cetaceans. The anticipated response from the close approaches that will be required for tagging, which occur at much closer distances (within a few meters) are further discussed below. Therefore, we conclude that the effects on ESA-listed cetaceans that may result from this stressor (close approaches for research activities other than active acoustic playbacks, biopsy sampling, and tagging) are insignificant.

The impact of vessel approaches (i.e., close approaches for research and enhancement activities other than active acoustic playbacks, biopsy sampling, and tagging) on ESA-listed pinnipeds, marine reptiles, fishes, marine invertebrates, or marine plants is insignificant and/or discountable based on information presented above. Any disturbance to ESA-listed pinnipeds, marine reptiles, fishes, marine reptiles, marine invertebrates, and marine plants that may result from this stressor (close approaches for research and enhancement activities other than active acoustic playbacks, biopsy sampling, and tagging) are insignificant. Some research methods involving close approaches that will usually result in not likely to adversely affect determinations may result in a likely to adversely affect determination under the ESA. This may occur when the research method is conducted in a manner that results in pursuit. A research vessel that closely approaches a cetacean is likely to result in a not likely to adversely affect determination. However; if researchers pursue the animal after the initial approach to continue to document behaviors, then the research and enhancement activities have the potential to result in pursuit, ESA harassment, and a likely to adversely affect determination (which may still be considered MMPA Level B harassment). The NMFS Permits and Conservation Division will carefully evaluate the research methods of the proposed action in applications to determine if research and enhancement activities will result in harassment under the ESA, and issue takes accordingly provided the research and enhancement activities fall within the scope of this programmatic consultation. If necessary, the NMFS Permits and Conservation Division will seek technical guidance from the NMFS ESA Interagency Cooperation Division to determine whether research and enhancement activities may result in ESA harassment (and may require additional mitigation measures).

Based on the available information, we conclude that these stressors (visual and/or auditory disturbance and close approach) may affect, but is not likely to adversely affect ESA-listed cetaceans, pinnipeds, marine reptiles, fishes, marine invertebrates, and marine plants, and will not be carried forward in this consultation.

6.1.3.1 Vessel Strike

Vessel surveys necessarily involve vessel traffic within the marine environment and the transit of any research vessel in waters inhabited by ESA-listed species carries the risk of a vessel strike. 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. 2010). 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 2013; 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.

Vessel traffic associated with the proposed action carries the risk of vessel strikes of ESA-listed species (e.g., marine mammals, marine reptiles, fish, marine invertebrates, and marine plants). In general, the probability of a vessel collision and the associated response depends, in part, on the size and speed of the vessel. The research vessels permitted under the proposed action will operate at speeds determined to reduce the potential impact to ESA-listed species. When conducting survey operations, most vessels typically cruise at 18.5 kilometers per hour (10 knots). The majority of vessel strikes of large cetaceans occur when vessels are traveling at speeds greater than approximately 18.5 kilometers per hour (10 knots), with faster travel, especially of large vessels (80 meters [262.5 feet] or greater), being more likely to cause serious injury or death (Conn and Silber 2013; Jensen and Silber 2004; Laist et al. 2001; Vanderlaan and Taggart 2007).

Several conservation measures proposed by the NMFS Permits and Conservation Division and/or researchers would minimize the risk of vessel strike. In addition, the overall level of vessel activity associated with the proposed action is low relative to the large size of the action area, further reducing the likelihood of a vessel strike of an ESA-listed species. Nevertheless, vessel strikes remain a potential stressor associated with the proposed action.

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. 1997). 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 2013; 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, NMFS Permits and Conservation Division and NMFS ESA Interagency Cooperation Division 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).

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 at the water's surface generally in open water. 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 as they will be swimming freely. 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.

The research vessels will be traveling at generally slow speeds, reducing the amount of noise produced by the propulsion system and the probability of a vessel strike (Kite-Powell et al. 2007; Vanderlaan and Taggart 2007). Our expectation of vessel strike is discountably small due to the hundreds of thousands of kilometers the permitted research vessels have traveled without a vessel strike, general expected movement of ESA-listed species away from or parallel to these vessels, as well as the generally slow movement of the survey vessels to occur while conducting permitted operations. In addition, adherence to observation and avoidance measures is also expected to avoid vessel strikes. All factors considered, we have concluded the potential for vessel strike from permitted research vessels is highly improbable. Because the potential for vessel strike is extremely unlikely to occur, we find that the risk from this potential stressor is discountable.

The potential for vessel strike on ESA-listed marine reptiles, marine invertebrates or marine plants is discountable based on information presented above. Any disturbance to ESA-listed species (i.e., marine reptiles, marine invertebrates, or marine plants) that may result from this stressor (vessel strike) during vessel surveys are discountable. Therefore, we conclude that vessel strike is not likely to adversely affect ESA-listed cetaceans, pinnipeds, marine reptiles, fishes, marine invertebrates, and marine plants, and will not be carried forward in this consultation.

6.1.3.2 Acoustic Noise, Vessel Noise, and Visual Disturbance

The proposed action will produce a variety of different sounds including those associated with vessel operations as well as active acoustics (e.g., playbacks and prey mapping that may produce an acoustic disturbance or otherwise affect ESA-listed species. It will also involve the presence of vessels (and associated gear or equipment) that produce a visual disturbance that may affect ESA-listed cetaceans, pinnipeds, marine reptiles, fishes, marine invertebrates, and marine plants.

Research vessels associated with the proposed action may cause visual or auditory disturbances to ESA-listed species that spend time near the surface, such as marine mammals, sea turtles, and fishes, which may generally disrupt their behavior. Studies have shown that vessel operation can result in changes in the behavior of marine mammals, sea turtles, and fishes (Hazel et al. 2007; Holt et al. 2009; Luksenburg and Parsons 2009; Noren et al. 2009; Patenaude et al. 2002; Richter et al. 2003; Smultea et al. 2008). In many cases, particularly when responses are observed at great distances, it is thought that animals are likely responding to sound more than the visual presence of vessels (Blane and Jaakson 1994; Evans et al. 1992; Evans et al. 1994). Nonetheless, it is generally not possible to distinguish responses to the visual presence of vessels from those to the sounds associated with those vessels. Moreover, at close distances animals may not even differentiate between visual and acoustic disturbances created by vessels and simply respond to the combined disturbance.

Unlike vessels, which produce sound as a byproduct of their operations, echosounders are designed to actively produce sound, and as such, the characteristics of these sound sources are deliberate and under control. Assessing whether these sounds may adversely affect ESA-listed species involves understanding the characteristics of the active acoustic sources, the species that may be present in the vicinity of the sound, and the effects that sound may have on the physiology and behavior of those species. Although it is known that sound is important for marine mammal communication, navigation, and foraging (NRC 2003b; NRC 2005), there are many unknowns in assessing impacts of sound, such as the potential interaction of different effects and the significance of responses by marine mammals to sound exposures (Nowacek et al. 2007; Southall et al. 2007). Other ESA-listed species such as such as sea turtles are often considered less sensitive to anthropogenic sound, but given that much less is known about how they use sound, the impacts of anthropogenic sound are difficult to assess (Nelms et al. 2016; Popper et al. 2014c). Nonetheless, depending on the circumstances exposure to anthropogenic sounds may result in auditory injury, changes in hearing ability, masking of important sounds, behavioral responses, as well as other physical and physiological responses (see Section 11.4.1).

Several of the conservation measures associated with the proposed action such as shut-down procedures are specifically designed to minimize effects that may result from active acoustic sound sources used during the research activities. While not specifically designed to do so, several aspects of the proposed mitigation measures to avoid vessel strike will minimize effects associated with vessel disturbance. However, even with these mitigation measures, visual and acoustic disturbances are considered a potential stressor.

Research vessels may cause auditory disturbance to ESA-listed species and more generally can disrupt their behavior. In addition to the active acoustic sound sources mentioned above, we expect that any research vessel permitted under the proposed action will add to the local noise environment in the action area due to the research vessel's propulsion and other noise characteristics of the research vessel's machinery.

Sounds emitted by large vessels can be characterized as low-frequency, continuous, or tonal, and sound pressure levels at a source will vary according to speed, burden, capacity and length (Kipple and Gabriele 2007; McKenna et al. 2012; Richardson et al. 1995b). Source levels for 593 container ship transits were estimated from long-term acoustic recording received levels in the Santa Barbara shipping channel, and a simple transmission loss model using Automatic Identification System data for source-receiver range (McKenna et al. 2013). Ship noise levels could vary five to ten decibels depending on transit conditions. Given the sound propagation of low frequency sounds, a large vessel in this sound range can be heard 139 to 463 kilometers (75.1 to 250 nautical miles) away (Polefka 2004). Hatch et al. (2008) measured commercial ship underwater noise levels and reported average source level estimates (71 to 141 Hertz, re: 1 μPa [rms] ± standard error) for individual vessels ranged from 158 ± 2 decibels (research vessel) to 186 ± 2 decibels (oil tanker). McKenna et al (2012) in a study off Southern California documented different acoustic levels and spectral shapes observed from different modern vessel-types.

Numerous studies of interactions between surface vessels and marine mammals have demonstrated that free-ranging marine mammals engage in avoidance behavior when surface vessels move toward them. It is not clear whether these responses are caused by the physical presence of a surface vessel, the underwater noise generated by the vessel, or an interaction between the two (Amaral and Carlson 2005; Au and Green 2000; Bain et al. 2006; Bauer 1986; Bejder et al. 1999; Bejder and Lusseau. 2008; Bejder et al. 2009; Bryant et al. 1984; Corkeron 1995; Erbe 2002b; Félix 2001; Goodwin and Cotton 2004; Lemon et al. 2006; Lusseau 2003; Lusseau 2006; Magalhaes et al. 2002; Nowacek et al. 2001; Richter et al. 2003; Scheidat et al. 2004; Simmonds 2005; Watkins 1986; Williams et al. 2002; Wursig et al. 1998). However, several authors suggest that the noise generated during motion is probably an important factor (Blane and Jaakson 1994; Evans et al. 1992; Evans et al. 1994). These studies suggest that the behavioral responses of marine mammals to surface vessels are similar to their behavioral responses to predators. For these reasons, we find the risk to ESA-listed species from this stressor (visual disturbance) is insignificant.

Very little research exists on sea turtle responses to vessel noise disturbance. Currently, there is nothing in the available literature specifically aimed at studying and quantifying sea turtle response to vessel noise. However, a study examining vessel strike risk to green sea turtles suggests that sea turtles may habituate to vessel sound 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). Regardless of the specific stressor associated with vessels to which turtles are responding, they only appear to show responses (i.e., avoidance behavior) at approximately 10 meters (32.8 feet) or closer (Hazel et al. 2007). Therefore, the noise from research vessels is not likely to affect sea turtles from further distances, and disturbance may only occur if a sea turtle hears a vessel nearby or sees it as it approaches. These responses appear limited to non-injurious, minor changes in behavior based on the limited information available on sea turtle response to vessel noise.

All fishes can detect vessel noise due to its low-frequency content and their hearing capabilities. Therefore, ESA-listed fishes could be exposed to a range of vessel noises, depending on the source and context of the exposure. Because of the characteristics of vessel noise, sound produced from research vessels are unlikely to result in direct injury, hearing impairment, or other trauma to fishes. Plus, in the near field, fish are able to detect water motion as well as visually locate an oncoming vessel. In these cases, most fishes located in close proximity that detect the research vessels either visually, via sound and motion in the water will be capable of avoiding the research vessel or move away from the area affected by vessel sound. Thus, fish are more likely to react to vessel noise at close range than to vessel noise emanating from a greater distance away. These reactions may include physiological stress responses, or avoidance behaviors.

The contribution of vessel noise by any research vessel is likely small in the overall regional sound field. Any research vessels passage past a cetacean, pinniped, marine reptile, fish, marine invertebrate, or marine plant will be brief and not likely to be significant in impacting any individual's ability to feed, reproduce, or avoid predators. Brief interruptions in communication via masking are possible, but unlikely given the habits of marine mammals to move away from vessels, either as a result of engine noise, the physical presence of the vessel, or both (Lusseau 2006; Mitson and Knudsen 2003). Also, as stated sea turtles are most likely to habituate and are shown to be less effected by vessel noise at distances greater than 10 meters (32.8 feet) (Hazel et al. 2007). In addition, during operations the research vessels will be traveling at slow speeds, reducing the amount of noise produced by the propulsions system and the probability of a vessel strike for marine mammals (Kite-Powell et al. 2007; Vanderlaan and Taggart 2007). The distance between the research vessel and observed marine mammals, per avoidance protocols, will also minimize the potential for acoustic disturbance from engine noise.

Because the potential acoustic interference from engine noise will be undetectable or so minor that it cannot be meaningfully evaluated, we find that the risk from this potential stressor is insignificant. Therefore, we conclude that acoustic interference from active acoustic sound sources and/or engine noise may affect, but are not likely to adversely affect ESA-listed cetaceans, pinnipeds, marine reptiles, fishes, marine invertebrates, or marine plants, and will not be carried forward in this consultation.

6.1.3.3 Behavioral Observation

Observation of cetaceans will occur during vessel surveys in the proposed action and may affect ESA-listed cetaceans within the action area. Behavioral observations are used to increase the understanding of cetacean ecology and behavior, as well as provide insight on the effects of anthropogenic disturbance on cetaceans. Behavioral observations will occur concurrently with other research and enhancement activities including aerial surveys, vessel surveys, focal follows, active acoustics, biological sampling, and tagging. Given that observation itself does not present any unique stressors not already described in detail for aerial and vessel surveys and close approaches, we do not anticipate unique responses to observation. However, the duration of observations following biological sampling or tagging will generally be greater than during a typical vessel survey. Researchers may observe North Atlantic right whales for up to four hours per behavioral observation period. This extended duration may increase the likelihood an individual will respond to the research vessel's close proximity. However, as detailed in Section 3.7.2.4 most of the time the research vessel will be at distances no closer than approximately 91.4 meters (300 feet). If the individual were to exhibit an indication of disturbance, then the researchers will move away and take all possible actions to minimize such disturbance because such disruption of natural behavior invalidates their dataset. Thus, given the far distances from which most observation will occur, and the motivation of the researchers to minimize disturbing cetaceans during observations, we expect no effects on fitness as the result of observations. The effects that may result from potential stressors from behavioral observation are considered insignificant. Therefore, we conclude that this stressor (behavioral observation) may affect, but are not likely to adversely affect ESA-listed cetaceans, pinnipeds, marine reptiles, fishes, marine invertebrates, and marine plants and will not be carried forward in this consultation.

6.1.3.4 Gear Entanglement

Any towed gear or equipment associated with the proposed action may pose a risk of entanglement to ESA-listed species. Entanglement can result in death or injury of cetaceans, pinnipeds, sea turtles, and fishes (Deakos and H. 2011; Duncan et al. 2017; Moore et al. 2009; van der Hoop et al. 2013). Cetaceans, pinnipeds, sea turtle, and fish entanglement, or bycatch, is a global problem that every year results in the death of hundreds of thousands of animals worldwide. Entangled cetaceans, pinnipeds, and sea turtles may drown or starve due to being restricted by gear, suffer physical trauma and systemic infections, and/or be hit by vessels due to an inability to avoid them. For smaller animals like sea turtles, death is usually quick, and due to drowning. However, large cetaceans, like North Pacific right whales, can typically pull gear, or parts of it, off the ocean floor, and are generally not in immediate risk of drowning. Nonetheless, depending on the entanglement, towing gear for long periods may prevent a large cetacean from being able to feed, migrate, or reproduce (Lysiak et al. 2018; van der Hoop et al. 2017).

Towed gear from the research and enhancement activities (e.g., passive acoustic monitoring, prey sampling) pose a risk of entanglement to ESA-listed cetaceans, pinnipeds, and sea turtles can also come in direct contact. Towed gear can include towed hydrophone arrays and hydrophones suspended in the water from a research vessel as well as bottom-mounted autonomous recorders for passive acoustic monitoring or towed nets from wire cables for prey sampling. The towed hydrophone arrays used during passive acoustic monitoring can come in direct contact with ESA-listed species and sea turtle entanglements have occurred in towed gear from seismic survey vessels. Entanglement is highly unlikely due to the hydrophone design as well as bottom-mounted autonomous recording devices fixed to buoys, as well as the fact that researchers monitor the equipment during deployment and recovery. Also, sea turtles have been observed investigating the towed hydrophone streamer and not becoming entangled or operating in regions of high sea turtle density and entanglements not occurring (Hauser 2008; Holst and

Smultea 2008a; Holst et al. 2005b; Holst et al. 2005c). The towed hydrophone array is rigid and as such will not encircle, wrap around, or in any other way entangle any of the cetaceans considered during this consultation. We expect the taut cables between the equipment and buoys will prevent entanglement and observers on research vessels will spot ESA-listed species prior to, during deployment, and during recovery of this equipment. Instances of such entanglement events with ESA-listed cetaceans and pinnipeds are unknown to us.

In addition to cetaceans, pinnipeds, and sea turtles, some of the ESA-listed fish species in the action area are more susceptible to entanglement in derelict fishing gear and other marine debris, compared to other fish groups. For example, the shape of the body of some elasmobranchs such as manta rays, increase their risk of entanglement compared to fishes with smoother, more streamlined bodies such as steelhead. Nevertheless, for most of the pelagic species of ESA-listed fish species including steelhead and oceanic whitetip sharks the risk of entanglement is unlikely given their body shape and ability to avoid materials that could entangle them in the water column.

Although the gear used for passive acoustic monitoring and prey sampling can come in direct contact with an ESA-listed species, entanglements are highly unlikely and considered discountable. Based upon extensive deployment of this type of equipment with no reported entanglement and the nature of the gear that is likely to prevent it from occurring, we find the probability of adverse impacts to ESA-listed species to be discountable. Therefore, we conclude that this stressor (gear entanglement) may affect, but is not likely to adversely affect ESA-listed cetaceans, pinnipeds, marine reptiles, fishes, marine invertebrates, and marine plants and will not be carried forward in this consultation.

6.1.3.5 Photography and Videography

Photography and videography will occur during vessel surveys as mentioned in the proposed action and may affect ESA-lsited cetaceans within the action area. Potential stressors associated with photography and videography include close approaches during vessel surveys (described above). Researchers typically observe cetaceans during vessel surveys at distances of 50 to 100 meters (164 to 328.1 feet) from small research vessels. Simply taking an animal's photograph or video is not expected to present any unique stressors that will cause additional responses. Therefore, no response is expected to photography and videography that has not already been described above. Photography and videography will not affect the fitness of individuals..

For lasers used during photogrammetry or videogrammetry, laser safety for various species of cetaceans and pinnipeds for which visual acuity data are available (Zorn et al. 2000). The authors analyzed the acuity data to show that the sensitivity ratio of these marine mammals was less than that of humans. Therefore, if the safety standards for humans are applied to these marine mammals, the probability of harm should be zero. The study was based on airborne light detection and ranging systems (LIDAR) in the blue-green region of the visible spectrum. The use of LIDAR underwater should be even less intrusive than in-air use as a portion of the energy of the laser beams will be attenuated in the water column. Whether this proposed system proves feasible in the long run remains to be investigated, but if it proves practical it would be a significant advance for the videogrammetric technique. We do not anticipate any effects to the fitness of individuals. The effects that may result from potential stressors from lasers on ESA-listed cetaceans are insignificant.

For underwater photography and videography, instruments associated with underwater divers/snorkelers conducting video or photography are not expected to pose a measurable risk to ESA-listed species. Cameras will not emit any sound that is measurable to the target cetaceans and using such equipment is not expected to disturb cetaceans any more than the close approach, as discussed above. Only experienced cetacean researchers are authorized to conduct underwater snorkeling or diving activities, and the researchers generally will not approach cetaceans closer than 10 to 25 meters (32.8 to 82 feet). The mitigation measures in the permit (see Section 19.3) also require researchers to stop research and enhancement activities if the target cetaceans exhibit avoidance or evasive behaviors indicative of disturbance. We do not anticipate any effects to the fitness of individuals. The effects that may result from potential stressors from lasters on ESA-listed cetaceans are considered insignificant. Therefore, we conclude that that may result from this stressor (underwater photography and videography) may affect, but are not likely to adversely affect ESA-listed cetaceans, and will not be carried forward in this consultation.

6.1.3.6 Remotely Operated Vehicles

Unmanned autonomous underwater (or remotely operated) vehicles will be launched from research vessels or land (amphibious) and travel through the water column at very slow speeds. Potential stressors associated with remotely operated vehicles include visual and/or audible disturbance similar to vessel surveys and vessel strike. If cetaceans respond to the remotely operated vehicles, we expect responses similar to those described above for vessel surveys and close approach or human divers in the water. Any disturbance will be temporary and animals are expected to return to normal behavior within minutes of the encounter. Researchers' observing natural behaviors of cetaceans do not intend to cause disturbance, as it will affect the data collected. We are not aware of any permit annual report describing adverse effects from remotely operated vehicles. We do not anticipate any effects to the fitness of individuals. The effects that may result from the potential stressors from remotely operated vehicles are considered insignificant and/or discountable. Therefore, we conclude that this stressor (remotely operated vehicles) may affect, but is not likely to adversely affect ESA-listed cetaceans, pinnipeds, marine reptiles, fishes, marine invertebrates, and marine plants, and will not be carried forward in this consultation.

6.2 Active Acoustics

Active acoustics includes playbacks, prey mapping, AEP tests, and remote ultrasound. These proposed research and enhancement activities are directed at ESA-listed cetaceans. Active acoustic playbacks and their potential affects on ESA-listed cetacean species are addressed further in Section 11.4.1. Potential affects of active acoustic stressors on non-cetacean ESA-listed species are addressed below.

6.2.1.1 Active Acoustics – Playbacks

Researchers may conduct active acoustic playbacks to study how cetaceans respond to different sounds (Section 3.7.3.2) as mentioned in the proposed action and may affect ESA-listed cetaceans, pinnipeds, marine reptiles, fishes, and marine invertebrates in the action area. Such research and enhancement activities provide empirical measurements of behavior in marine mammals and behavioral changes as a function of sound exposure so that sound producers and regulatory agencies can better understand, minimize, and manage noise impacts on protected species. These "behavioral response studies" document and quantify reactions or changes to natural and manmade sound stimuli (e.g., marine mammals calls, ship noise, naval exercises, drilling noise, pile-driving, or white noise). The sound source for an active acoustic trial is typically from playbacks; however, other sound sources can be used for research purposes including pingers (e.g., to study the effects of bycatch reduction), and controlled exposure experiments using sound sources such as sonar or seismic airgun arrays to study behavioral and physiological responses (Southall 2012; Gordon 2003; Tyack 2003). When combined with other research methods (e.g., behavioral observations, biopsy sampling, and tagging), researchers can also investigate an animal's stress response and fine scale behaviors through animal movements and dive patterns.

Pinnipeds may be exposed to research and enhancement activities with active acoustics, such as playbacks or prey mapping. Researchers will not be authorized for takes for ESA-listed pinnipeds, and will be required to shut-down any active acoustic sound source if ESA-listed pinnipeds approach their corresponding ESA harassment (MMPA Level B harassment) isopleth, as estimated by the method used to determine the isopleth distance corresponding to the ESA harm (MMPA Level A harassment) threshold (see Section 3.7.3.2). In some cases, researchers may request takes for unintentional disturbance to ESA-listed pinnipeds during active acoustics targeted at cetaceans. Playbacks using natural or biological sounds (e.g., cetacean calls or whistles) may be audible to pinnipeds, but these sounds can already be heard by pinnipeds in the environment and it is unlikely that any exposed pinnipeds will be able to distinguish playbacks from actual cetacean calls, nor do we expect pinnipeds to exhibit any response beyond that which they will show to naturally occurring calls in the environment. If such sound source levels disturb non-target pinnipeds, we will expect them to leave the area as a result of the active acoustic trial exposure. The maximum received levels of active acoustics under this programmatic consultation will be below which is expected to cause a PTS or injury in all marine mammal species. Furthermore, the nature of studies with active acoustics conducted under scientific research permits are not the same as other human activities, which may occur for longer periods of time or even continuously. The active acoustic playbacks permitted for research and enhancement activities do not occur 24 hours per day, instead, they are typically short in duration and occur during daylight hours. Researchers are often conducting experiments using active acoustics to examine the behavioral impacts of noise on marine mammals. They are not trying to induce hearing loss as even a minor threshold shift can alter a behavioral response and will only add a complicating factor to the research study. Therefore, if active acoustic playbacks are not expected to result in injury to targeted cetaceans, and non-target marine mammals of any hearing group, we do not expect injury or other adverse effects to non-target ESA-listed pinnipeds. Thus, even if non-target ESA-listed pinnipeds are exposed to sounds from active acoustics directed at cetaceans, we find it highly unlikely there will be any adverse effects. Therefore, we find the effects of disturbance to ESA-listed pinnipeds from the active acoustics to be insignificant or discountable.

ESA-listed marine reptiles may be exposed to active acoustic playbacks during research and enhancement activities on cetaceans; however, researchers will not be authorized takes for ESA-listed sea turtles and will be required to shut-down any active acoustic playbacks, or any other non-target protected species are observed. While less auditory data exists for sea turtles than marine mammals, the current best scientific evidence for hearing in sea turtles is thought to broadly encompass frequencies between 50 and 2,000 Hertz with peak hearing at frequencies between 100 to 400 Hertz in-water (Ridgway et al. 1969; Samuel et al. 2005; Martin et al. 2012; Piniak et al. 2012, 2016). Based on this information, many of the frequencies associated with the proposed active acoustic research methods as described in Section 3.7.3.2 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 NMFS Permits and Conservation Division does not expect exposed sea turtles will be able to distinguish playbacks from actual cetacean calls, and therefore does not expect sea turtles to respond differently to such playbacks compared to naturally occurring calls. If such sound source levels disturb these non-target sea turtles, the sea turtles are not expected to leave the area of sound exposure and are not expected to be harassed from disturbance.

Although no TTS or PTS onset studies have been conducted for sea turtles, noise-induced hearing loss thresholds for cetaceans or fish have been used as surrogates (Finneran and Jenkins 2012; Popper et al. 2014c). Acoustic thresholds for TTS and PTS for sounds have been developed by the U.S. Navy for Phase III of their programmatic approach to evaluating environmental effects of their military readiness activities (U.S. Navy 2017). The maximum received levels of active acoustics that may be authorized under this programmatic consultation will not result in ESA harm or cause PTS or injury (MMPA Level A harassment) in marine mammals, which are more conservative (lower) and protective of sea turtles. Thus, directed active acoustic playbacks are not expected to result in injury to targeted cetaceans, and non-target marine mammals of any hearing group, the NMFS Permits and Conservation Division do not expect injury or other adverse effects to sea turtles. For these reasons, we find that the effects of active acoustic playbackss on sea turtles are insignificant or discountable.

ESA-listed fishes may be exposed to active acoustic playbacks during research and enhancement activities on cetaceans. Researchers conducting methods with active acoustics (e.g., acoustic trials such as playbacks, or echosounders for prey mapping) during research and enhancement activities on cetaceans under this consultation may spatially or temporally overlap with ESA-listed fishes (Table 6). These fishes may travel through the action area during their ocean migration, transiting from rivers to the open ocean or vice versa, or reside in the research area. Therefore, it is possible that these ESA-listed fishes will be exposed to sounds from the active acoustic playbacks.

These ESA-listed species include the bony fishes (e.g., salmon, rockfishes, and sturgeon) and elasmobranchs (e.g., sawfishes, sharks, skates, and rays). Bony fishes are further analyzed based on the presence or absence of a swim bladder. Elasmobranchs do not possess a swim bladder and therefore are not as susceptible to injury from sound sources and are discussed separately.

As mentioned above, differences in fish sensitivity to acoustic pressure may be the result of the presence or absence of/and type of swim bladder, and more importantly, the proximity and linkage of the swim bladder to the ear (Halvorsen et al. 2012a; Halvorsen et al. 2012b; Popper et al. 2003; Popper et al. 2014b). All fishes have hearing capabilities and a lateral line capable of detecting water motion caused by sound (Hastings and Popper 2005; Popper and Schilt 2009). However, fishes with swim bladders may be more sensitive to sound, and therefore more susceptible to injury from underwater sound exposure, than fishes that lack swim bladders. The air within the swim bladder is a much lower density that that of water and the fish’s body. Thus the air (and swim bladder), can easily be compressed by sound pressure waves traveling through the fish’s body and leading to internal injuries, including injuries to ears.

Exposure to intense sounds can cause a permanent or temporary hearing loss in numerous species. Some anthropogenic sounds can cause TTS, depending on a number of variables including the frequency and intensity of sound, duration of exposure, etc. The physiological basis for TTS can involve reversible damage to the hair cells of the inner ear.

Fishes are susceptible to TTS (Popper et al. 2007). For example, fathead minnows (*Pimepheles promelas*) experienced TTS after exposure to playback of boat engine noise at 142 decibels for two hours (Scholik and Yan 2002), whereas goldfish (*Carassius auratus*) exhibited TTS after exposure to 166 to 170 decibels of white noise for ten minutes (Smith et al. 2004). In both studies, hearing returned to normal, but the length of time required for recovery varied as a function of the frequency of the sound and duration of exposure (Scholik and Yan 2001). It is likely that the actual sound levels needed to produce TTS will vary widely, and even differ by species.

Physical hair cell damage has been observed in several fish species following exposure to intense sounds. Hair cells were lost in goldfish after exposure to white noise at 170 decibels for 48 hours and monitored for eight days after exposure. Scientists found that the hair cell loss was accompanied by TTS. However, after seven days hearing thresholds returned to normal and the damaged hair cells started to be replaced (Smith et al. 2006).

In contrast to the effects seen in the above studies, caged rainbow trout (*Onchorhynchus mykiss*), channel catfish (*Ictalurus punctatus*), and hybrid sunfish (*Lepomis spp.*) exposed to U.S. Navy surveillance towed array sensor system low frequency active (SURTASS LFA) sound source (maximum received level of 193 decibels) for 324 or 628 seconds did not show exposure-related damage in the inner ear and other tissues (Halvorsen et al. 2012b), while both rainbow trout and channel catfish (but not the hybrid sunfish, largemouth bass [*Micropterus salmoides*], or yellow perch [*Perca flavescens*]) showed small TTS for several days after exposure (Halvorsen et al. 2012b; Halvorsen et al. 2013; Popper et al. 2007).

Additionally, exposure-related damage was not observed when these fish were exposed to mid-frequency signals (maximum received level 210 decibels) for 15 seconds (Kane et al. 2010). The duration and level of exposure to sonars in this study were much longer than would be encountered by fish exposed to sonar in the ocean. Similarly, in a study to test the effects of exposure to seismic airguns, devices used in geological exploration and search for oil and gas underwater, it was found that there was no damage to the ears of five different species of fish in the MacKenzie River Delta (Canada) (Song et al. 2008), although several species showed TTS that recovered within 18 hours of the exposure (Popper et al. 2005).

Many species, exposed to sounds longer and louder than those that result in TTS may experience PTS. PTS occurs when hair cells die and are not replaced. In contrast, fishes, including bony fishes and sharks, skates, and rays, can replace hair cells lost as a result of exposure to intense sounds (Lombarte and Popper 1994; Lombarte et al. 1993; Popper 2005; Popper et al. 2007; Popper and Hoxter 1984). Moreover, fishes add large numbers of hair cells, as well as repair and replace damaged hair cells, throughout life. For example, a small Mediterranean hake (*Merluccius merluccius*) may have 5,000 hair cells, whereas an adult may have two million. Lastly, regeneration is correlated with a functional recovery of hearing ability (Smith et al. 2006). As a consequence of the ability to repair and regenerate hair cells, the likelihood of PTS in fishes is considered to be very low. Therefore, discussions of any injury to fishes hearing as a result of any acoustic sources focus on TTS not PTS. However, the likelihood of TTS effects to ESA-listed fishes resulting from the proposed research and enhancement activities are expected to be minimized due to the ability of fishes to avoid areas of intense sound, the characteristics of the sound source frequency, exposure levels, and implementation of mitigation measures (i.e., ramp-up procedures) prior to active acoustic playbacks.

ESA-listed bony fishes, particularly mature individuals, are generally able to avoid the potential adverse conditions created by sound sources if those conditions are limited to areas that are small or local compared to the total habitat area, and if the system can recover before the next disturbance. Numerous studies have documented that fish may alter their behavior and avoid anthropogenic noise sources including oncoming vessels, airguns, pile-driving, and general construction noise (Ona 1990; De Robertis et al. 2012; Popper et al. 2014a). We expect most ESA-listed fishes to move out of an ensonified area to obtain a more favorable position within their range of tolerance along a complex gradient of temperature, turbidity, flow, noise, contaminants, and other environmental features. We cannot be certain that all fish will be able to detect and/or avoid underwater sound from active acoustic playbacks, but we expect larger, healthy individuals will be more likely to leave the area and avoid physical impacts. In most cases, we expect individuals to seek alternative habitat nearby that is not being exposed to elevated levels of underwater noise.

Very few studies have been conducted on the hearing ranges of ESA-listed fish; however, many fish species are considered "hearing generalists" and they do not have specializations that enhance their hearing ability (e.g., lower threshold and broad hearing range). However, fish may have hearing ranges that overlap with the range of the frequencies that could be authorized for active acoustic playbacks under the proposed cetacean research and enhancement activities.

Underwater sounds have been shown to alter the behavior of fishes (see review by Hastings and Popper 2005). Exposure to anthropogenic sound may result in agitation, alarm, or startle responses. The startle response in fishes is a quick burst of swimming that may be involved in avoidance of predators. Other potential changes include reduced predator awareness and reduced feeding. A study in Puget Sound, Washington suggests that pile-driving operations disrupt juvenile salmon schooling behavior and habitat use (Feist et al. 1992). Though no underwater sound measurements are available from that study, comparisons between juvenile salmon schooling behavior in areas subjected to pile-driving and other areas where there was no-pile driving indicate that there were fewer schools of fish in the pile-driving areas than in the non-pile-driving areas. The results are not conclusive but there is a suggestion that pile-driving operations may result in a disruption in the normal migratory behavior of the salmon in that study, though the mechanisms salmon may use for avoiding the area are not understood at this time. Other research suggests that fish will move away from a sound source such as impact pile-driving that is so loud that it can cause physiological damage (e.g., Anderson 1990; Dahl et al. 2015; Popper et al. 2014b). On the other hand, fish may respond to the first few strikes of an impact hammer with a startle response, but then the startle response wanes and some fish may remain within the potentially harmful area (Dolat 1997). The potential for adverse behavioral effects depend on a number of factors, including the sensitivity to sound, the type and duration of the sound, as well as life stages of fish that are present in the areas affected by underwater sound.

The current recommendations by the multi-agency Fisheries Hydroacoustic Working Group, determined that the thresholds for fish and impact pile-driving (i.e., impulsive sources) are:

- 206 decibels peak (regardless of fish size or hearing type) – onset of injury to mortality;
- 187 decibels cumulative sound exposure level for fish two grams or larger – onset of injury to mortality;
- 183 decibels cumulative sound exposure level for fish smaller than two grams – onset of injury to mortality; (Stadler and Woodbury 2009) and
- 150 decibels (root mean square) – onset of behavioral response (not necessarily take, depending on the circumstances).

The decision by this group to include the sound exposure level metric along with peak decibels sound pressure level metric was based upon the primary rationale that this sound exposure level metric provided a way to sum the energy over multiple impulses, which cannot be accomplished with peak pressure. Using sound exposure level, the exposure of fish to a total amount of energy (i.e., dose) can be used to determine if a physical injury occurs. Since the cumulative sound exposure level formula takes into account all impact pile strikes within a 24-hour period (to be reset only after a break of 12 hours or longer), the size of the injury zone is designated at its maximum extent through the course of a pile-driving day. During the early portion of an active acoustic playback, the ensonified area that may lead to potential injury (based on the cumulative sound exposure level metric) is expected be small and only gradually increase outward after all the active acoustic playbacks have been completed.

ESA-listed bony fishes (including salmonid species) may occur year-round in waters considered in this consultation and individuals may move through the action areas at varying rates and be exposed to sound from active acoustic playbacks. However, the likelihood of effects to ESA-listed bony fishes resulting from active acoustic playbacks will be minimized due to the hydroacoustic characteristics of the sound source (i.e., frequency, exposure level). ESA-listed salmonids, particularly mature individuals, are generally able to avoid the potential adverse conditions created by sound sources if those conditions are limited to areas that are small or local compared to the total habitat area, and if the system can recover before the next disturbance. Numerous studies have documented that fish may alter their behavior and avoid anthropogenic noise sources including oncoming vessels, airguns, pile-driving, and general construction noise (De Robertis and Handegard 2013; Olsen et al. 1983; Ona and Godo 1990; Popper et al. 2014b). This means we expect most ESA-listed bony fishes to move out of an ensonified area (e.g., the area around an active acoustic playback) to obtain a more favorable position within their range of tolerance along a complex gradient of temperature, turbidity, flow, noise, contaminants, and other environmental features.

Although the data available on the hearing sensitivities of salmon is limited, information suggests that species in the family Salmonidae have similar auditory systems and hearing sensitivities (Popper 1977; Popper et al. 2007; Wysocki et al. 2007). Most of the data available resulted from studies of the hearing capability of Atlantic salmon (*Salmo salar*), which can be used as a surrogate for other salmonids. This fish was found to be a “hearing generalist” with a relatively poor sensitivity to sound, having hearing sensitivities ranging from less than 100 Hertz to about 580 Hertz (Hawkins and Johnstone 1978; Knudsen et al. 1992; Knudsen et al. 1994; Popper 2008). We do not have specific information on hearing in eulachon, but we assume that they are hearing generalists whose hearing sensitivities will be similar to salmon. The hearing sensitivities of bocaccio and yelloweye rockfish have not been studied; however, they produce low frequency sounds (lower than 900 Hertz) (Sirovic and Demer 2009) and are believed to be low-frequency hearing generalists (Croll et al. 1999b). Playbacks of impact and vibratory pile-driving as well as control sounds, which range from 500 Hertz to 20 kiloHertz, will overlap with the hearing sensitivities of salmonids, eulachon, bocaccio, and yelloweye rockfish. These ESA-listed fishes are low-frequency specialists, which will overlap with the active acoustic playbacks as they range from 500 Hertz to 20 kiloHertz, but their most sensitive hearing range is at lower frequencies.

The information available on the hearing capabilities of sturgeon are based on data collected from two species of sturgeon. 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 Hertz to about 1 kiloHertz, indicating that sturgeon should be able to localize or determine the direction of the 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 Hertz to 2 kiloHertz, with best hearing sensitivity from 100 to 400 Hertz. 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 5 kiloHertz) than to the oscar (which is a non-specialist that can only detect sound up to 400 Hertz). However, these authors felt additional data were necessary before lake sturgeon can 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 Hertz, with the lowest hearing thresholds from frequencies in a bandwidth of between 200 and 300 Hertz and higher thresholds at 100 and 500 Hertz; lake sturgeon were not sensitive to sound pressure. We assume that the hearing sensitivities for these other species of sturgeon are representative of the hearing sensitivities of the ESA-listed sturgeon species considered in this consultation.

ESA-listed elasmobranchs (Table 6) may occur in the action area and be affected by sound fields generated by active acoustic playbacks. Elasmobranchs, like all fish, 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 elasmobranch fishes suggest they are capable of detecting sounds from approximately 20 Hertz to 1 kiloHertz with the highest sensitivity to sounds at lower ranges (Casper et al. 2012; Casper and Mann 2009; Casper 2006; Ladich and Fay 2013; Myrberg Jr. 2001; Yan 2003). However, unlike most bony fishes, elasmobranchs do not have swim bladders (or any other air-filled cavity), and thus are unable to detect sound pressure (Casper et al. 2012). Particle motion is presumably the only sound stimulus that can be detected by elasmobranchs (Casper et al. 2012). Given their assumed hearing range, elasmobranchs are anticipated to be able to detect the low frequency sounds from an active acoustic playback if exposed. However, the duration and intensity of low-frequency acoustic stressors and the implementation of mitigation measures (described in Section 19.3) will likely minimize the effect this stressor has on elasmobranchs. Furthermore, although some elasmobranchs are known to respond to anthropogenic sound, in general elasmobranchs are not considered particularly sensitive to sound (Casper et al. 2012).

As mentioned previously, it is generally assumed that most fishes will move away from a sound source that is so loud that it can cause physiological damage (e.g., Dahl et al. 2015). We believe the majority of fish potentially present in the action area will not remain close to the active acoustic playbacks of various noise types. However, the degree and effectiveness of the avoidance response varies with life stage, season, the frequency and duration of exposure to the unfavorable condition, and the ability of the individual to balance other behavioral needs for feeding, growth, migration, and territory. Also important is the exposed individual's degree of sensitivity to sound and the individual's ability to detect the sound and location of it.

We cannot be certain that all fish will be able to detect underwater sound from active acoustic playbacks and avoid injury, but we expect larger, healthy individuals (e.g., adults) will be more likely to leave the area and avoid physical impacts. In most cases, we expect individuals to seek alternative habitat nearby that is not currently being exposed to elevated levels of underwater noise. However, in some circumstances, forcing individuals to seek alternative habitat as a result of their reaction to active acoustic playback noise can result in an increased predation risk as they leave their preferred sheltering habitat.

Given the signal type and level of exposure to the sounds produced during active acoustic playbacks, we do not expect frequent exposure or significant responses from any exposures (including significant behavioral adjustments, TTS, PTS, injury, or mortality). Also, per requirements of cetacean research permitting program process, the sound source level of the active acoustic playbacks will be lower than the onset of injury or mortality for marine mammals, and because the marine mammal thresholds are more conservative, as described above for sea turtles, we do not expect injury or mortality for fish (regardless of fish size or hearing type). The most likely response of ESA-listed fishes (salmon, rockfishes, sturgeon, and elasmobranchs) to the 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 at the population level. Therefore, the potential effect of the proposed research and enhancement activities using active acoustic playbacks on ESA-listed fishes is considered insignificant.

The proposed active acoustic playbacks are also not likely to adversely affect ESA-listed marine invertebrates and the probability of being exposed to stressors capable of eliciting a negative response is sufficiently low as to be discountable. We do not expect ESA-listed marine invertebrates to respond strongly to active acoustic playbacks directed at cetaceans (Albert 2011; Bennet et al. 1994). A study on the effects of vessel noise on non-ESA-listed sea hares (*Stylocheilus striatus*) found that chronic exposure to vessel noise may affect some invertebrate's development and lead to increased mortality (Nedelec et al. 2014). However, the experimental conditions of this study are drastically different than the brief exposure to vessel noise that will result from research vessel operations. Another recent study examining the effects of broadband sounds, including recorded continuous vessel noise, on three representative, but not ESA-listed, benthic invertebrates (the clam, *Ruditapes philippinarum*; decapod, *Nephrops norvegicus*; and brittlestar, *Amphiura filiformis*) indicated that continued exposure to broadband sounds may affect benthic invertebrate behavior in ways that alter nutrient cycling (Solan et al. 2016). However, this study found no significant effects on invertebrate tissue biochemistry, and behavioral responses including avoidance behavior, were mixed (Solan et al. 2016). Importantly, this study examined time integrated effects, which differ from those that would result from the brief exposure to noise from a single, transiting vessel. Some studies indicate that exposure to sound has limited potential to affect invertebrates and available evidence does not suggest the sound sources used in cetacean research will typically be expected to cause mortality or physiological damage to invertebrates. Though squid and some other invertebrates appear to exhibit alarm responses and avoidance of sound sources, individuals will be expected to resume normal behaviors immediately after initial exposure. Sounds from the active acoustic playbacks of natural sounds are expected to have a negligible impact because they are mimicking sounds that already occur in the action area and are transient in nature. Some research has demonstrated that sound in the marine environment can affect the dispersal and recruitment success of coral larvae, and hypothesized that noise pollution in marine environment may represent a factor threatening coral reefs around the world (Stanley et al. 2012; Vermeij et al. 2010).

Given the signal type and level of exposure to the sounds produced during active acoustic playbacks, we do not expect frequent exposure or significant responses from any exposures (including significant behavioral adjustments, injury, or mortality). Also, per requirements of cetacean permits, the sound source level of the active acoustic playbacks will be lower than the onset of injury or mortality for cetaceans and pinnipeds. The most likely response of ESA-listed marine invertebrates to the active acoustic playbacks, if any, will be minor temporary changes in behavior, avoidance of the sound source, or changes in orientation to the sound source, none of which rise to the level of take. If these behavioral reactions were to occur, we do not expect that they will have fitness impacts for the individuals, or at the population level. Therefore, the potential effect of the proposed research and enhancement activities using active acoustics playbacks on ESA-listed marine invertebrates is considered insignificant.

Because the probability of ESA-listed species being exposed to this stressor (active acoustic playbacks) capable of eliciting a negative response is sufficiently low as to be insignificant. Therefore, we conclude that this stressor (active acoustic playbacks) may affect, but is not likely to adversely affect ESA-listed pinnipeds, marine reptiles, fishes, and marine invertebrates, and will not be carried forward in this consultation.

Potential affects of this stressor (active acoustic playbacks) on ESA-listed cetaceans is discussed in greater detail in Section 11.4.1.

6.2.1.2 Active Acoustics - Prey Mapping

Prey mapping will occur during vessel sureys as mentioned in the proposed action and may affect ESA-listed cetaceans, pinnipeds, marine reptiles, fishes, and marine invertebrates within the action area. Prey mapping will image prey fields, including while marine mammals utilize habitats for foraging. Most of the responses to prey mapping are associated with the vessel survey and observation described above. While prey mapping does present the unique stressors of sound used to map prey and close approaches to foraging cetaceans, we do not anticipate these will have significant impacts on cetaceans. Marine mammal hearing is suspected to not be above 160 kiloHertz, although 200 kiloHertz is often used as the cutoff for high-frequency cetaceans. For low-frequency cetaceans, such as mysticetes, the generalized hearing range is estimated to be from 7 Hertz to 35 kiloHertz. For mid-frequency cetaceans, such as false killer and killer whales, the generalized hearing range is 150 Hertz to 160 kiloHertz. The prey mapping equipment (echosounders) frequencies of 100 to 240 kiloHertz for imaging marine mammals and 34 to 462 kiloHertz for imaging prey fields are generally outside the predicted hearing ranges (7 Hertz to 53 kiloHertz) of low-frequency cetaceans (i.e., blue whales, bowhead whales, Gulf of Mexico subspecies of Bryde’s whale, fin whales, Western North Pacific population of gray whales, Arabian Sea DPS of humpback whales, Cape Verde Islands/Northwest Africa DPS of humpback whales, Central America DPS of humpback whales, Mexico DPS of humpback whales, Western North Pacific DPS of humpback whales, North Atlantic right whales, North Pacific right whales, sei whales, and Southern right whales) (NOAA 2018b), and thus, we do not anticipate a response to these sound sources. The dominant frequency of the echosounders will be above the hearing range of mid-frequency cetaceans, such as Southern Resident DPS of killer whales and other marine mammals being imaged (150 Hertz to 160 kiloHertz) (NOAA 2018b). Active acoustics involving a multi-beam echosounder with signal frequencies of 200 kiloHertz were used to monitor the behavior of spinner dolphins (*Stenella longirostris*) in Hawaii while foraging and the researchers did not report behavioral responses by the animals to the sound source (Benoit-Bird and Au 2009). Spinner dolphins are considered mid-frequency cetaceans with predicted hearing ranges similar to Cook Inlet DPS of beluga whales, Main Hawaiian Islands insular DPS of false killer whales, Southern Resident DPS of killer whales, and sperm whales (NOAA 2018b). South Island Hector’s dolphins are considered high-frequency cetaceans. Close approaches to actively feeding cetaceans can cause dense prey patches to break up or redistribute, but the amount of prey that will be disturbed will be insignificant compared to that which the animal consumes in any given mouthful and that is expected to be available in the action area.

Also, the ensonification of animals can be easily prevented (compared to active acoustic playbacks) given the sonar's relatively narrow beam production and directionality, which is often oriented downward thus making it likely that air-breathing, non-target vertebrates will go undetected. Relative to the speaker, sound frequency output is much higher and characterized by lower power, rapid signal attenuation, and a much more limited spatial theater over which the research and enhancement activities are conducted. Sound propagation, even when caused by narrow beam devices, often includes a strong spherical spreading component. The concentrated sound energy of narrow beam transducers are much higher in frequency and thus well above mysticete's hearing sensitivity, and attenuate rapidly further reducing their likelihood of affecting non-target ESA-listed cetacean species. Thus, we do not anticipate the unique stressors associated with prey mapping to affect the fitness of individuals. Therefore, we conclude that the effects on ESA-listed cetaceans.

Although no TTS or PTS onset studies have been conducted for sea turtles, noise-induced hearing loss thresholds for cetaceans or fish have been used as surrogates (Finneran and Jenkins 2012; Popper et al. 2014c). Acoustic thresholds for TTS and PTS for sounds have been developed by the U.S. Navy for Phase III of their programmatic approach to evaluating environmental effects of their military readiness activities (U.S. Navy 2017). No TTS or PTS for active acoustic prey mapping are expected or authorized under this programmatic consultation and therefore will not result in ESA harm or cause PTS or injury. The maximum received levels of active acoustics that may be authorized under this programmatic consultation will not result in ESA harm or cause PTS or injury (MMPA Level A harassment) in marine mammals, which are more conservative (lower) and protective of sea turtles. Thus, directed active acoustic prey mapping are not expected to result in injury to targeted cetaceans, and non-target marine mammals of any hearing group, the NMFS Permits and Conservation Division do not expect injury or other adverse effects to sea turtles. For these reasons, we find that the effects of active acoustic prey mapping on sea turtles are insignificant or discountable.

The echosounders used for prey mapping will be operated at frequencies higher than the hearing range of the ESA-listed fishes in Table 6. Hearing in these fishes is discussed above. Further, the signals used for imaging prey fields will likely be highly directional with a relatively narrow beam production and directionality, thus the ensonified zone of the water column will be narrow and spatially limited.

Given the signal type and level of exposure to the sounds produced during active acoustic prey mapping by the use of echosounders, we do not expect frequent exposure or significant responses from any exposures (including significant behavioral adjustments, TTS, PTS, injury, or mortality). Also, per requirements of the cetacean research permitting program, the sound source level of the active acoustic prey mapping will be lower than the onset of injury or mortality for marine mammals, and because the marine mammal thresholds are more conservative, as described above for sea turtles, we do not expect injury or mortality for fish. The most likely response of ESA-listed fishes (e.g., salmon, rockfishes, sturgeon, and elasmobranchs) to the echosounders used in prey mapping, if any, could include 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 at the population level. Therefore, we conclude that this stressor (active acoustic prey mapping) may affect, but is not likely to adversely affect ESA-listed cetaceans, pinnipeds, marine reptiles, fishes, and marine invertebrates, and will not carried forward in this consultation.

6.2.1.3 Auditory Evoked Potential or Auditory Brainstem Response Test

Auditory evoked potential or auditory brainstem response test procedures may be conducted on stranded animals or animals in rehabilitation. 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 water's surface or may be physically restrained (held by researchers) during the procedure. The minimally invasive procedure entails a small needle that pierces the skin.

In most cases, researchers will conduct AEP testing at the same time as other veterinary procedures. The extremely minor adjustments to the handling and restraining that will be required to allow AEP testing, such as slightly raising a cetacean's jaw, are very unlikely to cause adverse effects. In cases where researchers are not able to conduct AEP testing during other veterinary procedures, more handling and restraint will be required. However, given the short duration of this handling (approximately two hours maximum), the fact that it will be observed, directed, and stopped at any sign of adverse impacts by the stranding response coordinator or veterinarian onsite, and that in context of a stranded or rehabilitation animal such handling will be very minor compared to the handling that would be required to respond to the stranding or for rehabilitation, we find such effects on ESA-listed cetaceans to be extremely minor and insignificant. Given the non-invasive nature of the suction-cups, which will be applied and removed solely by hand, we anticipate minimal response to suction-cup attachments. While inflammation and hyperemia can result from the suction-cups, such responses will be short term and minimal. While the physical contact of the suction-cups can elicit a very minor behavioral or stress response, we find this highly unlikely given that individuals will either already be stranded or in a rehabilitation facility where substantial physical contact for other reasons is likely.

Needle electrodes will pierce the skin and thus may cause pain, infection, or even injury. However, the diameter of the largest needle electrodes are small compared to currently accepted procedures for tissue biopsy and tagging of large cetaceans, and will result in no more than minor discomfort and no risk of injury beyond that caused by the needle insertion. Some minor pain may be expected from the needles, but prior researchers have noted that the use needle electrodes in clinical settings on odontocetes have shown no response upon insertion. Due to the small gauge of the needles and the sterilization procedures required, infection and injury are extremely unlikely to occur and thus discountable. While needle electrode breakage is possible, we find such breakage to be highly unlikely given that needles will not penetrate the blubber-muscle interface where shearing forces that can lead to breakage occur. Based on these factors, we expect that adverse effects from needle electrodes will be insignificant. While the playback of an acoustic stimuli can result in both a behavioral and physiological response, the stimuli that will be used by researchers will be below the thresholds that will be expected to produce a TTS or PTS in the target animals. While a behavioral or stress response such as a startle response, small movement, change in respiration, or elevation of stress hormones is possible, such responses are rare and will be very short term and minor in the overall context of a stranding or the rehabilitation of an animal. Finally, we do not anticipate any response to the recording of the AEP tests since this simply involves recording the animal's natural response via already attached instrumentation.

AEP testing has been conducted on several marine mammal species without any documented adverse effects (Castellote et al. 2014; Mooney et al. 2008; Mooney et al. 2012; Szymanski et al. 1999; Szymanski et al. 1998; Yuen et al. 2005). Several stranded cetaceans that were tested with AEP tests under permits issued to the NMFS' Marine Mammal Health and Stranding Response Program; 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 test procedure. Thus, we do not anticipate the unique stressors associated with AEP tests to affect the fitness of individuals. The potential for equipment and sound sources associated with AEP tests to come in direct contact with ESA-listed pinnipeds, marine reptiles, fishes, marine invertebrates, and marine plants is highly unlikely and considered discountable. Therefore, we conclude that this stressor (AEP tests) may affect, but is not likely to adversely affect ESA-listed cetaceans, pinnipeds, marine reptiles, fishes, marine invertebrates, and marine plants, and will not be carried forward in this consultation.

6.2.1.4 Remote Ultrasound

The frequency of the remote ultrasound's active acoustic component is above the generalized hearing range of marine mammals and will have no effect on ESA-listed cetaceans and pinnipeds. Remote ultrasound will occur during vessel surveys as mentioned in the proposed action and may affect ESA-listed cetaceans in the action area. Potential stressors associated with remote ultrasound include close approaches during vessel sureys (described above). A very close approach is required for these research and enhancement activities, and so we anticipate the previously mentioned responses to a very close approach including momentary changes in swimming speed an orientation, diving, surface and foraging behavior, and respiratory patterns. The remote ultrasound does require a brief direct contact with an animal by using a long pole with an instrument attached near the animal from a research vessel, which presents the additional stressor of interaction with scientific equipment, but the contact is only expected to last for seconds. Moore et al. (2001) safely used the acoustic system on North Atlantic right whales. This procedure will not result in skin breakage, and therefore we do not expect any potential for serious injury or long-term effects. Direct contact is unlikely to cause injury, although it can produce a short to mid-term response (but will not significantly disrupt the normal behavioral pattern of cetaceans to an extent that will creat the likelihood of injury) in a similar way as decribed for initial suction-cup tag attachment. We do not anticipate any effects to the fitness of individuals. The effects that may result from potential stressors from remote ultrasound on ESA-listed cetaceans are considered insignificant. The potential for equipment from remote ultrasound to come in direct contact with ESA-listed pinnipeds, marine reptiles, fishes, marine invertebrates, and marine plants is highly unlikely and considered discountable. Therefore, we conclude that this stressor (remote ultrasound) may affect, but is not likely to adversely affect ESA-listed cetaceans, pinnipeds, marine reptiles, fishes, marine invertebrates, and marine plants, and will not be carried forward in this consultation.

6.2.2 Biological Sampling

Biological sampling is composed of a variety of research methods including breath, fecal, sloughed skin, skin, prey, environmental DNA, and biopsy sampling. Biopsy sampling is discussed in greater detail below in Section 11.4.2. All other biological sampling research methods are discussed below.

All forms of biological sampling (breath, fecal, skin, sloughed skin, prey, and environmental DNA sampling) are through research and enhancement activities directed at cetaceans.

6.2.2.1 Biopsy Sampling

Potential stressors associated with biopsy sampling include close approaches during vessel surveys (described above) and other directed at cetaceans such as direct animal contact, minor puncture wounds, and tissue collection (see Section 11). The potential for darts from biopsy sampling to come in direct contact with ESA-listed pinnipeds, marine reptiles, fishes, marine invertebrates, and marine plants is highly unlikely and considered discountable. Therefore, we conclude that this stressor (biopsy sampling) may affect, but is not likely to aversely affect ESA-listed pinnipeds, marine reptiles, fishes, marine invertebrates, and marine plants, and will not be carried forward in this consultation.

6.2.2.2 Breath Sampling

Exhaled breath sampling is mainly designed for cetaceans and will occur during aerial and vessel surveys. Potential stressors associated with breath sampling include close approaches during aerial and vessel surveys (described above). A very close approach is required for these research activities, and so we anticipate the previously mentioned responses to a very close approach including momentary changes in swimming speed and orientation, diving, surface and foraging behavior, and respiratory patterns. In addition, since sampling equipment will extend below the unmanned aerial system or from a long pole over and above the animal, it is possible that this activity may present the additional stressor of interaction with (i.e., direct contact) scientific equipment. Given that this is a relatively new technique, few data exist on the impacts of breath sampling on cetaceans, including possible interaction with breath sampling equipment. However, the technique was deliberately developed to provide an entirely non-invasive way to biologically sample free-ranging cetaceans with minimal impact (Hunt et al. 2013). We anticipate that researchers will make every effort not to contact animals, as doing so will result in contamination or possible loss of their sample or equipment. Furthermore, even if a cetacean were to contact the sampling equipment, it is unlikely to cause injury, although it can produce a response in a similar way as described for the initial suction-cup tag attachment. While we do not anticipate any contact between the breath sampling equipment and the animal, and thus no response from cetaceans to breath sampling, even if there were to be contact, we do not anticipate any effects to the fitness of individuals. The effects that may result from potential for equipment from breath sampling to come in direct contact with ESA-listed pinnipeds, marine reptiles, fishes, marine invertebrates, and marine plants is highly unlikely and considered discountable. Therefore, we conclude that this stressor (breath sampling) may affect, but is not likely to adversely affect ESA-listed cetaceans, pinnipeds, marine reptiles, fishes, marine invertebrates, and marine plants, and will not be carried forward in this consultation.

6.2.2.3 Fecal Sampling

Fecal sampling will occur during vessel surveys as mentioned in the proposed action and may affect ESA-listed cetaceans in the action area. Potential stressors associated with fecal sampling include those described above for vessel surveys. Fecal sampling is not expected to occur where cetaceans are, but rather in the path previously traveled by cetaceans. No approach to cetaceans will be made and the possibility that a cetacean surfaces at the same time and place as the fecal sample collection is remote. Nevertheless, if a cetacean were to approach researchers collecting a fecal sample, the sampling net or bag may present a stressor if the cetacean were to interact with (i.e., direct contact) it. However, if a cetacean were to come near the net or bag, given its small size and form, it is very unlikely to injure the cetacean. Also, we anticipate that researchers will make every effort not to contact animals, as doing so will result in possible loss of their sample or equipment. Furthermore, even if the fecal sampling equipment were to contact a cetacean, it is unlikely to cause injury, although it can produce a response in a similar way as described for initial suction-cup tag attachment. While, we do not anticipate any contact between the fecal sampling equipment and the animal, and thus no response from cetaceans to fecal sampling, even if there were to contact, we do not anticipate any effects to the fitness of individuals. The effects that may result from potential stressors from fecal sampling on ESA-listed cetaceans are considered insignificant and/or discountable. The potential for equipment from fecal sampling to come in direct contact with ESA-listed pinnipeds, marine reptiles, fishes, marine invertebrates, and marine plants is highly unlikely and considered discountable. Therefore, we conclude that this stressor (fecal sampling) may affect, but is not likely to adversely affect ESA-listed cetaceans, pinnipeds, marine reptiles, fishes, marine invertebrates, and marine plants, and is will not be carried forward in this consultation.

6.2.2.4 Prey Sampling

Prey sampling will occur during vessel surveys as mentioned in the proposed action and may affect ESA-listed cetaceans within the action area. Prey sampling is not expected to occur where cetaceans are, but rather in the path previously traveled by cetaceans. Researchers typically observe cetaceans during vessel surveys at distances of 50 to 100 meters (164 to 328.1 feet) from small researchvessels. If evidence of a predation is observed, the researcher will approach the sampling area and collect biological samples using a small, fine mesh, long-handled dip net, or small containers for collection of water samples. No approach to cetaceans will be made during collection of samples of prey and the possibility that a cetacean surfaces at the same time and place as the prey sample collection is remote. Nevertheless, if a cetacean were to approach researchers collecting a prey sample, the sampling net or container may present a stressor if the cetacean were to interact with (i.e., direct contact) it. However, if a cetacean were to come near the net or container, given its small size and form, it is very unlikely to injure the cetacean. Also, we anticipate that researchers will make every effort not to contact animals, as doing so will result in possible loss of their sample or equipment. Furthermore, even if the prey sampling equipment were to contact a cetacean, it is unlikely to cause injury, although it can produce a response in a similar way as described for initial suction-cup tag attachment. While we do not anticipate any contact between the fecal sampling equipment and the animal, and thus no response from cetaceans to prey sampling, even if there were to be contact, we do not antiipcate any effects to the fitness of individuals. The effects that may result from potential stressors from prey sampling on ESA-listed cetaceans are considered insignficiant and/or discountable. The potential for equipment from prey sampling to come in direct contact with ESA-listed pinnipeds, marine reptiles, fishes, marine invertebrates, and marine plants is highly unlikely and considered discountable. Therefore, we conclude that this stressor (prey sampling) may affect, but is not likely to adversely affect ESA-listed cetaceans, pinnipeds, marine reptiles, fishes, marine invertebrates, and marine plants, and will not be carried forward in this consultation.

6.2.2.5 Sloughed Skin Sampling

Sloughed skin sampling will occur during vessel surveys as mentioned in the proposed action and may affect ESA-listed cetaceans within the action area. Potential stressors associated with sloughed skin sampling include those described above for vessel surveys. Sloughed skin sampling is not expected to occur where cetaceans are, but rather in the path previously traveled by cetaceans. No approach to cetaceans will be made and the possibility that a cetacean surfaces at the same time and place as the sloughed skin sample collection is remote. Nevertheless, if a cetacean were to approach researchers collecting a sloughed skin sample, the sampling net may present a stressor if the cetacean were to interact with (i.e., direct contact) it. However, if a cetacean were to come near the net, given its small size and form, it is very unlikely to injure the cetacean. Also, we anticipate that researchers will make every effort not to contact animals, as doing so will result in possible loss of their sample or equipment. Furthermore, even if the sloughed skin sampling equipment were to contact a ceteacean, it is unlikely to cause injury, although it can produce a response in a similar way as described for initial suction-cup tag attachment. While, we do not anticipate any contact between the sloughed skin sampling equipment and the animal, and thus no response from cetaceans to sloughed skin sampling, even if there were to be contact, we do not anticipate any effects to the fitness of individuals. The effects that may result from potential stressors from sloughed skin sampling on ESA-listed cetaceans are considered insignificant and/or discountable. The potential for equipment from sloughed skin sampling to come in direct contact with ESA-listed pinnipeds, marine reptiles, fishes, marine invertebrates, and marine plants is highly unlikely and considered discountable. Therefore, we conclude that this stressor (sloughed skin sampling) may affect, but is not likely to adversely affect ESA-listed cetaceans, pinnipeds, marine reptiles, fishes, marine invertebrates, and marine plants, and will not be carried forward in this consultation.

6.2.2.6 Skin Sampling

Skin sampling has been safely used on cetaceans with no adverse effect (Harlin et al. 1999). Skin sampling will occur during vessel surveys as mentioned in the proposed action and may affect ESA-listed cetaceans in the action area. Potential stressors associated with skin sampling include close approaches during vessel surveys (described above). A very close approach is required for these research and enhancement activities, and so we anticipate the previously mentioned responses to a very close approach including momentary changes in swimming speed an orientation, diving, surface and foraging behavior, and respiratory patterns. The skin sample collection does require a brief direct contact with an animal by using a long pole with a sampling swab or scrub pad over and above the animal from a research vessel, which presents the additional stressor of interaction with scientific equipement, but the contact is only expected to last for seconds.

The sampling swab or scrub pad is sterile and will not contain any hazardous materials. This procedure will not result in skin breakage, and therefore we do not expect any potential for serious injury or long-term effects. Direct contact is unlikely to cause injury, although it can produce a short to mid-term response (but will not significantly disrupt the normal behavioral pattern of cetaceans to an extent that will create the likelihood of injury) in a similar way as described for the initial suction-cup tag attachment. We do not anticipate any effects to the fitness of individuals. The effects that may result from potential stressors from skin sampling on ESA-listed cetaceans are considered insignificant. The potential for equipment from skin sampling to come in direct contact with ESA-listed pinnipeds, marine reptiles, fishes, marine invertebrates, and marine plants is highly unlikely and considered discountable. Therefore, we conclude that this stressor (skin sampling) may affect, but is not likely to adversely affect ESA-listed cetaceans, pinnipeds, marine reptiles, fishes, marine invertebrates, and marine plants, and will not be carried forward in this consultation.

6.2.2.7 Environmental Deoxyribonucleic Acid Sampling

Environmental DNA sampling will occur during vessel surveys as mentioned in the proposed action and may affect ESA-listed cetaceans within the action area.

Water samples may be collected for environmental DNA analysis to genetically detect the presence of a species, or taxonomic group, in a habitat. Collecting environmental DNA samples in the presence of a particular species can be used to validate the method and allows researchers to sample other areas where the species has not been observed or is known to occur. Environmental DNA sampling is not expected to occur where cetaceans are, but may occur in the path previously traveled by cetaceans. Researchers may approach within their vicinity (91.4 meters [100 yards] for mysticetes and sperm whales, 45.7 meters [50 yards] for smaller cetacean species).

No approach to cetaceans will be made during collection of environmental DNA samples and the possibility that a cetacean surfaces at the same time and place as the water sample collection is remote. Nevertheless, if a cetacean were to approach researchers collecting an environmental DNA sample, the sampling equipment may present a stressor if the cetacean were to interact with (i.e., direct contact) with it. However, if a cetacean were to come near the equipment, given its small size and form, it is very unlikely to injure the cetacean. Also, we anticipate that researchers will make every effort not to contact animals, as doing so will result in possible loss of their sample or equipment. Furthermore, even if the sampling equipment were to contact a cetacean, it is unlikely to cause injury, although it can produce a response in a similar way as described for initial suction-cup tag attachment. While we do not anticipate any contact between the environmental DNA sampling equipment and the animal, and thus no response from cetaceans to environmental DNA sampling, even if there were to be contact, we do not ancipate any effects to the fitness of individuals. The effects that may result from potential stressors from environmental DNA sampling on ESA-listed cetaceans are considered insignificant and/or discountable. The potential for equipment from environmental DNA samping to come in direct contact with ESA-listed pinnipeds, marine reptiles, fishes, marine invertebrates, and marine plants is highly unlikely anc considered discountable. Therefore, we conclude that this stressor (environmental DNA sampling) may affect, but is not likely to adversely affect ESA-listed cetaceans, pinnipeds, marine reptiles, fishes, marine invertebrates, and marine plants, and will not be carried forward in this consultation.

6.2.3 Tagging

Potential stressors associated with tagging include close approaches during vessel surveys (described above) and other directed at cetaceans such as direct animal contact, initial attachment of the tag, and the continued attachment of tags (such as puncture wounds) (see Section 11). The potential for projectiles and tags from tagging to come in direct contact with ESA-listed pinnipeds, marine reptiles, fishes, marine invertebrates, and marine plants is highly unlikely and considered discountable. Therefore, we conclude that this stressor (tagging) may affect, but is not likely to adversely affect ESA-listed pinnipeds, marine reptiles, fishes, marine invertebrates, and marine plants, and will not be carried forward in this consultation.

6.2.4 Import/Export and Salvage of Carcass, Parts, or Tissues

We have determined the import and export of materials from ESA-listed cetacean species will have no effect on cetacean populations in the wild and discussion of these research and enhancement activities will not be carried forward in this consultation. The salvage of carcass, parts, or tissues has the potential for live animals to be unintentionally disturbed during collection, and we expect the same responses to ESA-listed species as described above for close approach. Therefore, we conclude that effects from theis stressor (import/export and salvage of carcass parts, or tissues) are insignificant and may effect but are not likely to adversely affect ESA-listed cetaceans, pinnipeds, marine reptiles, fishes, marine invertebrates, and marine plants and will not be carried forward in this consultation.

6.2.5 Captive Studies

Directed research and enhancement activities on cetaceans at rehabilitation or public display facilities can provide valuable scientific information about ESA-listed cetaceans in the wild without impacting animals in the wild. We expect that any effects to captive animals will be the same as those described above for wild animals and because these animals are confined in their respective facilities and may not be released to the wild, negative impacts to the species are limited to the individual animals at the facilities. Any research and enhancement activities on captive animals will be conducted under the supervision of the attending veterinarian in APHIS-approved facilities. Therefore, we conclude that effects from this stressor (captive studies) are insignificant and/or discountable and may affect but are not likely to adversely affect ESA-listed cetaceans, and will not be carried forward in this consultation.

6.3 Stressors Likely to Adversely Affect Endangered Species Act-Listed Species

The potential stressors associated with the proposed action that are likely to adversely affect ESA-listed cetaceans include active acoustic playbacks, biopsy sampling, and tagging. These potential stressors are further analyzed and evaluated in Section 11 below.

7 Species and Critical Habitat Not Likely to be Adversely Affected

This section identifies the ESA-listed species under NMFS jurisdiction that may occur within the action area (as described in Section 5) that are not likely to be adversely affected by the proposed action. NMFS uses two criteria to identify the ESA-listed species or critical habitat that are not likely to be adversely affected by the proposed action, as well as the effects of activities that are interrelated to or interdependent with the Federal agency’s 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 critical habitat is not likely to be adversely affected by those activities.

The second criterion is the probability of a response given exposure. ESA-listed species or designated critical habitat that is exposed to a potential stressor but is likely to be unaffected by the exposure is also not likely to be adversely affected by the proposed action. We applied these criteria to the ESA-listed species in Table 6 and we summarize our results below.

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. Beneficial effects are usually discussed when the project has a clear link to the ESA-listed species or its specific habitat needs and consultation is required because the species may be affected.

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.

Insignificant is the appropriate effect conclusion when plausible effects are going to happen, but will not rise to the level of constituting an adverse effect.

Discountable effects are those that are extremely unlikely to occur. For an effect to be discountable, there must be a plausible adverse effect (i.e., a credible effect that could result from the action and that would be an adverse effect if it did impact an ESA-listed species), but it is very unlikely to occur.

In this section, we evaluate effects to numerous ESA-listed species and proposed or designated critical habitat that may be affected, but are not likely to be adversely affected, by the proposed action. For the ESA-listed species, we focus specifically on stressors associated with the NMFS Permits and Conservation Division's proposed implementation of a program for the issuance permits for research and enhancement activities on cetaceans and their effects on these species. The effects of other stressors associated with the proposed action, which are also not likely to adversely affect ESA-listed species, are evaluated in Section 6. The species potentially occurring within the action area that may be affected, but are not likely to be adversely affected, are listed in Table 6, along with their regulatory status, proposed or designated critical habitat, and recovery plan.

Table 6. Endangered Species Act-listed threatened and endangered species and proposed or designated critical habitat potentially occurring in the action area that may be affected, but are not likely to be adversely affected.

Species	ESA Status	Critical Habitat	Recovery Plan
Marine Mammals – Cetaceans			
Gulf of California Harbor Porpoise/Vaquita (*Phocoena sinus*)	E – 50 FR 1056	-- --	-- --
Maui's Dolphin (*Cephalorhynchus hectori maui*)	E - 82 FR 43701	-- --	-- --
Taiwanese Humpback Dolphin (*Sousa chinensis taiwanensis*)	E – 83 FR 21182	-- --	-- --
Marine Mammals – Pinnipeds			
Bearded Seal (*Erignathus barbatus*) – Beringia DPS	T – 77 FR 76739	-- --	-- --
Bearded Seal (*Erignathus barbatus*) – Okhotsk DPS	T – 77 FR 76739	-- --	-- --
Guadalupe Fur Seal (*Arctocephalus townsendi*)	T – 50 FR 51252	-- --	-- --
Hawaiian Monk Seal (*Neomonachus schauinslandi*)	E – 41 FR 51611	80 FR 50925	72 FR 46966 2007

Species	ESA Status	Critical Habitat	Recovery Plan
Mediterranean Monk Seal (*Monachus monachus*)	E – 35 FR 8491	-- --	-- --
Ringed Seal (*Phoca hispida hispida*) – Arctic Subspecies	T – 77 FR 76706 Currently vacated, but listing will be reinstated	79 FR 73010 (Proposed)	-- --
Ringed Seal (*Phoca hispida botnica*) – Baltic Subspecies	T – 77 FR 76706	-- --	-- --
Ringed Seal (*Phoca hispida ochotensis*) – Okhotsk Subspecies	T – 77 FR 76706	-- --	-- --
Spotted Seal (*Phoca largha*) – Southern DPS	T – 75 FR 65239	-- --	-- --
Steller Sea Lion (*Eumetopias jubatus*) – Western DPS	E – 55 FR 49204	58 FR 45269	73 FR 11872 12/1992 03/2008
Marine Reptiles			
Dusky Sea Snake (*Aipysurus fuscus*)	E – 80 FR 60560	-- --	-- --
Green Turtle (*Chelonia mydas*) – Central North Pacific DPS	T – 81 FR 20057	-- --	63 FR 28359 01/1998
Green Turtle (*Chelonia mydas*) – Central South Pacific DPS	E – 81 FR 20057	-- --	63 FR 28359 01/1998
Green Turtle (*Chelonia mydas*) – Central West Pacific DPS	E – 81 FR 20057	-- --	63 FR 28359 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 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	FR Not Available 10/1991 – U.S. Atlantic
Green Turtle (*Chelonia mydas*) – North Indian DPS	T – 81 FR 20057	-- --	-- --
Green Turtle (*Chelonia mydas*) – South Atlantic DPS	T – 81 FR 20057	-- --	-- --

Species	ESA Status	Critical Habitat	Recovery Plan
Green Turtle (*Chelonia mydas*) – Southwest Indian DPS	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	57 FR 38818 08/1992 – U.S. Caribbean, Atlantic, and Gulf of Mexico 63 FR 28359 05/1998 – U.S. Pacific
Kemp's Ridley Turtle (*Lepidochelys kempii*)	E – 35 FR 18319	-- --	09/1991 – U.S. Caribbean, Atlantic, and Gulf of Mexico 09/2011
Leatherback Turtle (*Dermochelys coriacea*)	E – 35 FR 8491	44 FR 17710 77 FR 4170	10/1991 – U.S. Caribbean, Atlantic, and Gulf of Mexico 63 FR 28359 05/1998 – U.S. Pacific
Loggerhead Turtle (*Caretta caretta*) – Mediterranean Sea DPS	E – 76 FR 58868	-- --	-- --
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	-- --	-- --

Species	ESA Status	Critical Habitat	Recovery Plan
Loggerhead Turtle (*Caretta caretta*) – Northwest Atlantic Ocean DPS	T – 76 FR 58868	79 FR 39856	74 FR 2995 10/1991 – U.S. Caribbean, Atlantic, and Gulf of Mexico 05/1998 – U.S. Pacific 01/2009 – Northwest Atlantic
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/Not Mexico's Pacific Coast Breeding Colonies	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 (*Latimeria 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 39903	70 FR 75473 and 81 FR 18639 (Draft) 11/2005 03/2016 (Draft)
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	-- --

Species	ESA Status	Critical Habitat	Recovery Plan
Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) – South Atlantic DPS	E – 77 FR 5913	82 FR 39160	-- --
Banggai Cardinalfish (*Pterapogon kauderni*)	T – 81 FR 3023	-- --	-- --
Blackchin Guitarfish (*Rhinobatos cemiculus*)	T – 82 FR 6309	E – 82 FR 21722	-- --
Bocaccio (*Sebastes paucispinis*) – Puget Sound/Georgia Basin DPS	E – 75 FR 22276 and 82 FR 7711	79 FR 68041	81 FR 54556 (Draft) 10/2017
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
Chinook Salmon (*Oncorhynchus tshawytscha)* – Snake River Fall-Run ESU	T – 70 FR 37160	58 FR 68543	80 FR 67386 (Draft)
Chinook Salmon (*Oncorhynchus tshawytscha)* – Snake River Spring/Summer Run ESU	T – 70 FR 37160	64 FR 57399	81 FR 74770 (Draft)
Chinook Salmon (*Oncorhynchus tshawytscha)* – Upper Columbia River Spring-Run ESU	E – 70 FR 37160	70 FR 52629	72 FR 57303
Chinook Salmon (*Oncorhynchus tshawytscha)* – Upper Willamette River ESU	T – 70 FR 37160	70 FR 52629	76 FR 52317
Chum Salmon (*Oncorhynchus keta*) – Columbia River ESU	T – 70 FR 37160	70 FR 52629	78 FR 41911
Chum Salmon (*Oncorhynchus keta*) – Hood Canal Summer-Run ESU	T – 70 FR 37160	70 FR 52629	72 FR 29121

Species	ESA Status	Critical Habitat	Recovery Plan
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	2010 (Outline)
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	-- --	-- --
Oceanic Whitetip Shark (*Carcharhinus longimanus*)	T – 83 FR 4153	-- --	-- --

Species	ESA Status	Critical Habitat	Recovery Plan
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	-- --	-- --
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 12/1998
Smalltooth Sawfish (*Pristis pectinata*) – U.S. Portion of Range DPS	E – 68 FR 15674	74 FR 45353	74 FR 3566 01/2009
Smalltooth Sawfish (*Pristis pectinata*) – Non-U.S. Portion of Range DPS	E - 79 FR 73977	-- --	-- --
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 Angel Shark (*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

Species	ESA Status	Critical Habitat	Recovery Plan
Steelhead Trout (*Oncorhynchus mykiss*) – Puget Sound DPS	T – 72 FR 26722	81 FR 9251	-- --
Steelhead Trout (*Oncorhynchus mykiss*) – Snake River Basin DPS	T – 71 FR 834	70 FR 52629	81 FR 74770 (Draft)
Steelhead Trout (*Oncorhynchus mykiss*) – South-Central California Coast DPS	T – 71 FR 834	70 FR 52487	78 FR 77430
Steelhead Trout (*Oncorhynchus mykiss*) – Southern California DPS	E – 71 FR 834	70 FR 52487	77 FR 1669
Steelhead Trout (*Oncorhynchus mykiss*) – Upper Columbia River DPS	T – 71 FR 834	70 FR 52629	72 FR 57303
Steelhead Trout (*Oncorhynchus mykiss*) – Upper Willamette River DPS	T – 71 FR 834	70 FR 52629	76 FR 52317
Striped Smoothhound Shark (*Mustelus fasciatus*)	E – 82 FR 21722	-- --	-- --
Totoaba (*Totoaba macdonaldi*)	E – 44 FR 29478	-- --	-- --
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	-- --	-- --
Acropora jacquelineae Coral	T – 79 FR 53851	-- --	-- --
Acropora lokani Coral	T – 79 FR 53851	-- --	-- --
Acropora pharaonis Coral	T – 79 FR 53851	-- --	-- --
Acropora retusa Coral	T – 79 FR 53851	-- --	-- --
Acropora rudis Coral	T – 79 FR 53851	-- --	-- --
Acropora speciosa Coral	T – 79 FR 53851	-- --	-- --
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	-- --
Boulder Star Coral (*Orbicella franksi*)	T – 79 FR 53851	-- --	-- --
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	-- --	-- --

Species	ESA Status	Critical Habitat	Recovery Plan
Isopora crateriformis Coral	T – 79 FR 53851	-- --	-- --
Lobed Star Coral (*Orbicella annularis*)	T – 79 FR 53851	-- --	-- --
Montipora australiensis Coral	T – 79 FR 53851	-- --	-- --
Mountainous Star Coral (*Orbicella faveolata*)	T – 79 FR 53851	-- --	-- --
Rough Cactus Coral *(Mycetophyllia ferox)*	T – 79 FR 53851	-- --	-- --
Pavona diffluens Coral	T – 79 FR 53851	-- --	-- --
Pillar Coral (*Dendrogyra cylindrus*)	T – 79 FR 53851	-- --	-- --
Porites napopora Coral	T – 79 FR 53851	-- --	-- --
Seriatopora aculeata Coral	T – 79 FR 53851	-- --	-- --
Siderastrea glynni Coral	E – 80 FR 60560	-- --	-- --
Staghorn Coral (*Acropora cervicornis*)	T – 79 FR 53851	73 FR 72210	80 FR 12146
Tubastraea floreana Coral	E – 80 FR 60560	-- --	-- --
White Abalone (*Haliotis sorenseni*)	E – 66 FR 29046	66 FR 29046 (Not Prudent)	73 FR 62257
Marine Plants			
Johnson's Seagrass (*Halophila johnsonii*)	T – 63 FR 49035	65 FR 17786	67 FR 62230

DPS=Distinct Population Segment
ESU=Evolutionarily Significant Unit
E=Endangered
T=Threatened

7.1 Endangered Species Act-Listed Cetaceans

The proposed action spatially and temporally overlaps with several ESA-listed cetacean species (see Table 6) including the Gulf of California harbor porpoise/vaquita, Maui's dolphin, and Taiwanese humpback dolphin. These species occur in the foreign waters of Mexico, New Zealand, and Taiwan, respectively. A limited number of researchers may conduct research and enhancement activities in International and foreign waters worldwide and these ESA-listed cetacean species may be exposed to potential stressors described in Section 6. Under the cetacean research permitting program, directed takes under the ESA or MMPA cannot be authorized for the Gulf of California harbor porpoise/vaquita, Maui's dolphin, and Taiwanese humpback dolphin as they occur entirely in foreign waters. Researchers will not purposefully approach or pursue these ESA-listed species if encountered and will stop research and enhancement activities and move to another area or wait until they have left the area if any of these ESA-listed cetacean species are observed.

In summary, these ESA-listed cetaceans not likely to be adversely affected by the proposed action are those which occur entirely within foreign waters. No directed takes of these species are considered under the proposed action. While there is the potential for these species to be affected by the potential stressors discussed in Section 6 are possible, we believe the potential impacts to these ESA-listed cetaceans as a result of the proposed action will be insignificant or discountable. We conclude that the proposed action is not likely to adversely affect ESA-listed Gulf of California harbor porpoise/vaquita, Maui's dolphin, and Taiwanese humpback dolphin. As a result, these species will not be considered further in this consultation.

7.2 Endangered Species Act-Listed Pinnipeds

The proposed action spatially and temporally overlaps with ESA-listed pinniped species and/or DPSs (see Table 6) including the Beringia DPS of bearded seal, Okhotsk DPS of bearded seal, Guadalupe fur seal, Hawaiian monk seal, Mediterranean monk seal, Arctic subspecies of ringed seal, Baltic subspecies of ringed seal, Okhotsk subspecies of ringed seal, Southern DPS of spotted seal, and Western DPS of Steller sea lion. Researchers may encounter ESA-listed pinnipeds during research and enhancement activities targeting cetaceans and request opportunistic takes for research methods that are not expected to result in ESA harassment, but are expected to result in MMPA Level B harassment. The NMFS Permits and Conservation Division has decided that the authorization of unintentional disturbance will be considered on a case-by-case basis under the MMPA during proposed research and enhancement activities. However, interactions with ESA-listed pinnipeds could potentially occur during aerial (manned and unmanned) surveys, vessel surveys, passive acoustic monitoring, active acoustics, biological sampling, and tagging. Under the cetacean research permitting program, non-target ESA-listed pinnipeds may occasionally be present with targeted cetaceans. Researchers will not purposefully approach or pursue these ESA-listed pinnipeds if encountered and will stop research and enhancement activities and move to another area or wait until they have left the area if any of these ESA-listed pinnipeds are observed. The collection of dead parts during prey sampling is not expected to result in the take of live animals.

While there is the potential for these species to be affected by the potential stressors discussed in Section 6 are possible, we believe the potential impacts to ESA-listed pinnipeds as a result of the proposed action will be insignificant or discountable. We conclude that the proposed action is not likely to adversely affect ESA-listed Beringia DPS of bearded seals, Okhotsk DPS of bearded seals, Guadalupe fur seals, Hawaiian monk seals, Mediterranean monk seals, Arctic subspecies of ringed seals, Baltic subspecies of ringed seals, Okhotsk subspecies of ringed seals, Southern DPS of spotted seals, and Western DPS of Steller sea lions. As a result, these species or DPSs will not be considered further in this consultation.

7.3 Endangered Species Act-Listed Marine Reptiles

The proposed action spatially and temporally overlaps with ESA-listed marine reptile (sea snakes and sea turtles) species and/or DPSs (see Table 6) including the Dusky sea snake, Central North Pacific DPS of green turtle, Central South Pacific DPS of green turtle, Central West Pacific DPS of green turtle, East Indian-West Pacific DPS of green turtle, East Pacific DPS of green turtle, North Atlantic DPS of green turtle, South Atlantic DPS of green turtle, Mediterranean DPS of green turtle, North Indian DPS of green turtle, Southwest Indian DPS of green turtle, Southwest Pacific DPS of green turtle, hawksbill turtle, Kemp's ridley turtle, leatherback turtle, Mediterranean Sea DPS of loggerhead turtle, Northeast Atlantic Ocean DPS of loggerhead turtle, Northwest Atlantic Ocean DPS of loggerhead turtle, North Indian Ocean DPS of loggerhead turtle, North Pacific Ocean DPS of loggerhead turtle, South Atlantic Ocean DPS of loggerhead turtle, Southeast Indo-Pacific Ocean DPS of loggerhead turtle, Southwest Indian Ocean DPS of loggerhead turtle, South Pacific Ocean DPS of loggerhead turtle, and Mexico's Pacific Coast breeding colonies as well as all other areas of olive ridley turtle. Under the cetacean research permitting program, non-target ESA-listed marine sea turtles may occasionally be present with targeted cetaceans. Research and enhancement activities that have the potential to disturb marine reptiles 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 these ESA-listed marine reptiles if encountered and will stop research and enhancement activities and move to another area or wait until they have left the area if any of these ESA-listed marine reptiles are observed. Researchers will constantly be on the lookout for cetaceans and thus be able to spot sea turtles (and sea snakes) at a distance (approximately 100 to 200 meters, 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 were 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 (see Section 19.3, Conditions A.2 and B.5af). 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 marine reptile 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 is not expected to have fitness consequences.

While there is the potential for these species to be affected by the potential stressors discussed in Section 6 are possible, we believe the potential impacts to ESA-listed marine reptiles as a result of the proposed action will be insignificant or discountable. We conclude that the proposed action is not likely to adversely affect the Dusky sea snake, Central North Pacific DPS of green turtle, Central South Pacific DPS of green turtle, Central West Pacific DPS of green turtle, East Indian-West Pacific DPS of green turtle, East Pacific DPS of green turtle, North Atlantic DPS of green turtle, South Atlantic DPS of green turtle, Mediterranean DPS of green turtle, North Indian DPS of green turtle, Southwest Indian DPS of green turtle, Southwest Pacific DPS of green turtle, hawksbill turtle, Kemp's ridley turtle, leatherback turtle, Mediterranean Sea DPS of loggerhead turtle, Northeast Atlantic Ocean DPS of loggerhead turtle, Northwest Atlantic Ocean DPS of loggerhead turtle, North Indian Ocean DPS of loggerhead turtle, North Pacific Ocean DPS of loggerhead turtle, South Atlantic Ocean DPS of loggerhead turtle, Southeast Indo-Pacific Ocean DPS of loggerhead turtle, Southwest Indian Ocean DPS of loggerhead turtle, South

Pacific Ocean DPS of loggerhead turtle, and Mexico's Pacific Coast breeding colonies as well as all other areas of olive ridley turtle. As a result, these species or DPSs will not be considered further in this consultation.

7.4 Endangered Species Act-Listed Fish

The proposed action spatially and temporally overlaps with numerous ESA-listed fish species, DPS's, and ESU's of elasmobranchs and bony fishes (see Table 6) including the Tanzanian DPS of African coelacanth, Gulf of Maine DPS of Atlantic salmon, Carolina DPS of Atlantic sturgeon, Chesapeake DPS of Atlantic sturgeon, Gulf of Maine DPS of Atlantic sturgeon, New York Bight DPS of Atlantic sturgeon, South Atlantic DPS of Atlantic sturgeon, blackchin guitarfish, Puget Sound/Georgia Basin DPS of bocaccio, California Coastal ESU of chinook salmon, Central Valley Spring-Run ESU of chinook salmon, Lower Columbia River ESU of chinook salmon, Puget Sound ESU of chinook salmon, Sacramento River Winter-Run ESU of chinook salmon, Snake River Fall-Run ESU of chinook salmon, Snake River Spring/Summer Run ESU of chinook salmon, Upper Columbia River Spring-Run ESU of chinook salmon, Upper Willamette River ESU of chinook salmon, Columba River ESU of chum salmon, Hood Canal Summer-Run ESU of chum salmon, Central California Coast ESU of coho salmon, Lower Columbia River ESU of coho salmon, Oregon Coast ESU of coho salmon, Southern Oregon and Northern California ESU of coho salmon, common angelshark, common guitarfish, daggernose shark, dwarf sawfish, Southern DPS of eulachon, giant manta ray, green sawfish, Southern DPS of green sturgeon, Gulf grouper, Gulf sturgeon, Island grouper, Kaluga sturgeon, largetooth sawfish, narrow sawfish, narrownose smoothhound shark, Nassau grouper, oceanic whitetip shark, Sakhalin sturgeon, sawback angelshark, Central and Southwest Atlantic DPS of scalloped hammerhead shark, Eastern Atlantic DPS of scalloped hammerhead shark, Eastern Pacific DPS of scalloped hammerhead shark, Indo-West Pacific DPS of scalloped hammerhead shark, shortnose sturgeon, U.S. portion of range DPS of smalltooth sawfish, non-U.S. portion of range of smalltooth sawfish, smoothback angelshark, Ozette Lake ESU of sockeye salmon, Snake River ESU of sockeye salmon, spiny angelshark, California Central Valley DPS of steelhead trout, Central California Coast DPS of steelhead trout, Lower Columbia River DPS of steelhead trout, Middle Columbia River DPS of steelhead trout, Northern California DPS of steelhead trout, Puget Sound DPS of steelhead trout, Snake River Basin DPS of steelhead trout, South-Central California Coast DPS of steelhead trout, Southern California DPS of steelhead trout, Upper Columbia River DPS of steelhead trout, Upper Willamette River DPS of steelhead trout, striped smoothhound shark, and Puget Sound/Georgia Basin DPS of yelloweye rockfish. Under the cetacean research permitting program, non-target ESA-listed fishes may occasionally be present with targeted cetaceans. Research and enhancement activities that have the potential to disturb fishes include (aerial (manned and unmanned) surveys, vessel surveys, underwater photography and videography, passive acoustic monitoring, active acoustics, biological sampling, and tagging. Researchers will not purposefully approach or purse these ESA-listed fishes if encountered and will stop research and enhancement activities and move to another area if any of these ESA-listed fishes are observed. In the event a fish 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 is not expected to have fitness consequences.

While there is the potential for these species to be affected by the potential stressors discussed in Section 6 are possible, we believe the potential impacts to ESA-listed fishes.as a result of the proposed action will be insignificant or discountable. We conclude that the proposed action is not likely to adversely affect the Tanzanian DPS of African coelacanth, Gulf of Maine DPS of Atlantic salmon, Carolina DPS of Atlantic sturgeon, Chesapeake DPS of Atlantic sturgeon, Gulf of Maine DPS of Atlantic sturgeon, New York Bight DPS of Atlantic sturgeon, South Atlantic DPS of Atlantic sturgeon, blackchin guitarfish, Puget Sound/Georgia Basin DPS of bocaccio, California Coastal ESU of chinook salmon, Central Valley Spring-Run ESU of chinook salmon, Lower Columbia River ESU of chinook salmon, Puget Sound ESU of chinook salmon, Sacramento River Winter-Run ESU of chinook salmon, Snake River Fall-Run ESU of chinook salmon, Snake River Spring/Summer Run ESU of chinook salmon, Upper Columbia River Spring-Run ESU of chinook salmon, Upper Willamette River ESU of chinook salmon, Columba River ESU of chum salmon, Hood Canal Summer-Run ESU of chum salmon, Central California Coast ESU of coho salmon, Lower Columbia River ESU of coho salmon, Oregon Coast ESU of coho salmon, Southern Oregon and Northern California ESU of coho salmon, common angelshark, common guitarfish, daggernose shark, dwarf sawfish, Southern DPS of eulachon, giant manta ray, green sawfish, Southern DPS of green sturgeon, Gulf grouper, Gulf sturgeon, Island grouper, Kaluga sturgeon, largetooth sawfish, narrow sawfish, narrownose smoothhound shark, Nassau grouper, oceanic whitetip shark, Sakhalin sturgeon, sawback angelshark, Central and Southwest Atlantic DPS of scalloped hammerhead shark, Eastern Atlantic DPS of scalloped hammerhead shark, Eastern Pacific DPS of scalloped hammerhead shark, Indo-West Pacific DPS of scalloped hammerhead shark, shortnose sturgeon, U.S. portion of range DPS of smalltooth sawfish, non-U.S. portion of range of smalltooth sawfish, smoothback angelshark, Ozette Lake ESU of sockeye salmon, Snake River ESU of sockeye salmon, spiny angelshark, California Central Valley DPS of steelhead trout, Central California Coast DPS of steelhead trout, Lower Columbia River DPS of steelhead trout, Middle Columbia River DPS of steelhead trout, Northern California DPS of steelhead trout, Puget Sound DPS of steelhead trout, Snake River Basin DPS of steelhead trout, South-Central California Coast DPS of steelhead trout, Southern California DPS of steelhead trout, Upper Columbia River DPS of steelhead trout, Upper Willamette River DPS of steelhead trout, striped smoothhound shark, and Puget Sound/Georgia Basin DPS of yelloweye rockfish. As a result, these species, DPSs, and ESUs will not be considered further in this consultation.

7.5 Endangered Species Act-Listed Marine Invertebrates

The proposed action spatially and temporally overlaps with ESA-listed marine invertebrate species (see Table 6) including *Acropora globiceps* coral, *Acropora jacquelineae* coral, *Acropora lokani* coral, *Acropora pharaonis* coral, *Acropora retusa* coral, *Acropora rudis* coral, *Acropora speciosa* coral, *Acropora 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, rough cactus coral, *Pavona diffluens* coral, pillar coral, *Porites napopora* coral, *Seriatopora aculeata* coral, *Siderastrea glynni* coral, staghorn coral, *Tubastaea floreana* coral, and white abalone . Under the cetacean research permitting program, non-target ESA-listed marine invertebrates may occasionally be present with targeted cetaceans. Research and enhancement activities that have the potential to disturb marine reptiles include vessel surveys, passive acoustic monitoring, and active acoustics. The possibility of these interactions is considered remote because the proposed research and enhancement activities are directed at cetaceans at the water surface, and thus the proposed action will not adversely affect the benthic habitat or area of the water column where these species generally occur. Researchers will not purposely approach or pursue these ESA-listed marine invertebrates if encountered and will stop research activities and move to another area or wait until they have left the area if any of these ESA-listed marine invertebrates are observed. In the event a marine reptile is exposed to vessel surveys, passive acoustic monitoring, and active acoustics, exposure will likely be brief and temporary and result in short-term behavioral reactions, such as swimming away from the research vessel, which is not expected to have fitness consequences.

While there is the potential for these species to be affected by the potential stressors discussed in Section 6 are possible, we believe the potential impacts to ESA-listed marine invertebrates as a result of the proposed action will be insignificant or discountable. We conclude that the proposed action is not likely to adversely affect *Acropora globiceps* coral, *Acropora jacquelineae* coral, *Acropora lokani* coral, *Acropora pharaonis* coral, *Acropora retusa* coral, *Acropora rudis* coral, *Acropora speciosa* coral, *Acropora 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, rough cactus coral, *Pavona diffluens* coral, pillar coral, *Porites napopora* coral, *Seriatopora aculeata* coral, *Siderastrea glynni* coral, staghorn coral, *Tubastaea floreana* coral, and white abalone. As a result, these species will not be considered further in this consultation.

7.6 Endangered Species Act-Listed Marine Plants

The proposed action spatially and temporally overlaps with one ESA-listed marine plant species, Johnson's seagrass. Johnson's seagrass has been found only along an approximately 200 kilometer (124.3 miles) stretch of coastline in Southeastern Florida between Sebastian Inlet and north Biscayne Bay. Under the cetacean research permitting program, non-target ESA-listed plants may occasionally be present with targeted cetaceans. Research and enhancement activities that have the potential to disturb marine plants include vessel surveys and passive acoustic monitoring. Routine vessel traffic has been shown to result in scarring of some seagrass species. Researchers will not purposely approach or pursue this ESA-listed plant if encountered and will stop research and enhancement activities and move to another area if any ESA-listed marine plants are observed. Researchers conducting research and enhancement activities within areas where this species is found are directed to avoid conducting research activities in Johnson seagrass designated critical habitat when possible, and we expect minimal vessel traffic in these areas where propeller damage can occur.

While there is the potential for these species to be affected by the potential stressors discussed in Section 6 are possible, we believe the potential impacts to ESA-listed marine plants as a result of the proposed action will be insignificant or discountable. We conclude that the proposed action is not likely to adversely affect ESA-listed Johnson's seagrass. As a result, this species will not be considered further in this consultation.

7.7 Proposed or Designated Critical Habitat

The proposed action will take place worldwide and within the EEZ of U.S. waters. The action area includes proposed or designated critical habitat for multiple ESA-listed species (Table 6).

7.7.1 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 (Figure 53). 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).

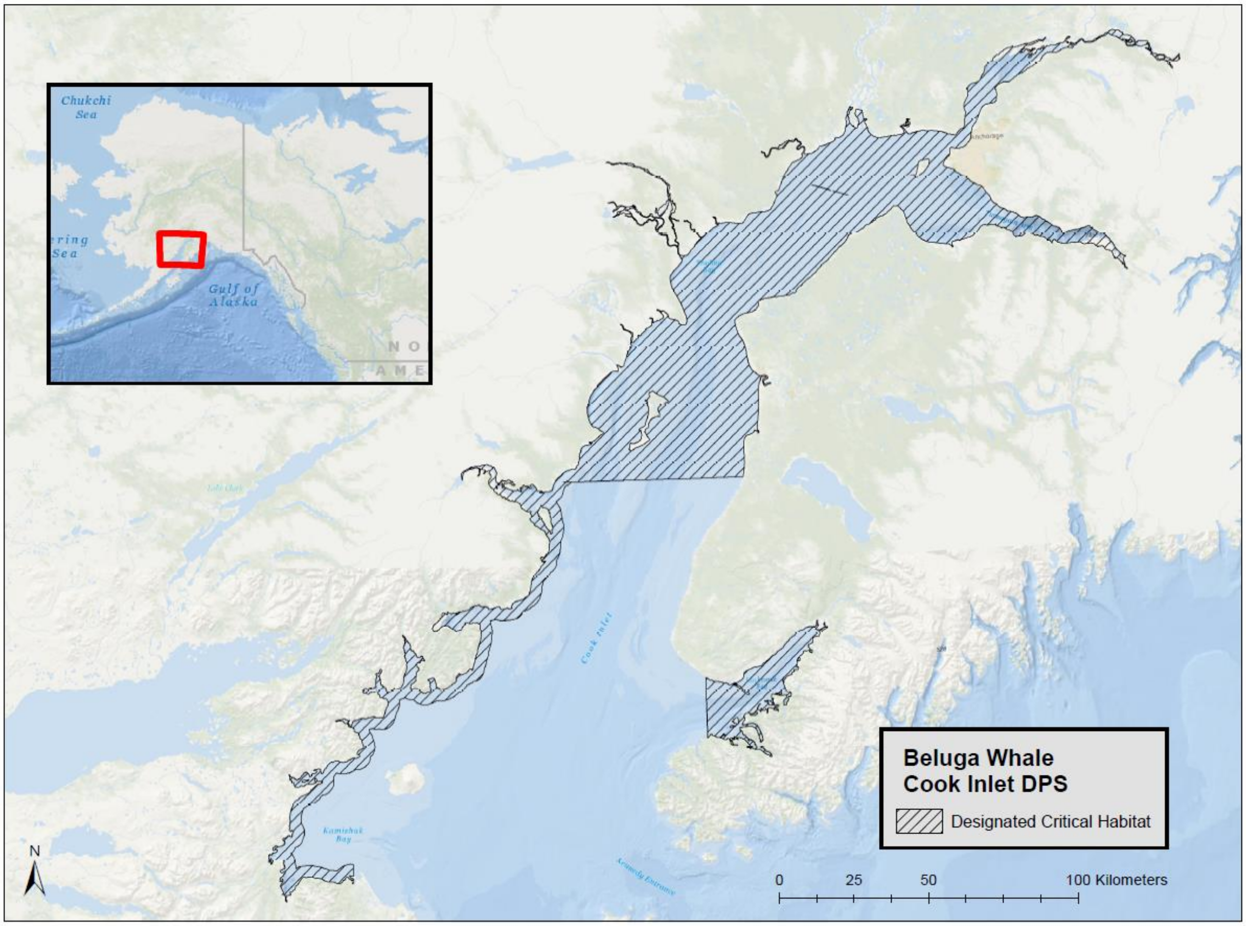

Figure 27. Map identifying the general range and designated critical habitat for the endangered Cook Inlet distinct population segment of beluga whale.

7.7.2 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 (Figure 28). 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.

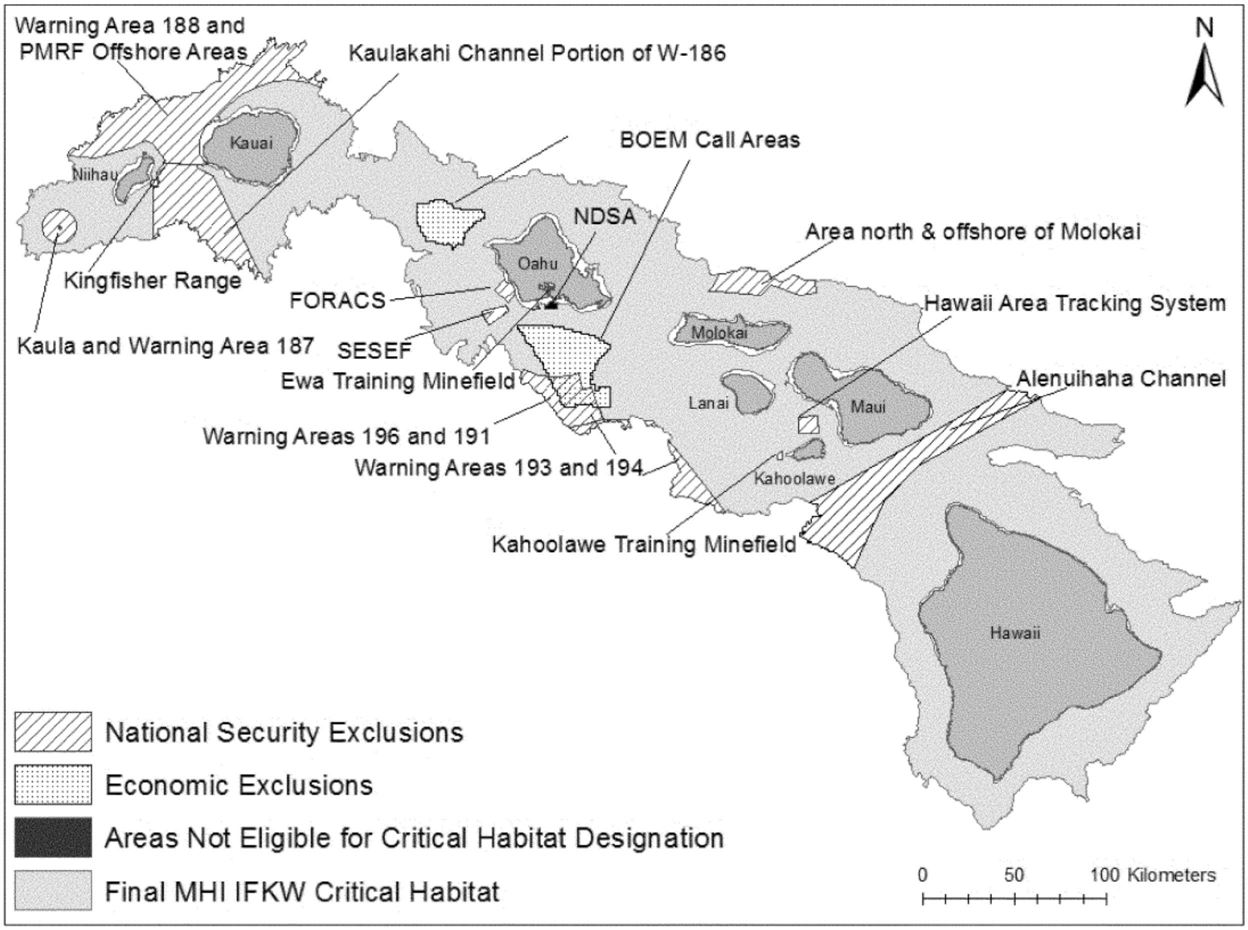

Figure 28. Map identifying designated critical habitat for the endangered Main Hawaiian Islands insular distinct population segment of false killer whale (83 FR 36062).

7.7.3 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). The 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 (Figure 29), which comprise approximately 6,630 square kilometers (1,933 square nautical miles) of marine habitat (Figure 29).

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.

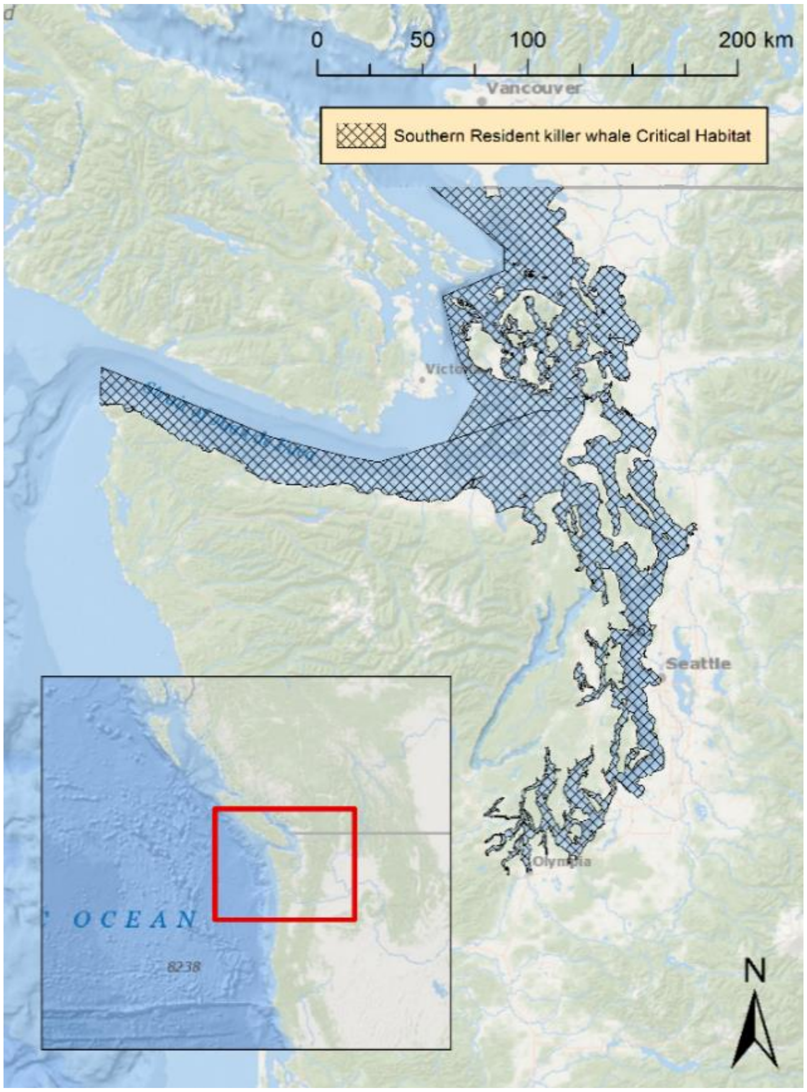

Figure 29. Map identifying designated critical habitat for the endangered Southern Resident distinct population segment of killer whale.

7.7.4 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 (Figure 30 and Figure 31). 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) (Figure 30 and Figure 31).

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).

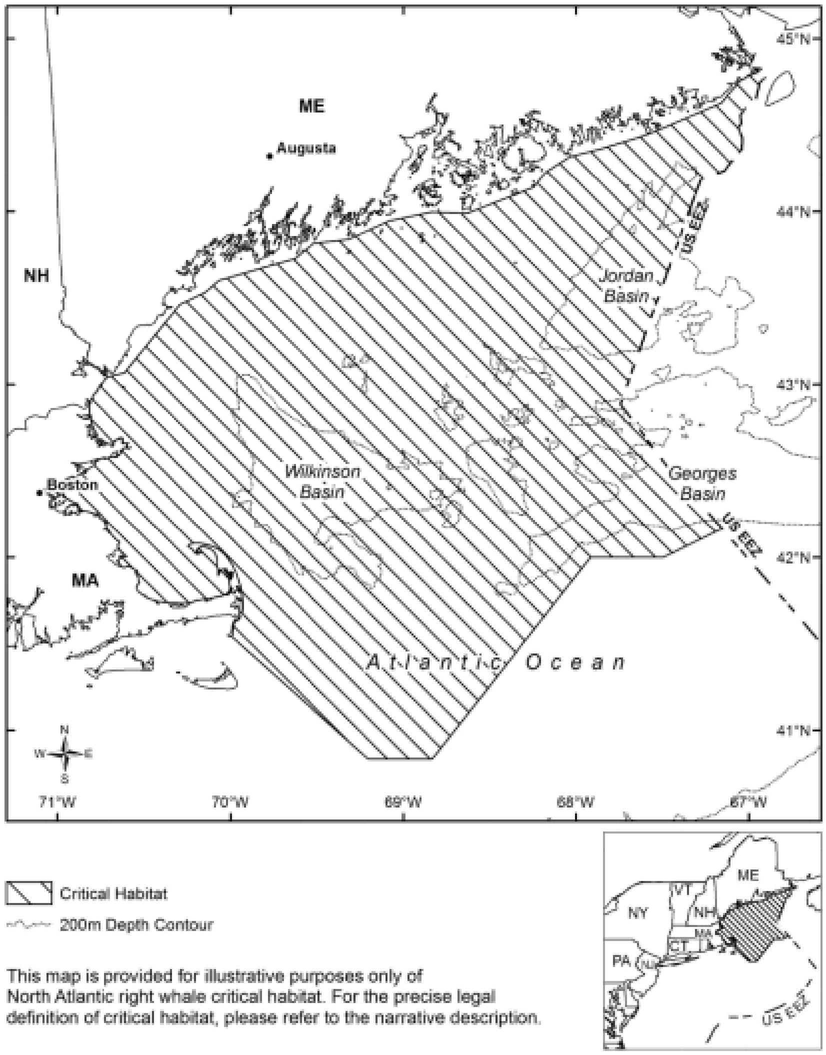

Figure 30. Map identifying designated critical habitat in the northeastern foraging area for the endangered North Atlantic right whale.

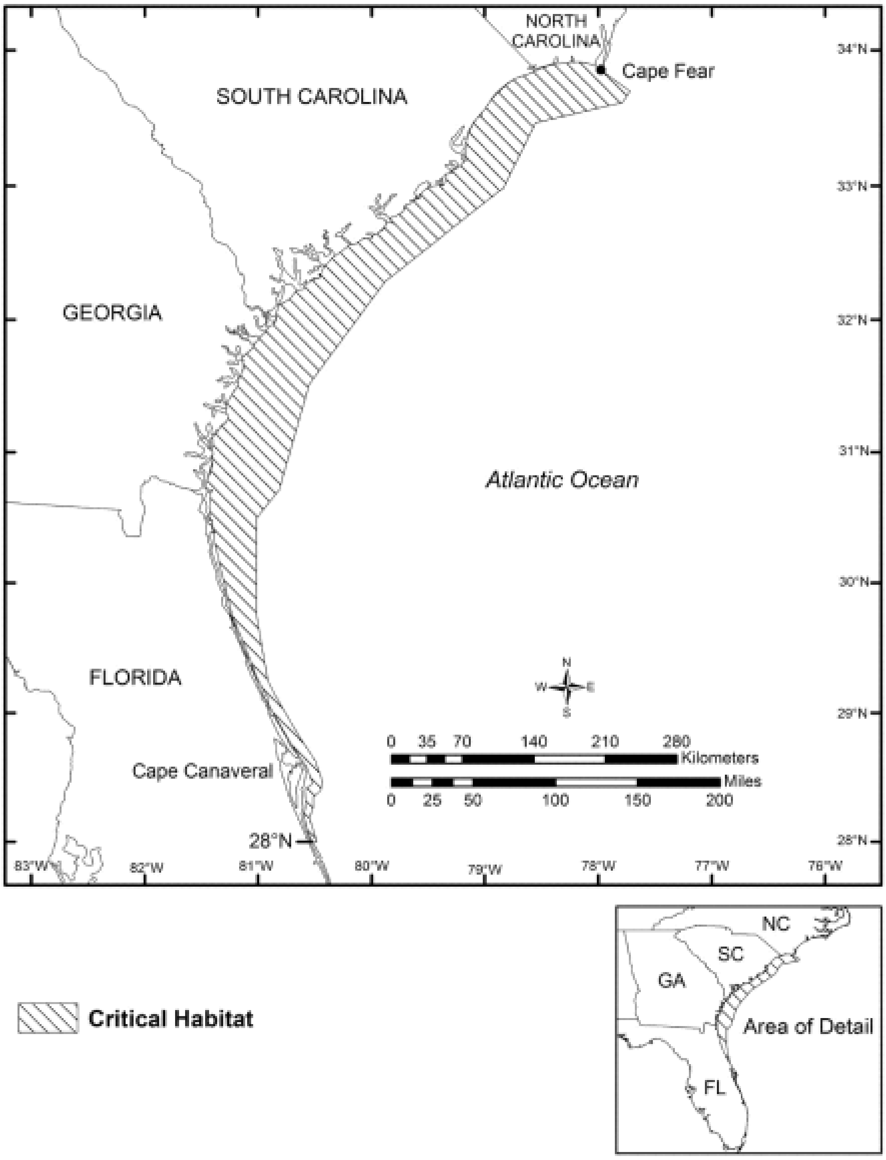

Figure 31. Map identifying designated critical habitat in the southeastern calving area for the endangered North Atlantic right whale.

7.7.5 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 (Figure 32). 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).

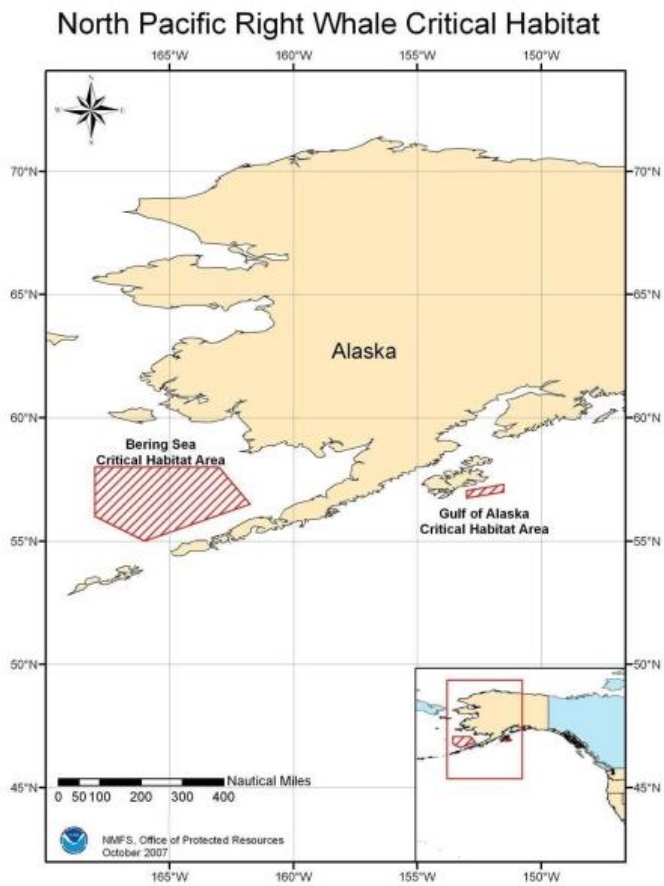

Figure 32. Map identifying designated critical habitat for the endangered North Pacific right whale in the Southeast Bering Sea and south of Kodiak Island in the Gulf of Alaska.

7.7.6 Hawaiian Monk Seal 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 (Figure 33).

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) (Figure 33).

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).

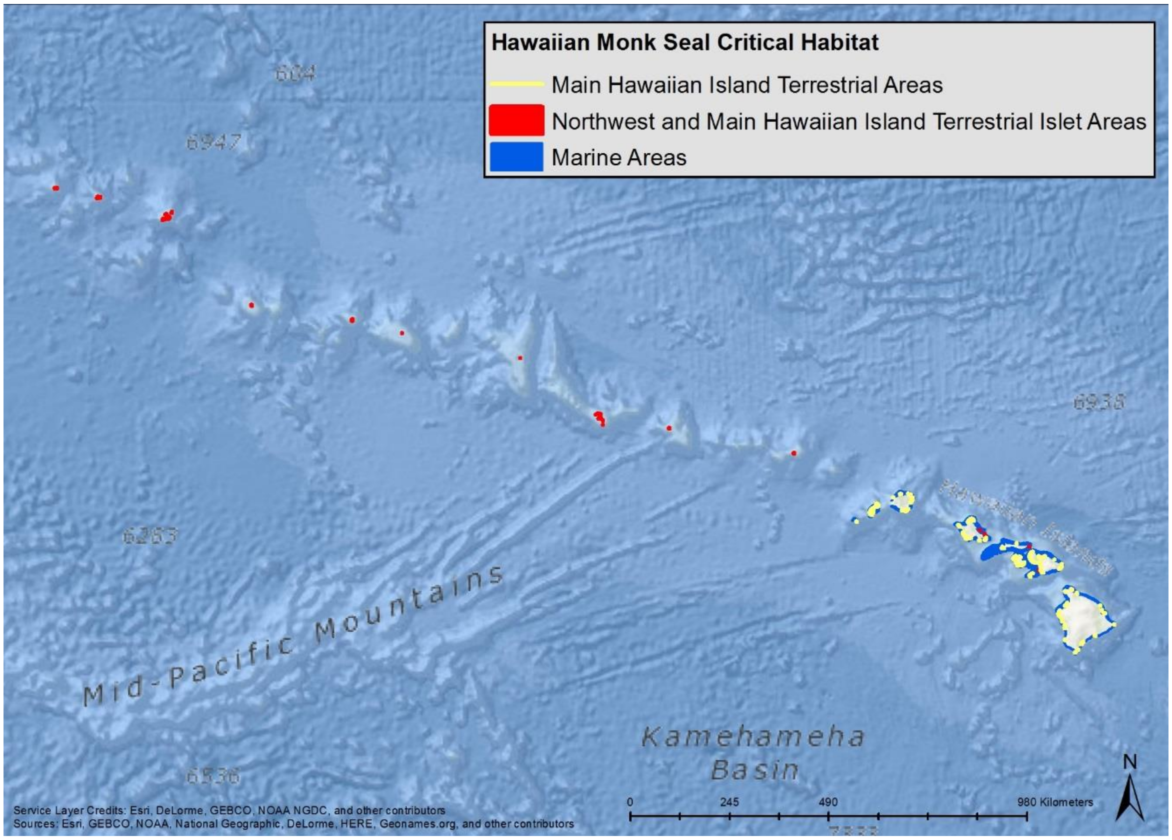

Figure 33. Map identifying designated critical habitat in the Northwest Hawaiian Islands and Main Hawaiian Islands for the endangered Hawaiian monk seal.

7.7.7 Proposed Ringed Seal – Arctic Subspecies Critical Habitat

In 2014, NMFS proposed to designate critical habitat for the Arctic subspecies of ringed seal in the northern Bering, Chukchi, and Beaufort Seas in Alaska (79 FR 73010) (Figure 33).

The physical or biological features essential to the conservation of the species are: (1) 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 seasonal landfast (shorefast) ice, except for any bottom-fast ice extending seaward from the coastline in waters less than 2 meters (6.6 feet) deep, or dense, stable pack ice, that has undergone deformation and contains snowdrifts at least 54 centimeters (21.3 inches) deep; (2) sea ice habitat suitable as a platform for basking and molting, which is defined as sea ice of 15 percent or more concentration, except for any bottom-fast ice extending seaward from the coastline in waters less than 2 meters (6.6 feet) deep; (3)

primary prey resources to support Arctic ringed seals, which are defined to be Arctic cod, saffron cod, shrimps, and amphipods.

Figure 34. Map identifying proposed designated critical habitat for the threatened Arctic subspecies of ringed seal in the Bering, Chukchi, and Beaufort Seas in Alaska.

7.7.8 Steller Sea Lion – Western Distinct Population Segment 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) (Figure 33). 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).

Figure 35. Map identifying designated critical habitat for the endangered Western distinct population segment of Steller sea lion in Alaska.

7.7.9 Green Turtle – North Atlantic Distinct Population Segment Critical Habitat

In 1998, NMFS designated critical habitat for green turtles, which include coastal waters surrounding Culebra Island, Puerto Rico (Figure 36). 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.

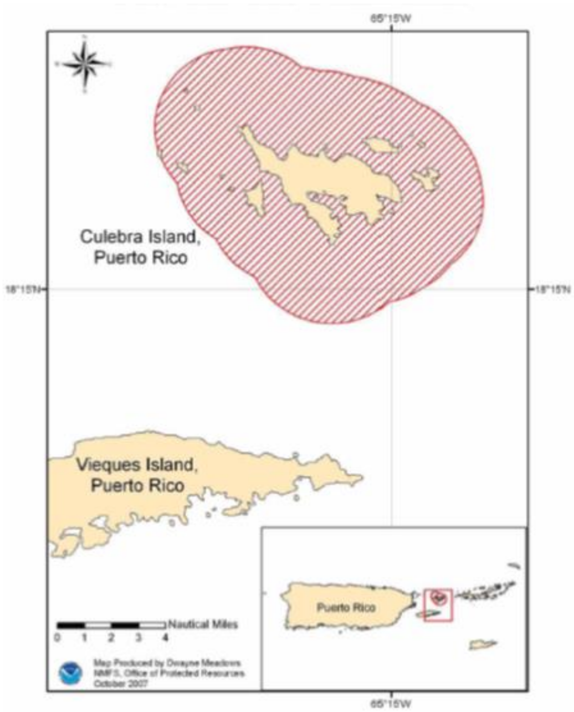

Figure 36. Map identifying designated critical habitat for the threatened North Atlantic distinct population segment of green turtle in Culebra Island, Puerto Rico.

7.7.10 Hawksbill Turtle Critical Habitat

In 1998, NMFS established critical habitat for hawksbill turtles around Mona and Monito Islands, Puerto Rico (Figure 37). Aspects of these areas that are important for hawksbill turtle survival and recovery include important natal development habitat, refuge from predation, shelter between foraging periods, and food for hawksbill turtle prey.

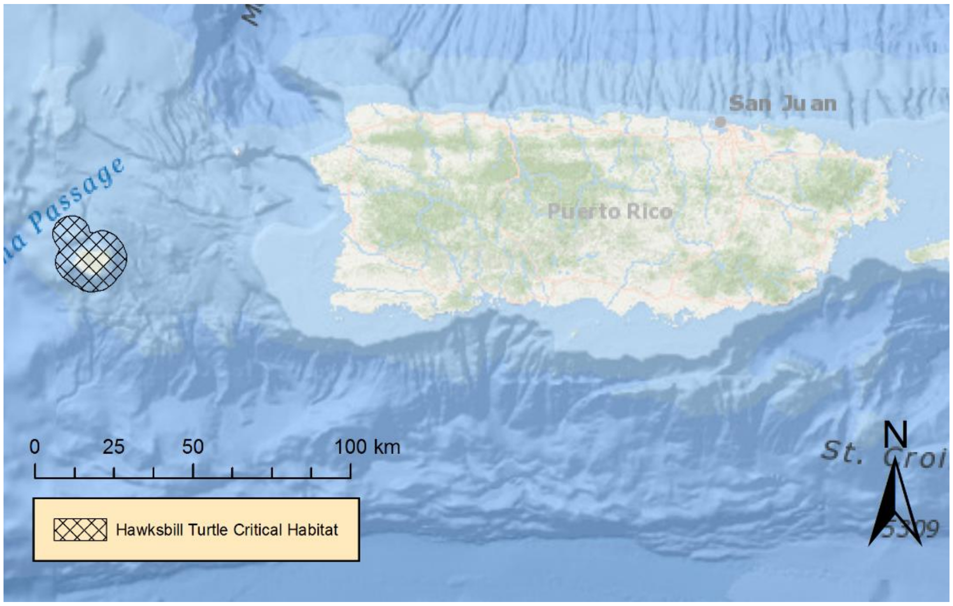

Figure 37. Map identifying designated critical habitat for the endangered hawksbill turtle.

7.7.11 Leatherback Turtle 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 (Figure 38). 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 2013d).

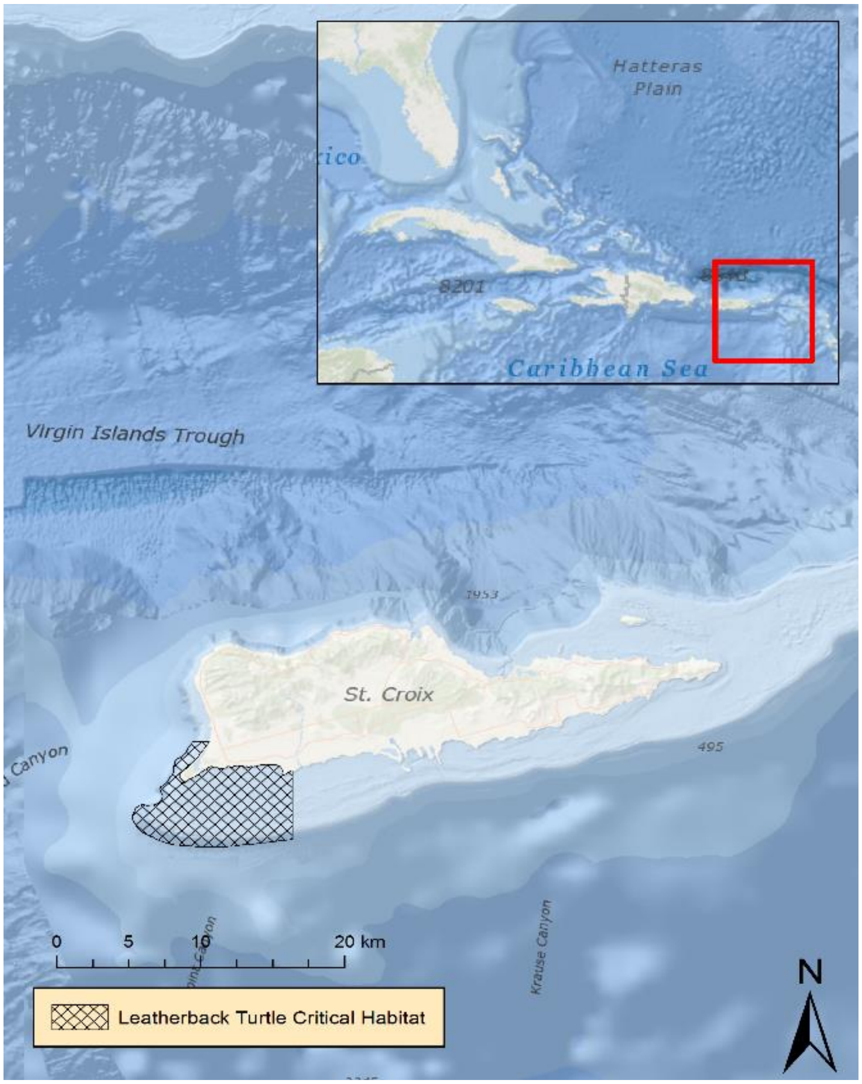

Figure 38. Map identifying designated critical habitat for the endangered leatherback turtle in the United States Virgin Islands.

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) (Figure 39).

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).

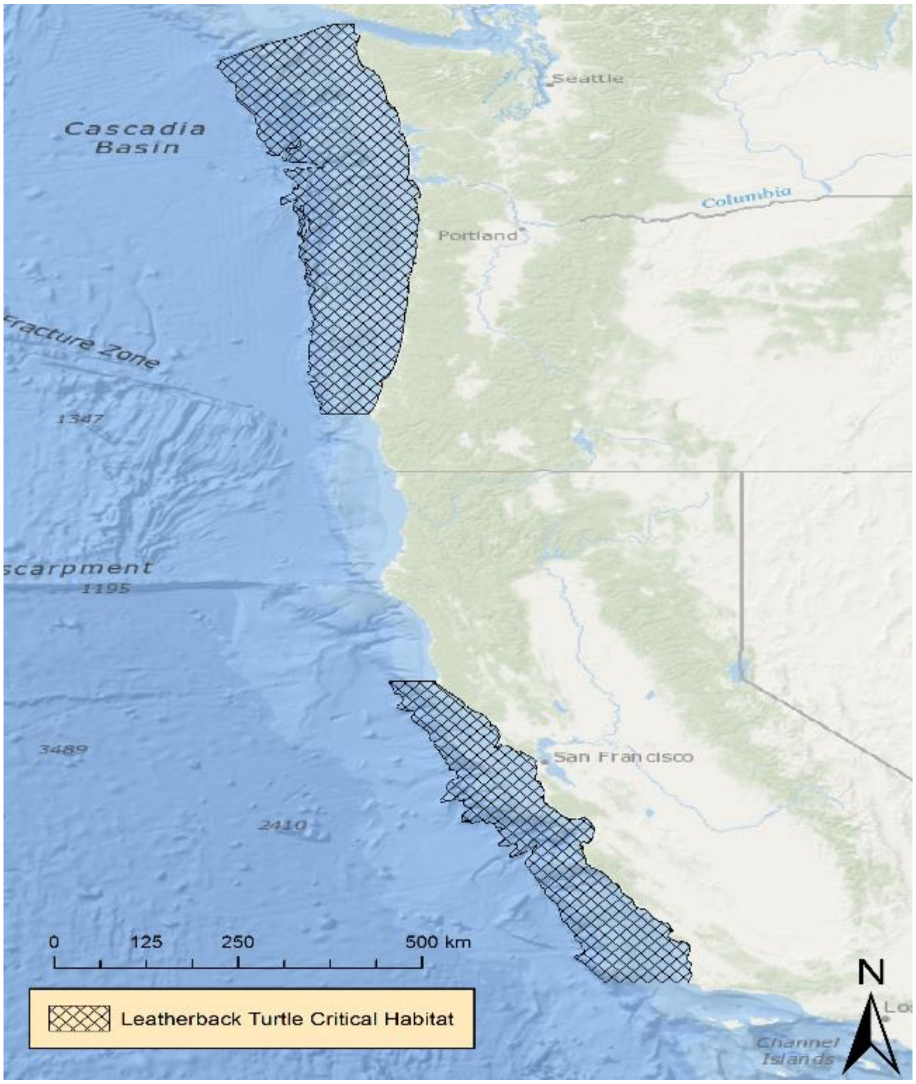

Figure 39. Map identifying designated critical habitat for the endangered leatherback turtle along the United States Pacific Coast.

7.7.12 Loggerhead Turtle – North Atlantic Ocean Distinct Population Segment 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) (Figure 40). 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 7).

Table 7. 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. 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 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. 2. Continental shelf waters in proximity to the western boundary of the Gulf Stream. 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. 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. 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. 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. 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 7.

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 7). The physical and biological features for winter habitat are shown in Table 7.

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 7.

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 7.

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 7.

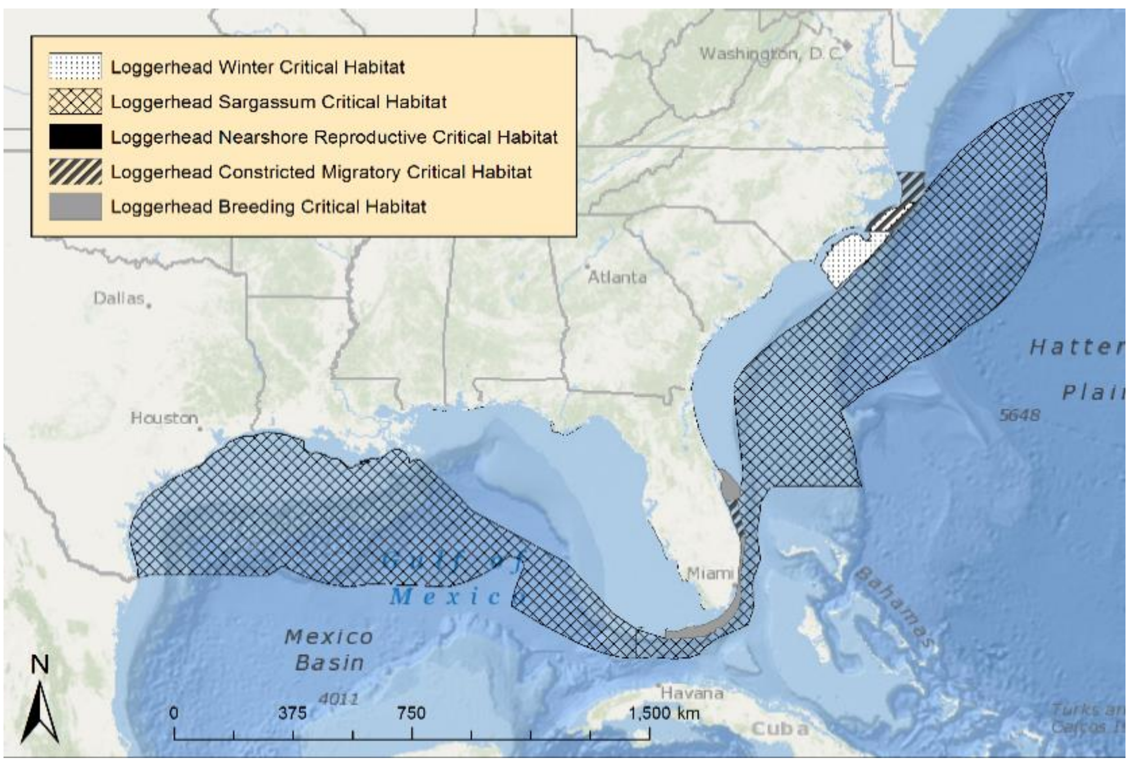

Figure 40. Map identifying designated critical habitat for the threatened Northwest Atlantic Ocean distinct population segment of loggerhead turtles.

7.7.13 Atlantic Salmon – Gulf of Maine Distinct Population Segment 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 (Figure 41).

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.

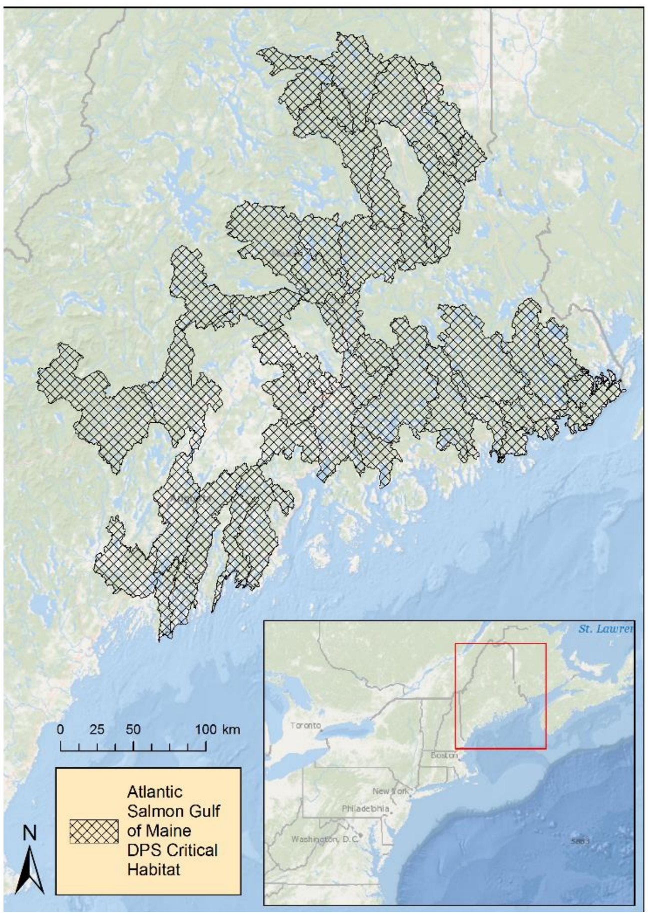

Figure 41. Map of designated critical habitat for the endangered Atlantic salmon Gulf of Maine distinct population segment.

7.7.14 Pacific Salmonid 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 6). 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 (Figure 42).

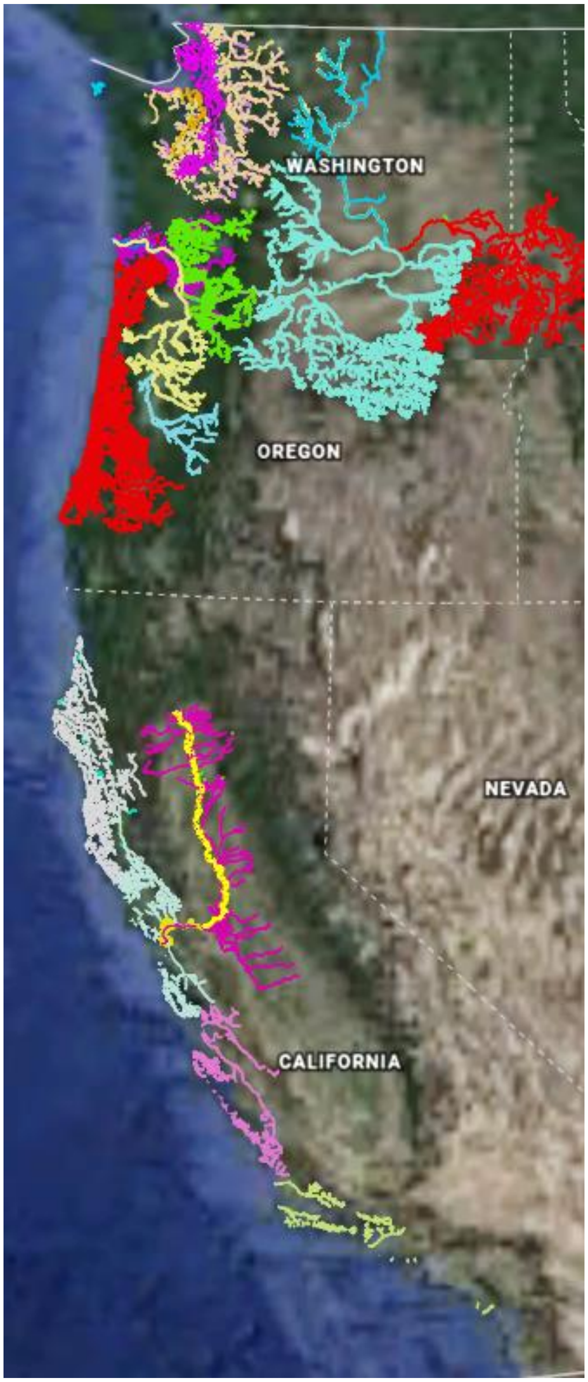

Figure 42. Map identifying designated critical habitat for all of the threatened and endangered distinct population segments and evolutionarily significant units of Pacific salmon and steelhead.

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.

7.7.15 Atlantic Sturgeon 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 (Figure 43). 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 8).

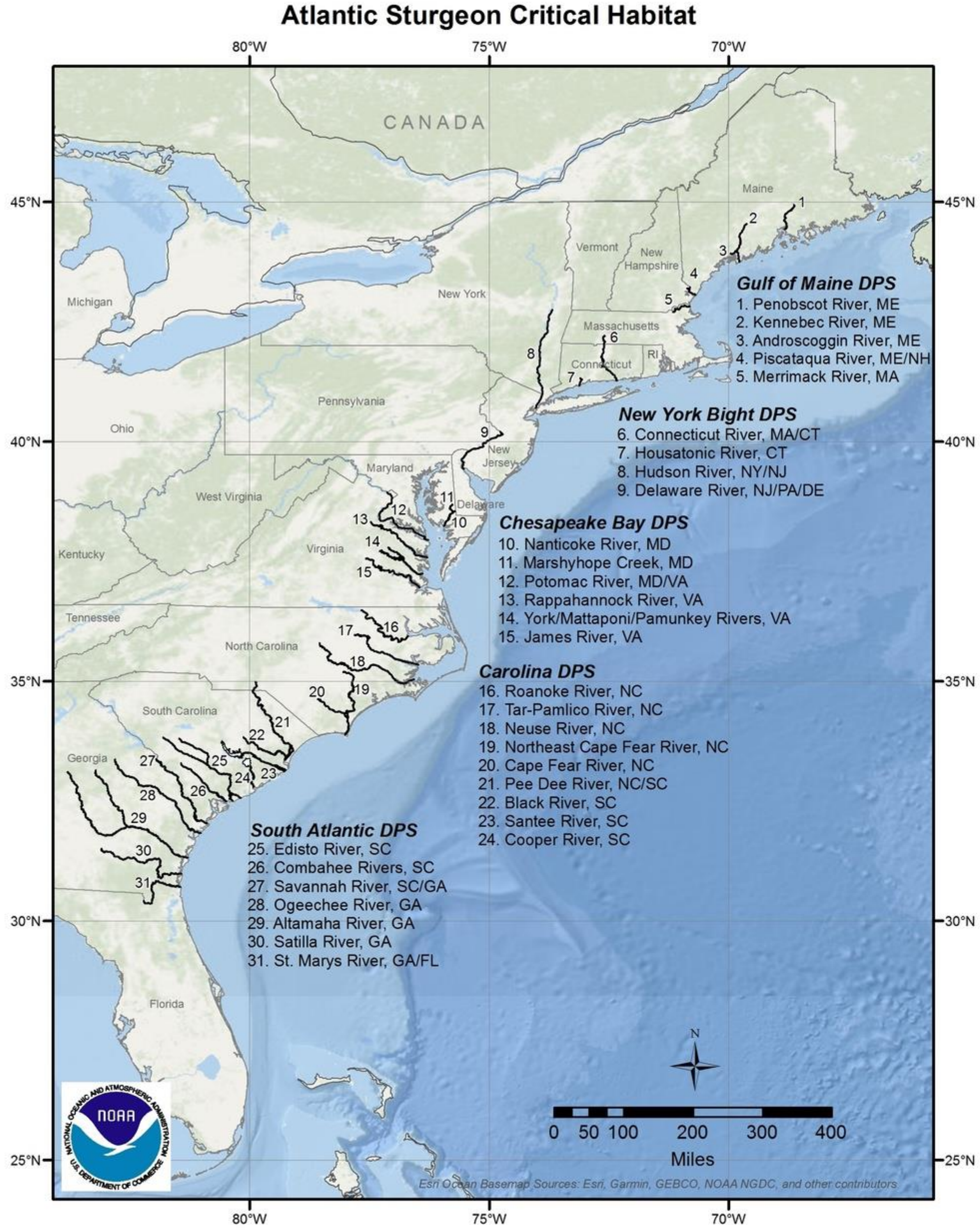

Figure 43. Map of designated critical habitat from Maine to Florida for five threatened and endangered distinct population segments of Atlantic sturgeon.

Table 8. 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 New York Bight 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 New York Bight 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 New York Bight 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: 1. Unimpeded movement of adults to and from spawning sites; 2. Seasonal and physiologically dependent movement of juvenile Atlantic sturgeon to appropriate salinity zones within the river estuary; and 3. Staging, resting, or holding of subadults or spawning condition adults Water depths in 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 New York Bight Chesapeake Bay	Water, especially in the bottom meter of the water column, with the temperature, salinity, and oxygen values that, combined, support: 1. Spawning; 2. Annual and interannual adult, subadult, larval, and juvenile survival; and 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 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 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 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: 1. Unimpeded movement of adults to and from spawning sites; 2. Seasonal and physiologically dependent movement of juvenile Atlantic sturgeon to appropriate salinity zones within the river estuary; and 3. Staging, resting, or holding of subadults and spawning condition adults. 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 South Atlantic	Water quality conditions, especially in the bottom meter of the water column, with temperature and oxygen values that support: 1. Spawning; 2. Annual and inter-annual adult, subadult, larval, and juvenile survival; and 3. Larval, juvenile, and subadult growth, development, and recruitment. 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

7.7.16 Green Sturgeon – Southern Distinct Population Segment 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 (Figure 44).

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.

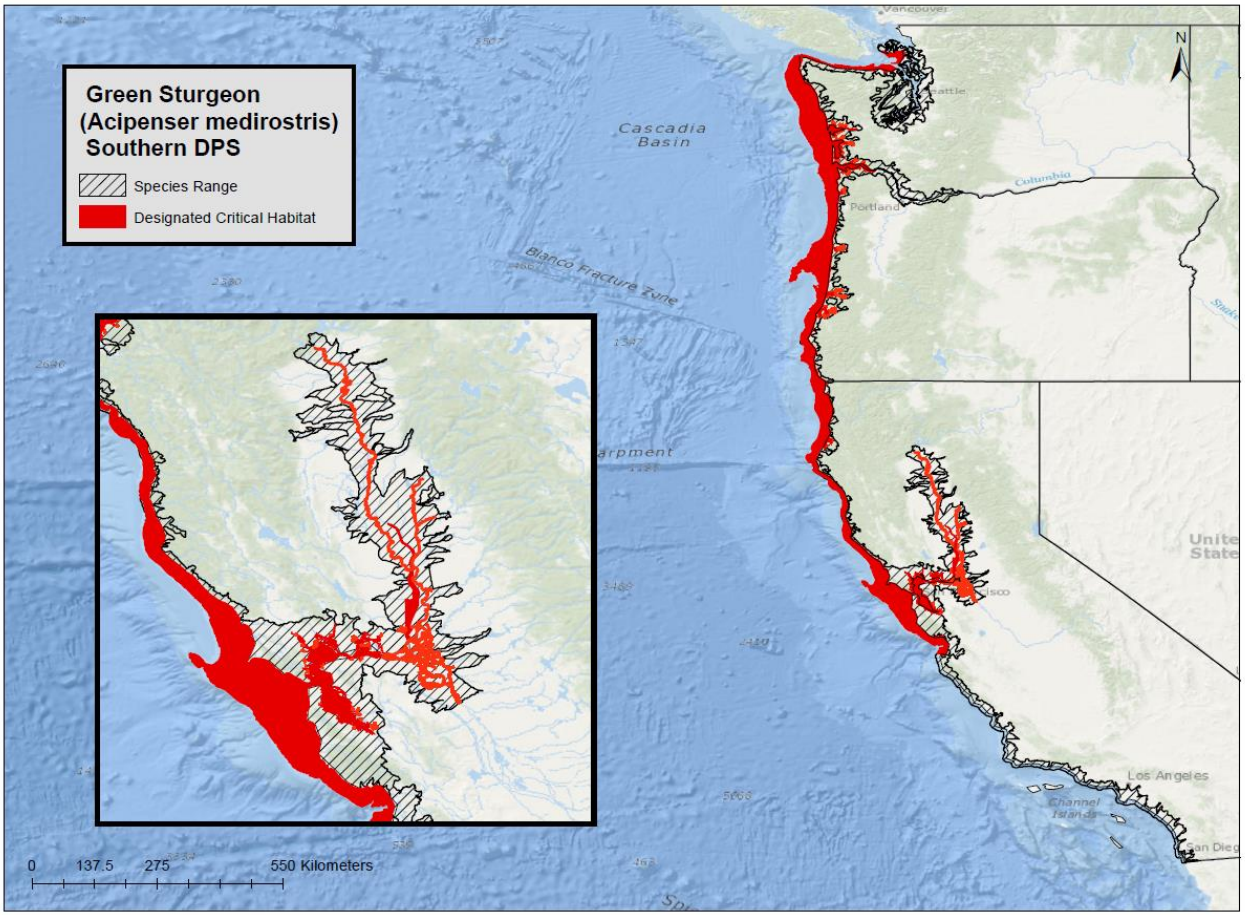

Figure 44. Map of geographic range (within the contiguous U.S.) and designated critical habitat for the threatened Southern distinct population segment of green sturgeon.

7.7.17 Gulf Sturgeon 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 (Figure 45).

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.

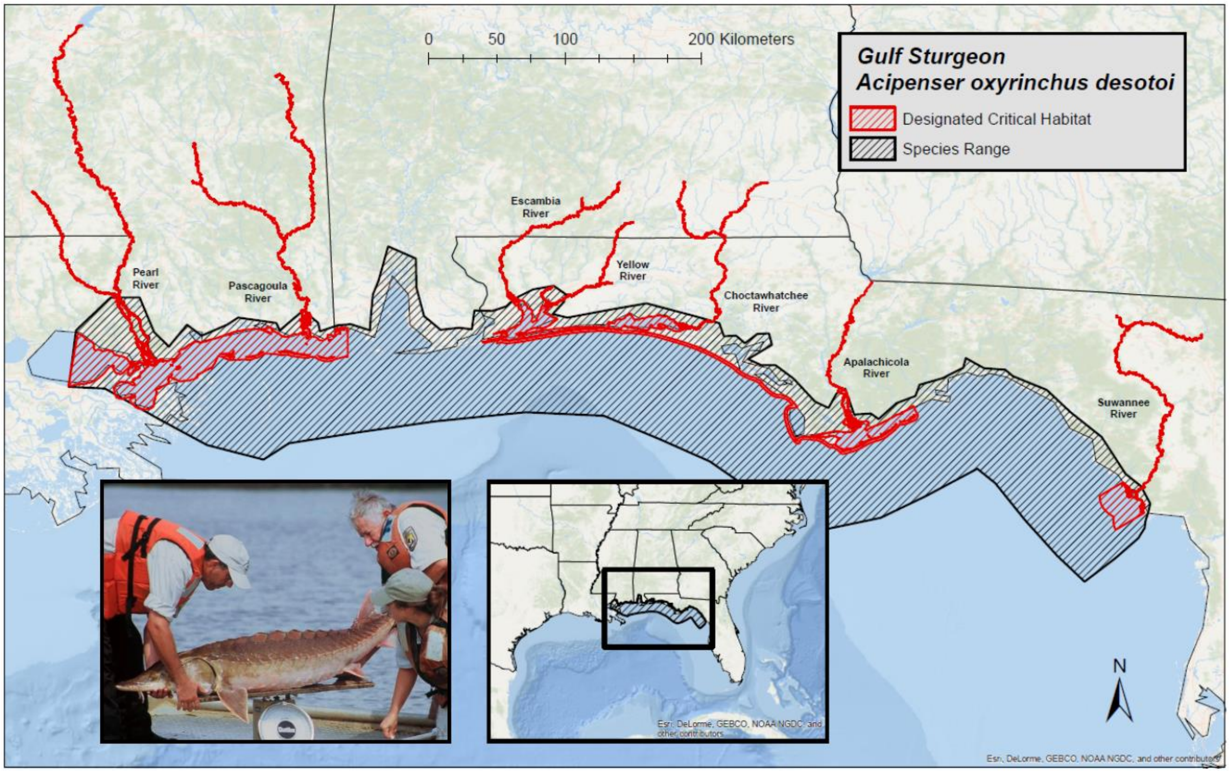

Figure 45. Map identifying designated critical habitat for the threatened Gulf sturgeon.

7.7.18 Rockfish – Bocaccio and Yelloweye Rockfish – Puget Sound/Georgia Basin Distinct Population Segment 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 (Figure 46).

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.

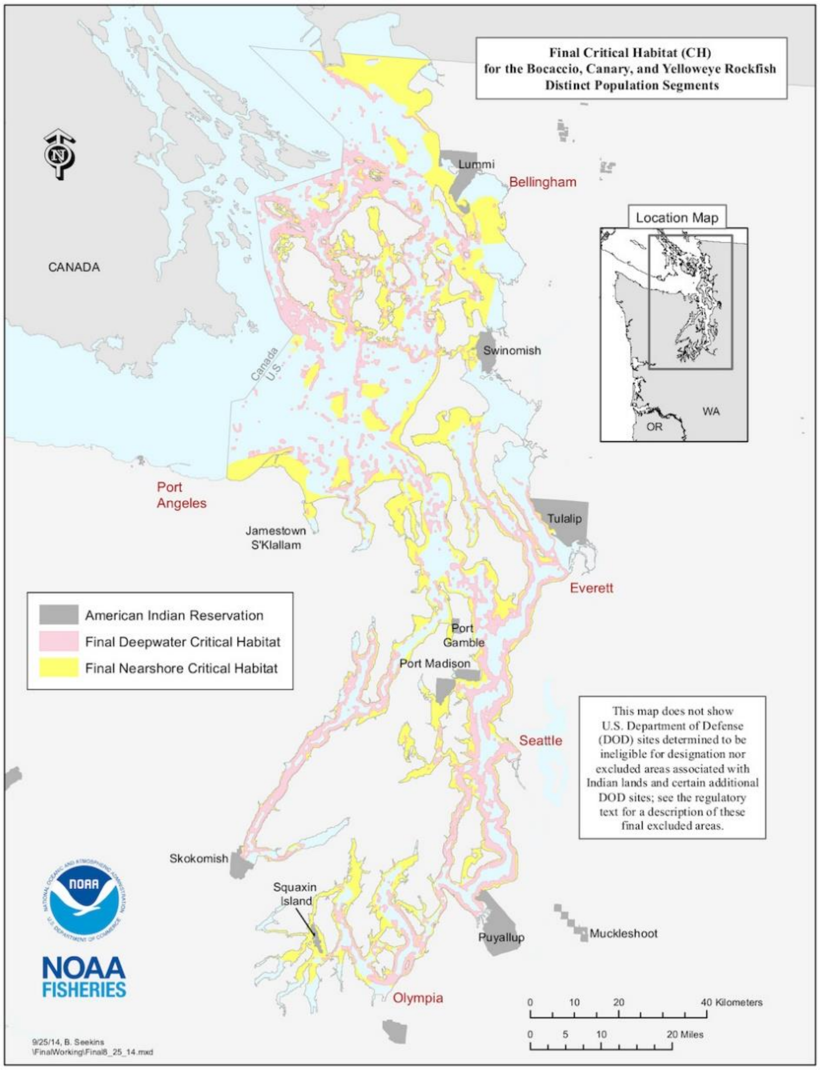

Figure 46. Map of designated critical habitat for the threatened and endangered Puget Sound/Georgia Basin distinct population segments of bocaccio and yelloweye rockfish.

7.7.19 Eulachon – Southern Distinct Population Segment Critical Habitat

In 2011, NMFS designated critical habitat (76 FR 65324). Sixteen areas were designated in the states of Washington, Oregon, and California (Figure 47). 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.

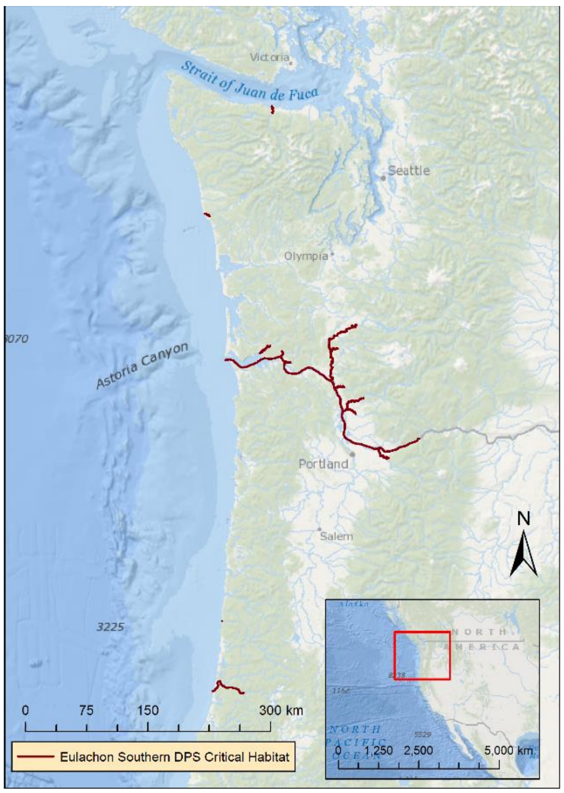

Figure 47. Map of designated critical habitat for the threatened Southern distinct population segment of eulachon.

7.7.20 Smalltooth Sawfish – U.S. Portion of Range Distinct Population Segment Critical Habitat

Critical habitat for smalltooth sawfish was designated in 2009 and includes two major units: Charlotte Harbor (221,459 acres) and Ten Thousand Islands/Everglades (619,013 acres) (Figure 48). 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).

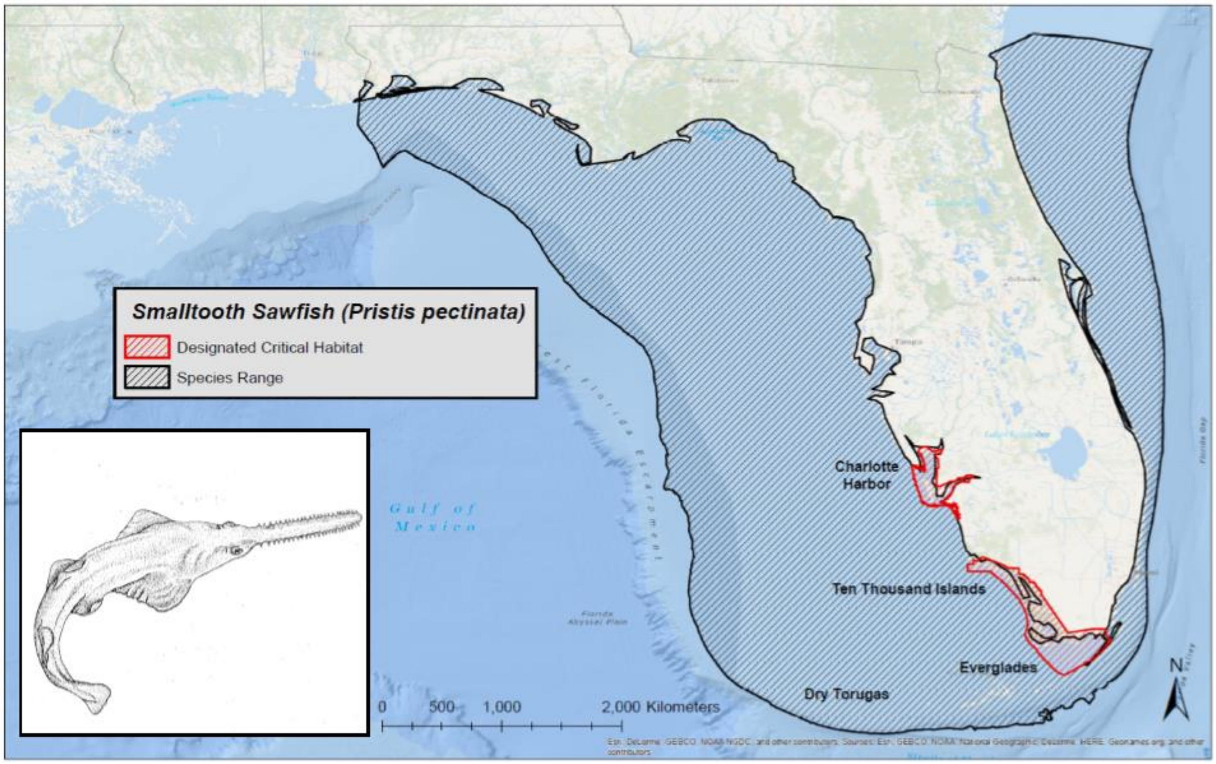

Figure 48. Range and designated critical habitat for the endangered U.S. portion of range distinct population segment of smalltooth sawfish.

7.7.21 Black Abalone Critical Habitat

In 2011, the 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 (Figure 49).

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).

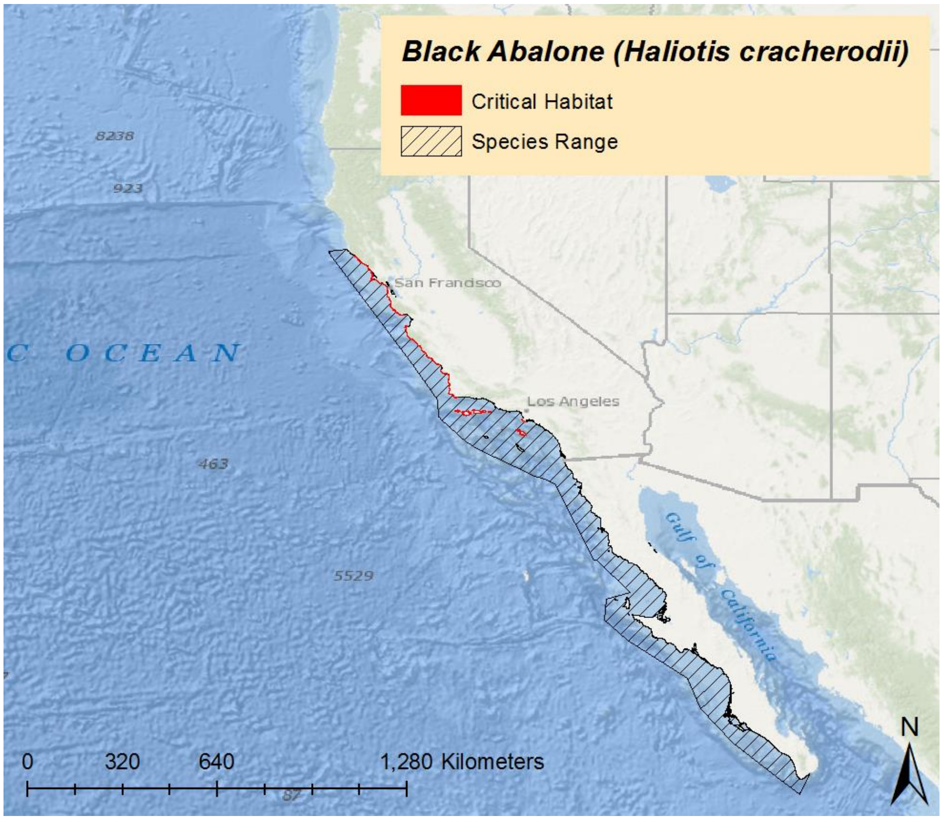

Figure 49. The range and designated critical habitat of the endangered black abalone along the Pacific Coast of North America.

7.7.22 Elkhorn and Staghorn Coral 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) (Figure 50 and Figure 51).

Within the geographic area occupied by a 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.

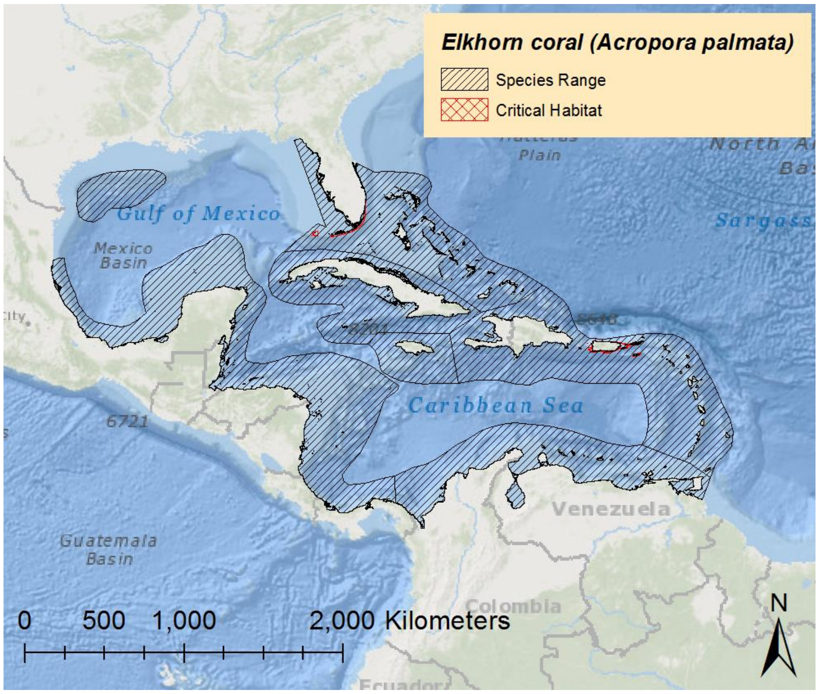

Figure 50. The range and designated critical habitat of the threatened elkhorn coral throughout the Atlantic Ocean, Caribbean Sea, and Gulf of Mexico.

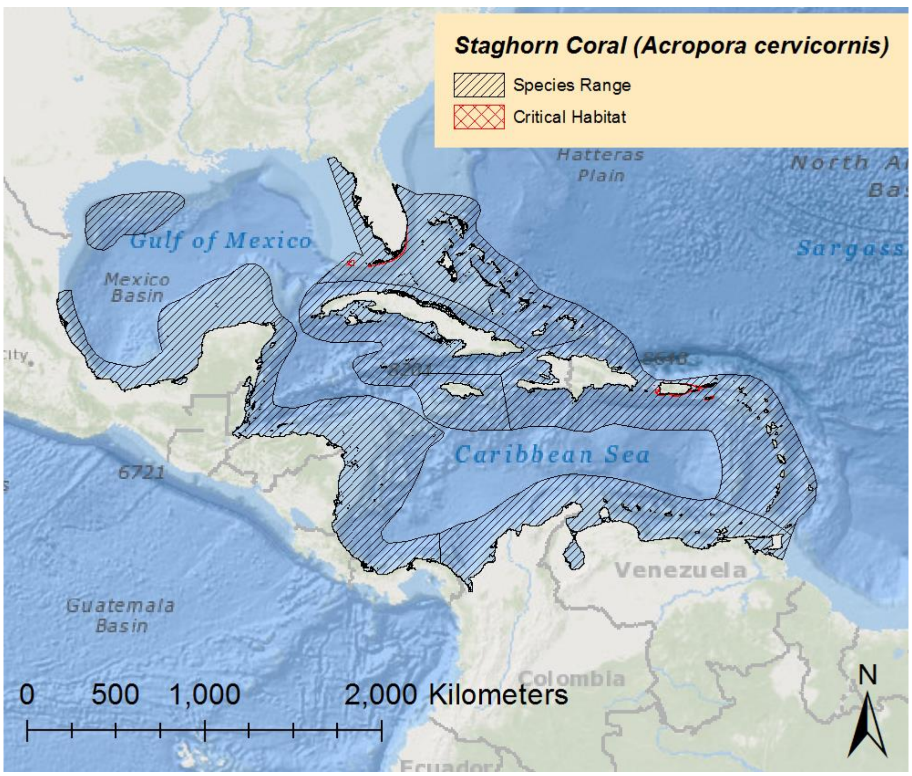

Figure 51. The range and designated critical habitat of the threatened staghorn coral throughout the Atlantic Ocean, Caribbean Sea, and Gulf of Mexico.

7.7.23 Johnson's Seagrass Critical Habitat

In 2000, NMFS designated ten portions of the Indian River Lagoon and Biscayne Bay, Florida, as critical habitat within the current range of Johnson's seagrass (Figure 52). These portions present the following physical and biological elements essential for the specie and are defined as these criteria:

1. Populations that have persisted for ten years;
2. Persistent flowering populations;
3. Northern and southern limits of the species;
4. Unique genetic diversity; and
5. A documented high abundance of the Johnson's seagrass compared to the other areas in the species' range.

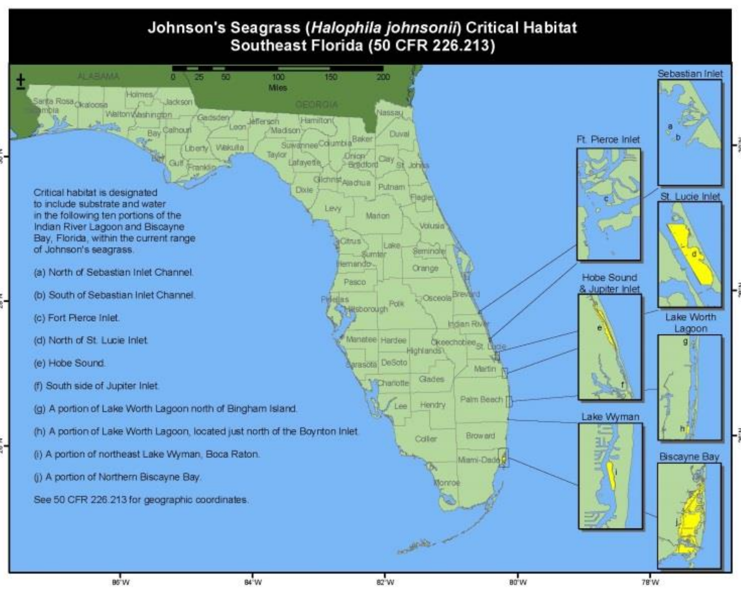

Figure 52. Map identifying the ten areas of designated critical habitat for the threatened Johnson's seagrass.

7.7.24 Effects to Designated Critical Habitat

Designated critical habitat for several ESA-listed species occurs within the action area and may be affected by the proposed action. Each critical habitat is characterized by physical and biological features (previously referred to by NMFS as primary constituent elements) that are deemed essential to the conservation of the ESA-listed species for which the habitat was designated. Below we describe physical and biological features of each critical habitat, and then evaluate the effects that the proposed action may have on these physical and biological features. In determining if designated critical habitat is likely to be adversely modified or destroyed, we assess whether the proposed action would appreciably diminish the value of designated critical habitat for the conservation of an ESA-listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features (50 C.F.R. §402.02). If the proposed action would not appreciably diminish the conservation value of designated critical habitat, we conclude that the proposed action is not likely to adversely modify or destroy the designated critical habitat and do not consider that critical habitat further.

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 9 lists these physical and biological features and also highlights those that may be affected by the proposed action. With a few 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).

Other. Additionally, smalltooth sawfish critical habitat includes the presence of red mangroves, 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, and Johnson’s seagrass critical habitat includes sufficient water transparency and stable, unconsolidated sediments.

Table 9. 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 (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	1, 3, 5

	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
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.*	2, 3 None

	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. Calving habitat (Unit 2) – (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 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		
Hawaiian Monk Seal	Terrestrial habitat for resting, pupping, and nursing habitat.	3, Other

	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.	
Ringed Seal – Arctic Subspecies (Proposed)	(1) 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 seasonal landfast (shorefast) ice, except for any bottom-fast ice extending seaward from the coast line in waters less than 2 meters (6.6 feet) deep, or dense, stable pack ice, that has undergone deformation and contains snowdrifts at least 54 centimeters (21.3 inches) deep; (2) sea ice habitat suitable as a platform for basking and molting, which is defined as sea ice of 15 percent or more concentration, except for any bottom-fast ice extending seaward from the coastline in water less than 2 meters (6.6 feet) deep; (3) primary prey resources to support Arctic ringed seals, which are defined to be Arctic cod, saffron cod, shrimps, and amphipods.	3, Other
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	4, 5

	pollution, fishing activities, dredge and fill activities, habitat restoration	
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. 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); (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. Winter Habitat:	1, 3, 5, Other

	(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). Breeding Habitat – (1) High densities of reproductive male and female loggerheads; (2) proximity to primary Florida migratory corridor; and (3) proximity to Florida nesting grounds. Migratory Habitat – (1) Constricted continental shelf area relative to nearby continental shelf waters that concentrate migratory pathways; and (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; (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 (see **Table 7**).	
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; 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.	1,2,3,4

	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. 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 8**).	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	1, 2, 3, 4

	quality, migratory corridors, depth (greater than or equal to 5 meters [16.4 feet], and sediment quality.	
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
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]). 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 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.	1,2,3

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), junvenile 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

Marine Plants		
Johnson's Seagrass	(1) Populations that have persisted for ten years; (2) Persistent flowering populations; (3) northern and southern limits of the species; (4) unique genetic diversity; and (5) a documented high abundance of the Johnson's seagrass compared to the other areas in the species' range.	2, 4, Other

As described in the NMFS Permits and Conservation Division's biological assessment, research and enhancement 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 in order to determine if the proposed action is likely to modify or destroy the designated critical habitat.

Potential stressors from the proposed action that may affect the physical and biological features of designated critical habitat include pollution, aerial surveys, vessel surveys (including vessel transit, noise and visual disturbance), passive acoustic monitoring, active acoustics, biological sampling (breath sampling, environmental DNA sampling, fecal sampling, sloughed skin sampling, skin sampling, prey sampling), and tagging. However, as further outlined below, the effects of these stressors on the identified physical and biological features were determined to be either insignificant or discountable based on the nature of the feature and the stressor. As mentioned above, most of the physical and biological features of proposed or designated critical habitat can be grouped into categories one through five (see Table 9). We evaluate the potential effects of the proposed action on these categories below and for any features that do not fall into these categories (i.e., "other" in Table 9), a separate analysis is presented.

1 – Waters free from obstruction.

The proposed action will not result in obstructions to migratory pathways for any species in areas of designated or proposed critical habitat. While the project may result in individual animals temporarily avoiding a small area during research and enhancement activities in critical habitat, the avoidance will be short in duration (i.e., lasting a few hours) and localized. During the short time periods that research and enhancement 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 research and enhancement activities, the presence of these researchers does not prevent animals from accessing preferred habitat areas. For these reasons, the research and enhancement activities are expected to have an insignificant effect on essential features of designated and proposed critical habitat related to obstructions and migratory pathways.

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.

5 – Habitat free from disturbance (including anthropogenic noise).

Other.

Generally speaking for all designated or proposed critical habitat, interactions that may result from the proposed research and enhancement activities will be limited to aerial and vessel surveys and active acoustics, because all other research and enhancement activities will be directed at individual cetaceans. 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 significantly altered. Aerial and vessel surveys will not significantly 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 will 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 individual prey can be killed. However, even if this unlikely event were to occur, the removal of 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. Only aerial surveys will take aircraft and vessel pollution and noise will occur, it will be short-term, minimal, diluted, and will not have any measurable impact on the physical and biological features.

While the proposed research and enhancement 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 research and enhancement activities will not significantly alter the physical or oceanographic conditions within the action area, as only very minor changes in water flow and current will be expected from vessel traffic and no changes in ocean bathymetry will occur. The proposed research and enhancement activities will in no way alter the sea state, temperature, or water depth.

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 are proposed to be used during research and enhancement 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 research and enhancement 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 agree with the NMFS Permits and Conservation Division and believe the effects of vessel transit on proposed or designated critical habitat associated with the proposed research and enhancement 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 (see Section 7.7) for fish and invertebrates, respectively. However, given the frequency bandwidth and sound sources, the NMFS Permits and Conservation Division expect 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 3.7.3) are temporary, short duration sounds, and as discussed in Section 6, will only result in temporary ESA harassment (MMPA Level B 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 agree with the NMFS Permits and Conservation Division and 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 research and enhancement activities on the physical and biological features of the proposed or designated critical habitat listed in Table 9 are either insignificant or discountable. As such, these proposed research and enhancement activities are not likely to destroy or adversely modify proposed or designated critical habitat under NMFS jurisdiction and will not be carried forward in this consultation.

8 Species Likely to be Adversely Affected

This section identifies the ESA-listed species that occur within the action area (see Figure 22, Figure 23, Figure 24,

Figure 25, and Figure 26) that may be affected by NMFS Permits and Conservation Division's proposed action of issuance of scientific research and enhancement permits by the cetacean research permitting program (Table 10). The regulatory status and recovery plan references for these species are also included in Table 10.

Table 10. Endangered Species Act-listed threatened and endangered species that may be affected by the National Marine Fisheries Service's Permits and Conservation Division's proposed action of issuance of scientific research and enhancement permits by the cetacean research permitting program.

Species	ESA Status	Recovery Plan
Marine Mammals – Cetaceans		
Beluga Whale (*Delphinapterus leucas*) – Cook Inlet DPS	E – 73 FR 62919	82 FR 1325
Blue Whale (*Balaenoptera musculus)*	E – 35 FR 18319	07/1998
Bowhead Whale (*Balaena mysticetus*)	E – 35 FR 18319	-- --
Bryde's Whale (*Balaenoptera edeni*) – Gulf of Mexico Subspecies	E – 81 FR 88639 (Proposed)	-- --
False Killer Whale (*Pseudorca crassidens*) – Main Hawaiian Islands Insular DPS	E – 77 FR 70915	-- --
Fin Whale (*Balaenoptera physalus)*	E – 35 FR 18319	75 FR 47538 07/2010
Gray Whale (*Eschrichtius robustus*) Western North Pacific Population	E – 35 FR 18319	-- --
Humpback Whale (*Megaptera novaeangliae*) – Arabian Sea DPS	E – 81 FR 62259	11/1991
Humpback Whale (*Megaptera novaeangliae*) – Cape Verde Islands/Northwest Africa DPS	E – 81 FR 62259	11/1991
Humpback Whale (*Megaptera novaeangliae*) – Central America DPS	E – 81 FR 62259	11/1991
Humpback Whale (*Megaptera novaeangliae*) – Mexico DPS	T – 81 FR 62259	11/1991
Humpback Whale (*Megaptera novaeangliae*) – Western North Pacific DPS	E – 81 FR 62259	11/1991
Killer Whale (*Orcinus orca*) – Southern Resident DPS	E – 70 FR 69903	73 FR 4176 01/2008
North Atlantic Right Whale (*Eubalaena glacialis*)	E – 73 FR 12024	70 FR 32293 08/2004
North Pacific Right Whale (*Eubalaena japonica*)	E – 73 FR 12024	78 FR 34347 06/2013

Species	ESA Status	Recovery Plan
Sei Whale (*Balaenoptera borealis*)	E – 35 FR 18319	12/2011
Southern Right Whale (*Eubalaena australis*)	E – 35 FR 8491	-- --
Sperm Whale (*Physeter macrocephalus*)	E – 35 FR 18319	75 FR 81584 12/2010
South Island Hector's Dolphin (*Cephalorhynchus hectori hectori*)	T – 82 FR 43701	-- --

9 STATUS OF SPECIES LIKELY TO BE ADVERSELY AFFECTED

This section identifies and examines the status of each species that would be adversely affected by the proposed actions. The status includes the existing level of risk that the ESA-listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. The species status section helps to inform the description of the species' current "reproduction, numbers, or distribution," which 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 this NMFS website: https://www.fisheries.noaa.gov/species-directory/threatened-endangered among others.

9.1 Beluga Whale – Cook Inlet Distinct Population Segment

Cook Inlet DPS of beluga whales reside in Cook Inlet (Figure 53) 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).

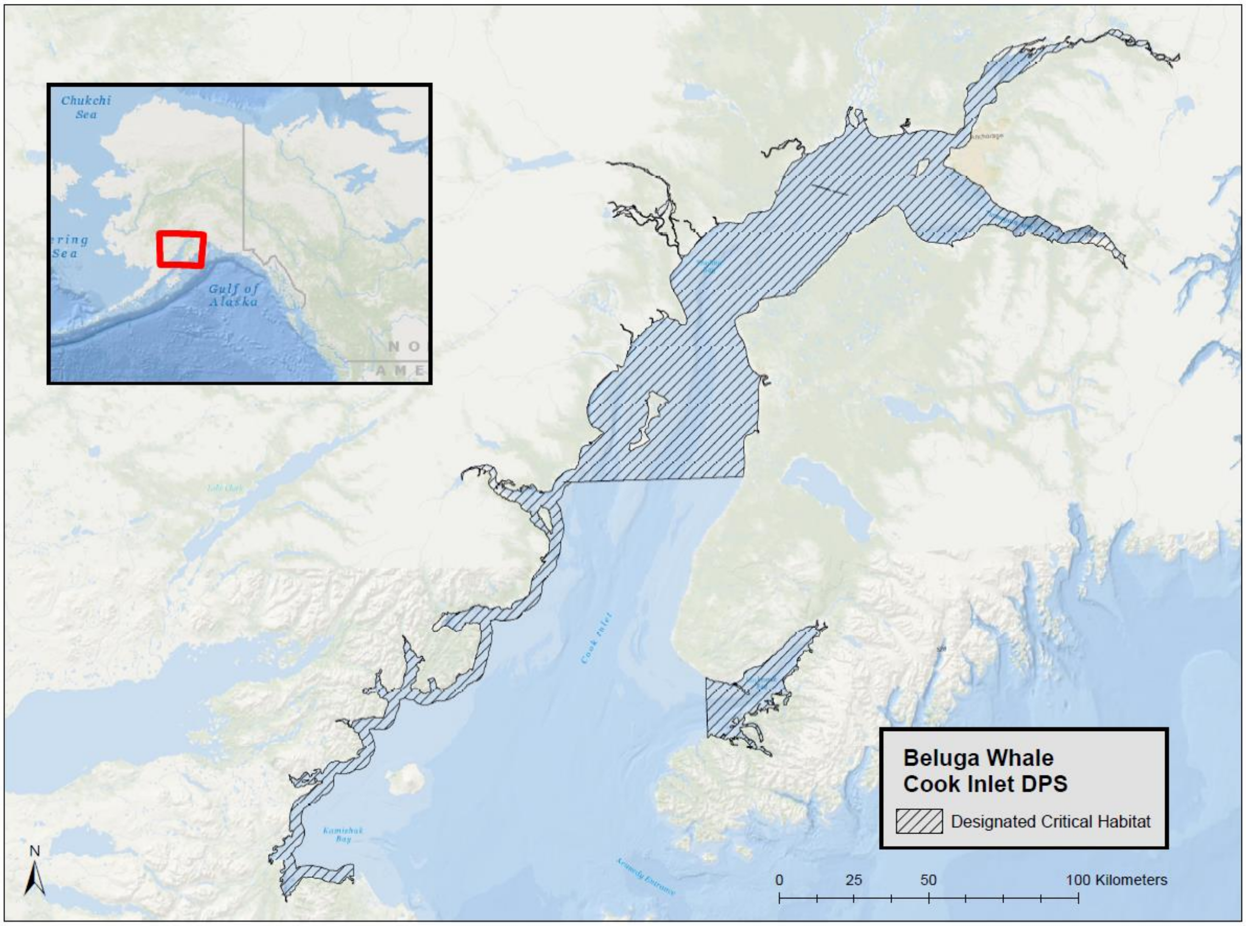

Figure 53. Map identifying the general range and designated critical habitat of the endangered Cook Inlet distinct population segment of beluga whale.

The beluga whale, 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 2016d). The Cook Inlet DPS of beluga whales was listed as endangered under the ESA effective October 22, 2008 (73 FR 62919).

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

9.1.1 Life History

Beluga whales are long-lived (60 to 70 years) and have a relatively slow reproductive cycle; sexual maturity is believed to be attained at four to ten years for females and at eight to 15 years 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).

Beluga whales 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 DPS of beluga whales 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 2016d).

9.1.2 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 DPS of beluga whale.

The current best available estimate of the Cook Inlet DPS of beluga whale is 312 individuals N_{min}=287, potential biological removal -0.57) (Muto et al. 2018). The best available historical abundance estimate of 1,293 Cook Inlet DPS of beluga whales was obtained from an aerial survey conducted in 1979 (Calkins 1989). NMFS has adopted 1,300 as the value for the carrying capacity to be used for management purposes. Cook Inlet DPS of beluga whales 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 beluga whales hunted from 1999 through 2014, over 16 years), NMFS anticipated that the population would begin to increase at a growth rate of between two and six percent per year (NMFS 2016d). The 2014 abundance estimate was 340 beluga whales, with a declining trend for both the most recent ten-year time period (–0.4 percent per year; standard error = 1.3 percent) and since the hunt was managed in 1999 (–1.3 percent per year, standard error = 0.7 percent) (Shelden et al. 2015). Thus, the population is not growing as expected despite the regulation of the subsistence harvest.

The degree of genetic differentiation between the Cook Inlet DPS and the other four Alaska beluga whale 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 DPS of beluga whales 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 DPS of beluga whales unless the population is reduced to fewer than 200 whales (Hobbs et al. 2008).

Multiple data sources indicate that beluga whales exhibit seasonal shifts in distribution and habitat use within Cook Inlet; however, beluga whales in Cook Inlet do not migrate out of Cook Inlet. Generally, Cook Inlet belugas spend the ice-free months in the upper part of Cook Inlet (often at discrete high-use areas), then expand their distribution south and into more offshore waters of the middle part of Cook Inlet in winter (Hobbs et al. 2008), although they may be found throughout Cook 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 beluga whales in close proximity to Anchorage during summer months, where there is an increased potential for disturbance from human activities (NMFS 2016d).

9.1.3 Vocalization and Hearing

Beluga whale whistles range between 0.26 to 20 kiloHertz, pulsed tones between 0.4 to 12 kiloHertz, noisy vocalizations between 0.5 to 16 kiloHertz (Schevill and Lawrence 1949, Sjare and Smith 1986a; Sjare and Smith 1986b, Richardson et al. 1995b) and their echolocation clicks have been recorded up to 120 kiloHertz (Au et al. 1985). Whistles, noisy vocalizations, and pulsed sounds at lower frequencies are generally associated with social behaviors (Sjare and Smith 1986b; Faucher 1988; Karlsen et al. 2002; Belikov and Belkovich 2006; Belikov and Belkovich 2007; Belikov and Belkovich 2008), while high frequency echolocation clicks are generally associated with navigation and foraging (Au et al. 1985; Au et al. 1987; Faucher 1988; Turl and Penner 1989; Turl 1990). Echolocation clicks have been examined in captive belugas (Au et al. 1985; Au et al. 1987; Turl and Penner 1989; Lammers and Castellote 2009), but have not been compared between wild stocks. Belugas emit two distinct pulses in a single echolocation click (Lammers and Castellote 2009) and their click trains can be separated into three categories based on their distinctly different interclick interval patterns (Au et al. 1987). Additionally, beluga clicks may vary in frequency and bandwidth depending on the ambient noise levels (Au et al. 1985). Currently, there are no peer-reviewed studies on the vocal repertoire of the Cook Inlet beluga whale.

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).

9.1.4 Status

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

9.1.5 Critical Habitat

Critical habitat has been designated for the Cook Inlet DPS of beluga whale and was previously discussed in Section 7.7.

9.1.6 Recovery Goals

In response to the current threats facing the species, NMFS developed goals to recover Cook Inlet DPS of beluga whale populations. These threats will be discussed in further detail in the *Environmental Baseline* section of this consultation. The 2016 Cook Inlet Beluga Recovery Plan (NMFS 2016d) contains complete demographic and threat-based downlisting and delisting criteria. A general summary of the criteria for considering reclassification is provided in Table 2 below.

Table 11: Criteria for considering reclassification (from endangered to threatened, or from threatened to not listed) for Cook Inlet distinct population segment of beluga whales.

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

9.2 Blue Whale

The blue whale is a widely distributed baleen whale found in all major oceans (Figure 54).

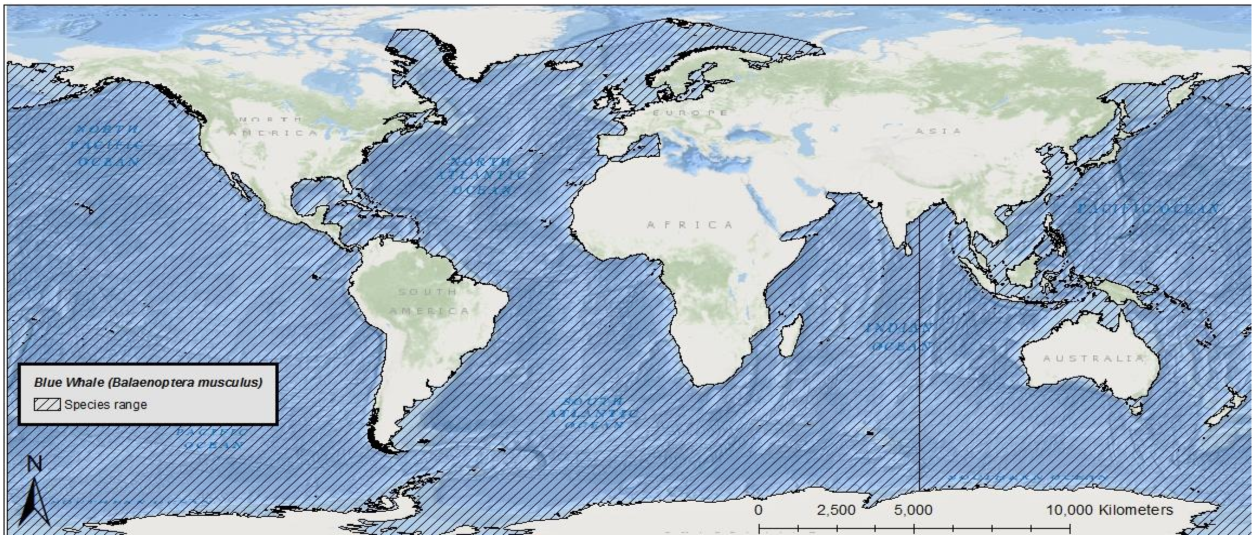

Figure 54. Map identifying the range of the endangered blue whale.

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, proportionally smaller dorsal fin, and are a mottled gray color 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*, 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 available from the recovery plan (NMFS 1998), recent stock assessment reports (Carretta et al. 2018; Hayes et al. 2018b; Muto et al. 2018), and status review (COSEWIC 2002) were used to summarize the life history, population dynamics and status of the species as follows.

9.2.1 Life History

The average life span of blue whales is 80 to 90 years. They have a gestation period of ten to 12 months, and calves nurse for six to seven months. Blue whales reach sexual maturity between five and 15 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 (7,936.6 pounds) daily. Feeding aggregations are often found at the continental shelf edge, where upwelling produces concentrations of krill at depths of 90 to 120 meters (295.3 to 393.7 feet).

9.2.2 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 Ocean, North Pacific Ocean, and Southern Hemisphere. There are three stocks of blue whales designated in U.S. waters: the Eastern North Pacific Ocean (N = 1,647; N_{min} = 1,551), Central North Pacific Ocean (N = 133; N_{min} = 63), and Western North Atlantic Ocean (N = 400 to 600; N_{min} = 440). In the Southern Hemisphere, the latest abundance estimate for Antarctic blue whales is 2,280 individuals in 1997/1998 [95 percent confidence intervals 1,160 to 4,500 (Branch 2007)]. While no range-wide estimate for pygmy blue whales exists (Thomas et al. 2016), the latest estimate for pygmy blue whales off the west coast of Australia is 662 to 1,559 individuals based on passive acoustic monitoring (McCauley and Jenner 2010), or 712 to 1,754 individuals based on photographic mark-recapture (Jenner 2008).

Current estimates indicate the Eastern North Pacific stock shows no signs of population growth since the early 1990s, perhaps because the population is nearly at carry capacity (Carretta et al. 2018). An overall population growth rate for the species or growth rates for the two other individual U.S. stocks are not available at this time. In the Southern Hemisphere, population growth estimates are available only for Antarctic blue whales, which estimate a population growth rate of 8.2 percent per year (95 percent confidence interval 1.6 to 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. 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°S and 61°S latitude) and close to the ice edge. The subspecies *B. m. brevicauda* is typically distributed north of the Antarctic Convergence.

9.2.3 Vocalizations and Hearing

Blue whale vocalizations tend to be long (greater than 20 seconds), low frequency (less than 100 Hertz) signals (Thomson and Richardson 1995), with a range of 12 to 400 Hertz and dominant energy in the infrasonic range of 12 to 25 Hertz (Ketten 1998; McDonald et al. 2001; McDonald et al. 1995; Mellinger and Clark 2003). Vocalizations are predominantly songs and calls.

Calls are short-duration sounds (two to five seconds) that are transient and frequency-modulated, having a higher frequency range and shorter duration than song units and often sweeping down in frequency (20 to 80 Hertz), with seasonally variable occurrence. Blue whale calls have high acoustic energy, with reports of source levels ranging from 180 to 195 decibels re: 1 μPa at 1 meter (Aburto et al. 1997; Berchok et al. 2006; Clark and Gagnon 2004; Cummings and Thompson 1971b; Ketten 1998; McDonald et al. 2001; Samaran et al. 2010). Calling rates of blue whales tend to vary based on feeding behavior. For example, blue whales make seasonal migrations to areas of high productivity to feed, and vocalize less at the feeding grounds then during migration (Burtenshaw et al. 2004). Stafford et al. (2005) recorded the highest calling rates when blue whale prey was closest to the surface during its vertical migration. Wiggins et al. (2005) reported the same trend of reduced vocalization during daytime foraging followed by an increase at dusk as prey moved up into the water column and dispersed. Oleson et al. (2007c) reported higher calling rates in shallow diving whales (less than 30 meters [98.4 feet]), while deeper diving whales (greater than 50 meters [164 feet]) were likely feeding and calling less.

Although general characteristics of blue whale calls are shared in distinct regions (McDonald et al. 2001; Mellinger and Clark 2003; Rankin et al. 2005; Thompson et al. 1996), some variability appears to exist among different geographic areas (Rivers 1997). Sounds in the North Atlantic Ocean have been confirmed to have different characteristics (i.e., frequency, duration, and repetition) than those recorded in other parts of the world (Berchok et al. 2006; Mellinger and

Clark 2003; Samaran et al. 2010). Clear differences in call structure suggestive of separate populations for the western and eastern regions of the North Pacific Ocean have also been reported (Stafford et al. 2001); however, some overlap in calls from the geographically distinct regions have been observed, indicating that the whales may have the ability to mimic calls (Stafford and Moore 2005). In Southern California, blue whales produce three known call types: Type A, B, and D. B calls are stereotypic of blue whale population found in the eastern North Pacific (McDonald et al. 2006b) and are produced exclusively by males and associated with mating behavior (Oleson et al. 2007a). These calls have long durations (20 seconds) and low frequencies (10 to 100 Hertz); they are produced either as repetitive sequences (song) or as singular calls. The B call has a set of harmonic tonals, and may be paired with a pulsed Type A call. D calls are produced in highest numbers during the late spring and early summer and in diminished numbers during the fall, when A-B song dominates blue whale calling (Hildebrand et al. 2011; Hildebrand et al. 2012; Oleson et al. 2007c).

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

As with other baleen whale vocalizations, blue whale vocalization function is unknown, although numerous hypotheses exist (maintaining spacing between individuals, recognition, socialization, navigation, contextual information transmission, and location of prey resources) (Edds-Walton 1997; Oleson et al. 2007b; Payne and Webb 1971; Thompson et al. 1992). Intense bouts of long, patterned sounds are common from fall through spring in low latitudes, but these also occur less frequently while in summer high-latitude feeding areas. Short, rapid sequences of 30 to 90 Hertz calls are associated with socialization and may be displays by males based upon call seasonality and structure. The low frequency sounds produced by blue whales can, in theory, travel long distances, and it is possible that such long distance communication occurs (Edds-Walton 1997; Payne and Webb 1971). The long-range sounds may also be used for echolocation in orientation or navigation (Tyack 1999).

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. 2007c; Stafford and Moore 2005). In terms of functional hearing capability, blue whales belong to the low frequency group, which have a hearing range of 7 Hertz to 35 kiloHertz (NOAA 2018b).

9.2.4 Status

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

9.2.5 Critical Habitat

No critical habitat has been designated for the blue whale.

9.2.6 Recovery Goals

In response to the current threats facing the species, NMFS developed goals to recover blue whale populations. These threats will be discussed in further detail in the *Environmental Baseline* section of this consultation. See the 1998 Final Recovery Plan for the blue whale for complete down listing/delisting criteria for each of the following recovery goals:

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

9.3 Bowhead Whale

The bowhead whale is a circumpolar baleen whale found throughout high latitudes in the Northern Hemisphere (Figure 55).

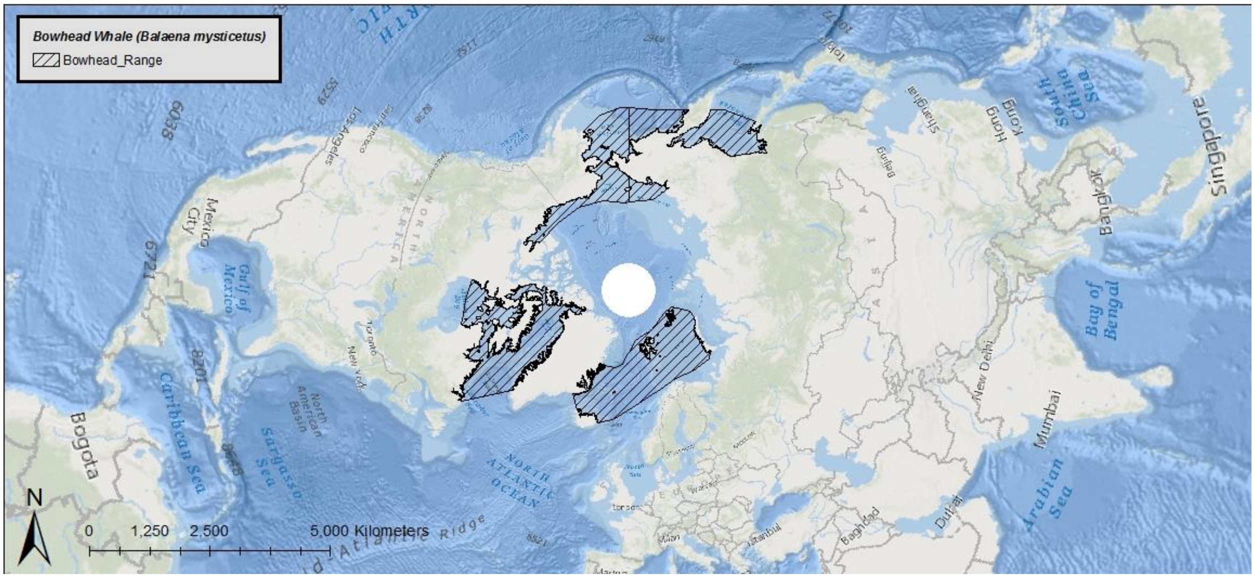

Figure 55. Map identifying the range of the endangered bowhead whale.

Bowheads are baleen whales distinguishable from other whales by a dark body with a distinctive white chin, no dorsal fin, and a bow-shaped skull that takes up about 35 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. 2017) and the scientific literature was used to summarize the life history, population dynamics, and status of the species as follows.

9.3.1 Life History

The average lifespan of bowhead whales 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 twenty 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. Bowhead whales use their large skulls to break through thick ice and feed on zooplankton (crustaceans like copepods, euphausiids, and mysids), other invertebrates, and fish.

9.3.2 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 animals. There are currently four or five recognized stocks of bowhead whales, 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 United States 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 and Hudson Bay stock may have contained over 11,000 individuals, but now it is thought to number around 7,000 bowhead whales (Cosens et al. 2006). In the Okhotsk Sea, there were originally more than 3,000 bowhead whales, but now there are only about 200 (Cooke and Reeves 2018). The Spitsbergen stock originally had about 24,000 bowhead whales and supported a huge European fishery, but today is thought to only contain hundreds of individuals (Cooke and Reeves 2018).

Current estimates indicate approximately 16,892 (N_{min}=16,091) 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 68 different haplotypes defined by 44 variable sites (Leduc et al. 2008) making it the most diverse stock of bowhead whales. 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 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 smaller population size (Alter et al. 2012; LeDuc et al. 2005; MacLean 2002). The Davis Strait and Hudson Bay stock has 23 mitochondrial DNA haplotypes, making it more diverse than the Okhotsk stock but less diverse than the large Western Arctic stock (Alter et al. 2012). Based on historic mitochondrial DNA, the Spitsbergen stock previously had at least 58 mitochondrial DNA 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 Ocean (Rugh and Shelden 2009) (Figure 55).

9.3.3 Vocalization and Hearing

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

9.3.4 Status

The bowhead whale is endangered because of past commercial whaling. Prior to commercial whaling, thousands of bowhead whales existed. Global abundance declined to 3,000 by the 1920's. Bowhead whales may be killed under "aboriginal subsistence whaling" provisions of the International Whaling Commission. 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.

9.3.5 Critical Habitat

No critical habitat has been designated for the bowhead whale.

9.3.6 Recovery Goals

NMFS has not prepared a recovery plan available for the bowhead whale.

9.4 Bryde's Whale – Gulf of Mexico Subspecies

The Bryde's whale is a widely distributed baleen whale found in tropical and subtropical oceans. The Gulf of Mexico subspecies of Bryde's whale is the only known baleen whale to inhabit the Gulf of Mexico year-round. The Gulf of Mexico subspecies of Bryde'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 (Figure 56).

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 are baleen whales that grow to lengths of 13 to 16.5 meters (42.7 to 54.1 feet). Bryde's whales in the Gulf of Mexico are a taxonomically distinct subspecies. The Gulf of Mexico subspecies of Bryde's whales 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).

Information available from the status review (Rosel 2016a), the proposed listing (81 FR 88639), final rule (84 FR 15446), recent stock assessment report (Hayes et al. 2017), and available literature were used to summarize the life history, population dynamics, and status of the species as follows.

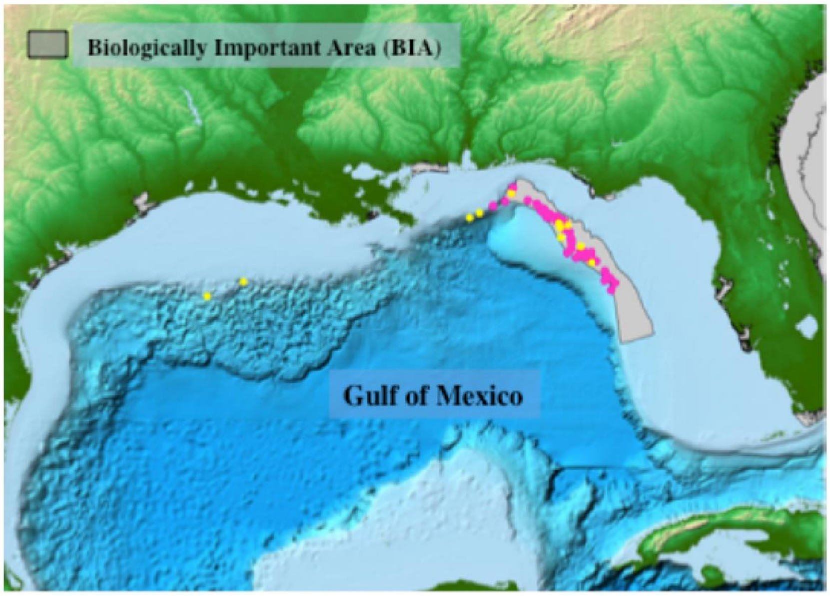

Figure 56. Map identifying the biologically important area and known range of the endangered Gulf of Mexico sub-species of Bryde's whale (Rosel 2016).

9.4.1 Life History

Little is known about the Gulf of Mexico subspecies of Bryde's whale life history compared to Bryde's whales more generally and worldwide. The life expectancy of Gulf of Mexico subspecies of Bryde'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 Gulf of Mexico subspecies Bryde's whales specifically, but Bryde's whales are thought to be sexually mature at eight to 13 years. Peak breeding and calving probably occurs in the fall. Females breed every second year. Gulf of Mexico subspecies of Bryde's whales exhibit a typical diel dive pattern, with deep dives in the daytime, and shallow dives at night. Bryde's whales generally feed on schooling fishes (e.g., anchovy, sardine, mackerel, and herring) and small crustaceans (Rosel 2016b).

Bryde's whales, unlike other baleen whales, are not known to make long foraging migrations (Figueiredo et al. 2014). The Gulf of Mexico subspecies 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).

9.4.2 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 Gulf of Mexico sub-species Bryde's whale.

The Gulf of Mexico subspecies of Bryde's whale population is very small; the most recent 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). There is no population trend information available for the Gulf of Mexico subspecies of Bryde's whale.

Genetic diversity within the Gulf of Mexico subspecies of Bryde'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 Gulf of Mexico subspecies of Bryde's whales sampled (Rosel 2016a).

Phylogenetic reconstruction using the control region and all published Bryde's whale sequences reveal that the Gulf of Mexico Bryde'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 Gulf of Mexico subspecies of Bryde'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 Gulf of Mexico subspecies of Bryde's whales is primarily in a small, biologically important area in the northeastern Gulf of Mexico near De Soto Canyon, in waters 100 to 400 meters (328 to 1,312 feet) deep along the continental shelf break (Figure 56). It inhabits the Gulf of Mexico year round, but its distribution outside of this biologically important area is unknown.

9.4.3 Vocalization and Hearing

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

9.4.4 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 Gulf of Mexico subspecies of Bryde'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 Gulf of Mexico subspecies of Bryde's whales' ability to communicate. Vessel traffic from commercial shipping and the oil and gas industry also poses a risk of vessel strike for Gulf of Mexico subspecies of Bryde's whales. Entanglement from fishing gear is also a threat, and several fisheries operate within the range of the species. The *Deepwater Horizon* oil spill severely impacted Bryde's whales in the Gulf of Mexico, with an estimated 17 percent of the population killed, 22 percent of females exhibiting reproductive failure, and 18 percent of the population suffering adverse health effects (DWHTrustees 2016). Because the Gulf of Mexico subspecies of Bryde's whale population is so small size and has low genetic diversity, it is highly susceptible to further perturbations.

9.4.5 Critical Habitat

No critical habitat has been designated for Gulf of Mexico subspecies of Bryde's whales.

9.4.6 Recovery Goals

NMFS has not prepared a recovery plan for the Gulf of Mexico subspecies of Bryde's whales.

9.5 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 (3,281 feet) deep. The Main Hawaiian Islands insular DPS of false killer whales is found in waters around the Main Hawaiian Islands (Figure 57).

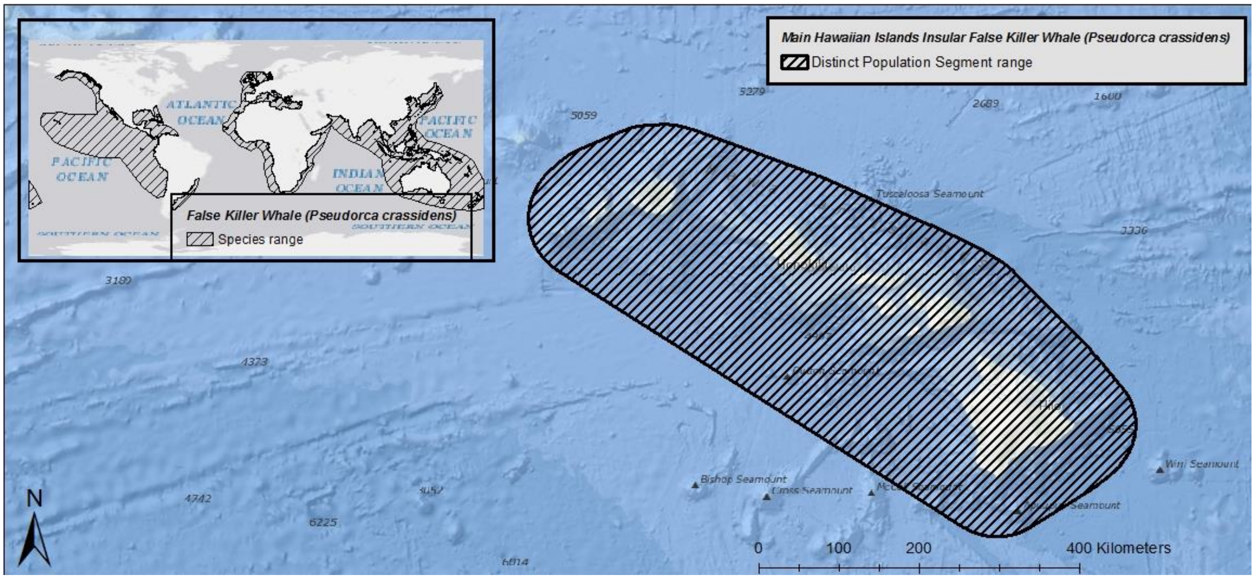

Figure 57. Map identifying the range of false killer whales and the endangered Main Hawaiian Islands insular distinct population segment of false killer whale.

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 status review (NMFS 2010c) and recent stock assessment (Carretta et al. 2017) were used to summarize the status of the species as follows.

9.5.1 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.

9.5.2 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.

The 2017 NMFS stock assessment report estimates 167 individuals (N_{min}=149) (Carretta et al. 2018). Recent, unpublished estimates of abundance for two time periods, 2000 through 2004 and 2006 through 2009, were 162 and 151 respectively. The minimum population estimate for the Main Hawaiian Islands insular DPS of false killer whale is the number of distinct individuals identified during the 2011 through 2014 photo-identification studies, or 92 false killer whales (Baird et al. 2015).

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

The Main Hawaiian Islands insular DPS of false killer whale is considered resident to the Main Hawaiian Islands and is genetically and behaviorally distinct compared to other stocks. Genetic data suggest little immigration into the Main Hawaiian Islands insular DPS of false killer whale (Baird et al. 2012). 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 Ocean.

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 40 kilometers (21.6 nautical miles) of the Main Hawaiian Islands belong to the insular stock and all false killer whales beyond 140 kilometers (75.6 nautical miles) 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.

9.5.3 Vocalization and Hearing

There are three categories of sounds that odontocetes make. The first includes echolocation sounds of high intensity, high frequency, high repetition rate, and very short duration (Au et al. 2000). The second category of odontocete sounds is comprised of pulsed sounds. Burst pulses are generally very complex and fast, with frequency components sometimes above 100 kiloHertz and average repetition rates of 300 per second (Yuen et al. 2007).

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

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

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

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)

9.5.4 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).

9.5.5 Critical Habitat

Critical habitat has been designated for the Main Hawaiian Islands Insular DPS of false killer whale and was previously discussed in Section 7.7.

9.5.6 Recovery Goals

NMFS has not prepared a recovery plan for the Main Hawaiian Islands insular DPS of the false killer whale.

9.6 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 58).

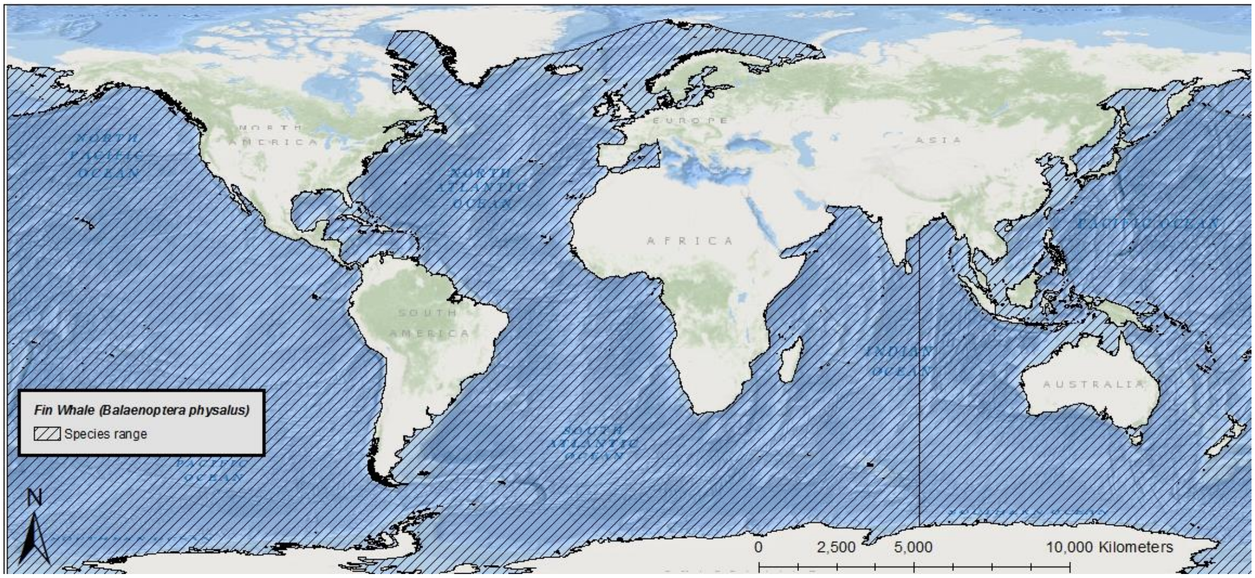

Figure 58. Map identifying the range of the endangered fin whale.

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 lower jaw is gray or black on the left side and creamy white on the right side. The fin whale was originally listed as endangered on December 2, 1970.

Information available from the recovery plan (NMFS 2010b), recent stock assessment reports (Carretta et al. 2018; Hayes et al. 2018b; Muto et al. 2018) and status review (NMFS 2011a) were used to summarize the life history, population dynamics and status of the species as follows.

9.6.1 Life History

Fin whales can live, on average, 80 to 90 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.

9.6.2 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 Ocean was 42,000 to 45,000 (Ohsumi and Wada 1974). In the North Atlantic Ocean, at least 55,000 fin whales were killed between 1910 and 1989. Approximately 704,000 fin whales were killed in the Southern Hemisphere from 1904 through 1975. Of the three to seven stocks thought to occur in the North Atlantic Ocean (approximately 50,000 individuals), one occurs in U.S. waters, where NMFS' best estimate of abundance is 1,618 individuals (N_{min}=1,234); however, this may be an underrepresentation as the entire range of the stock was not surveyed (Palka 2012a). There are three stocks in U.S. Pacific Ocean waters: Northeast Pacific (N= 3,168; N_{min}=2,554), Hawaii (approximately 154 individuals, N_{min}=75) and California/Oregon/Washington (approximately 9,029 individuals, N_{min}=8,127) (Nadeem et al. 2016). The International Whaling Commission (IWC) also recognizes the China Sea stock of fin whales, found in the Northwest Pacific Ocean, 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. 2016).

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

Archer et al. (2013) recently examined the genetic structure and diversity of fin whales globally. Full sequencing of the mitochondrial DNA genome for 154 fin whales sampled in the North Atlantic Ocean, North Pacific Ocean, 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 Ocean, 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 populations 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 Ocean, North Pacific Ocean, and Southern Hemisphere where they appear to be reproductively isolated. The availability of prey, sand lice in particular, is thought to have had a strong influence on the distribution and movements of fin whales.

9.6.3 Vocalizations and Hearing

Fin whales produce a variety of low frequency sounds in the 10 to 200 Hertz range (Edds 1988; Thompson et al. 1992; Watkins 1981; Watkins et al. 1987). Typical vocalizations are long, patterned pulses of short duration (0.5 to two seconds) in the 18 to 35 Hertz range, but only males are known to produce these (Clark et al. 2002; Patterson and Hamilton 1964). The most typically recorded call is a 20 Hertz pulse lasting about one second, and reaching source levels of 189 ± 4 decibels re: 1 μPa at 1 meter (Charif et al. 2002; Clark et al. 2002; Edds 1988; Garcia et al. 2018; Richardson et al. 1995b; Sirovic et al. 2007; Watkins 1981; Watkins et al. 1987). These pulses frequently occur in long sequenced patterns, are down swept (e.g., 23 to 18 Hertz), and can be repeated over the course of many hours (Watkins et al. 1987). In temperate waters, intense bouts of these patterned sounds are very common from fall through spring, but also occur to a lesser extent during the summer in high latitude feeding areas (Clark and Charif 1998). Richardson et al. (1995c) reported this call occurring in short series during spring, summer, and fall, and in repeated stereotyped patterns in winter. The seasonality and stereotype nature of these vocal sequences suggest that they are male reproductive displays (Watkins 1981; Watkins et al. 1987); a notion further supported by data linking these vocalizations to male fin whales only (Croll et al. 2002). In Southern California, the 20 Hertz pulses are the dominant fin whale call type associated both with call-counter-call between multiple animals and with singing (U.S. Navy 2010; U.S. Navy 2012). An additional fin whale sound, the 40 Hertz call described by Watkins (1981), was also frequently recorded, although these calls are not as common as the 20 Hertz fin whale pulses. Seasonality of the 40 Hertz calls differed from the 20 Hertz calls, since 40 Hertz calls were more prominent in the spring, as observed at other sites across the northeast Pacific Ocean (Sirovic et al. 2012). Source levels of Eastern Pacific Ocean fin whale 20 Hertz calls has been reported as 189 ± 5.8 decibels re: 1 μPa at 1 meter (Weirathmueller et al. 2013). Some researchers have also recorded moans of 14 to 118 Hertz, with a dominant frequency of 20 Hertz, tonal and upsweep vocalizations of 34 to 150 Hertz, and songs of 17 to 25 Hertz (Cummings and Thompson 1994; Edds 1988; Garcia et al. 2018; Watkins 1981). In general, source levels for fin whale vocalizations are 140 to 200 decibels re: 1 μPa at 1 meter (see also Clark and Gagnon 2004; as compiled by Erbe 2002b). The source depth of calling fin whales has been reported to be about 50 meters (164 feet) (Watkins et al. 1987). Although acoustic recordings of fin whales from many diverse regions show close adherence to the typical 20-Hertz bandwidth and sequencing when performing these vocalizations, there have been slight differences in the pulse patterns, indicative of some geographic variation (Thompson et al. 1992; Watkins et al. 1987).

Although their function is still in doubt, low frequency fin whale vocalizations travel over long distances and may aid in long distance communication (Edds-Walton 1997; Payne and Webb 1971). During the breeding season, fin whales produce pulses in a regular repeating pattern, which have been proposed to be mating displays similar to those of humpback whales (Croll et al. 2002). These vocal bouts last for a day or longer (Tyack 1999). Also, it has been suggested that some fin whale sounds may function for long range echolocation of large-scale geographic targets such as seamounts, which might be used for orientation and navigation (Tyack 1999).

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 2018b).

9.6.4 Status

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

9.6.5 Critical Habitat

No critical habitat has been designated for the fin whale.

9.6.6 Recovery Goals

In response to the current threats facing the species, NMFS developed goals to recover fin whale populations. These threats will be discussed in further detail in the *Environmental Baseline* section of this consultation. See the 2010 Final Recovery Plan for the fin whale for complete downlisting/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.

9.7 Gray Whale – Western North Pacific Population

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 59).

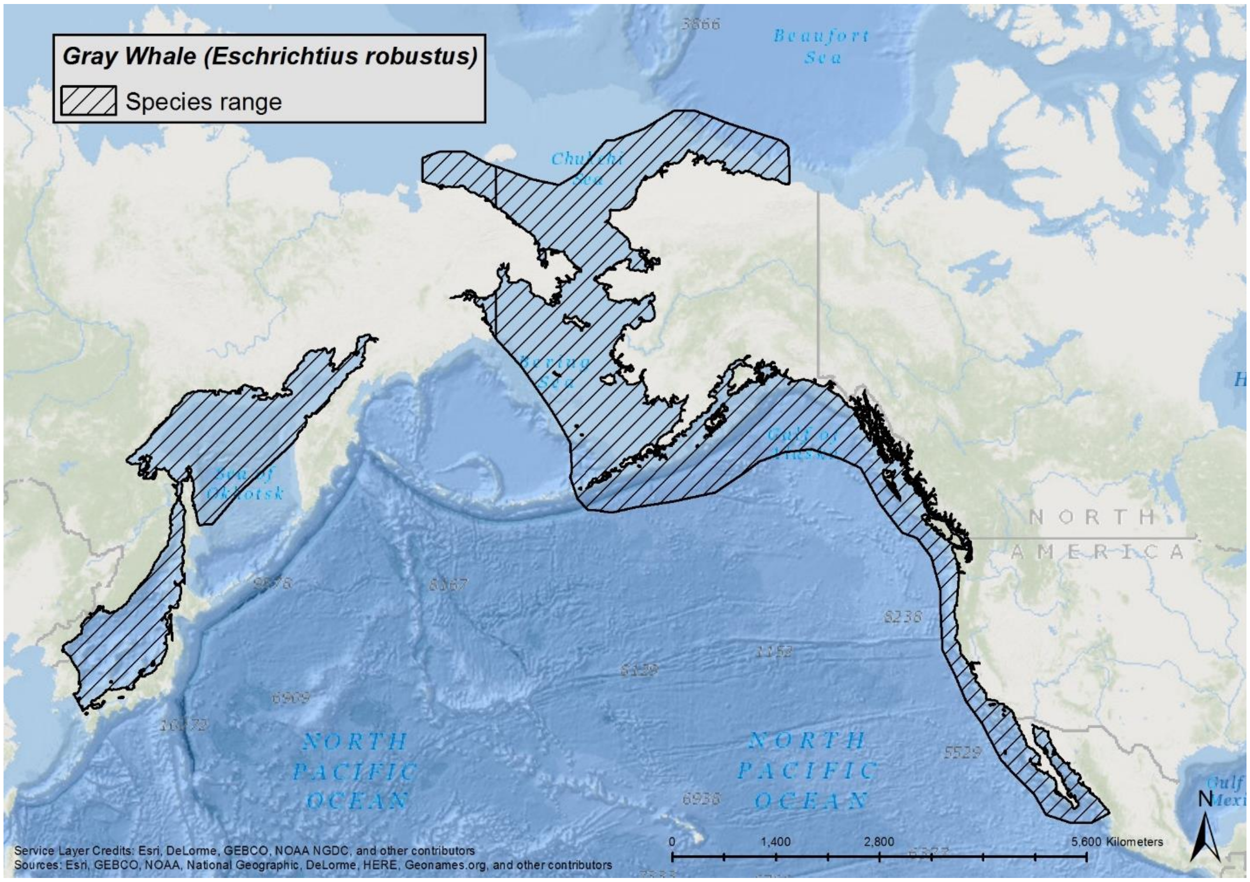

Figure 59. Map identifying the range of the gray whale.

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 14 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. 2016b; Muto et al. 2016; Waring et al. 2016b) were used to summarize the life history, population dynamics and status of the species as follows.

9.7.1 Life History

The average life span of gray whales is unknown but it is thought to be as long as 80 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 12 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.

9.7.2 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 best estimate of the Western North Pacific population of gray whales is 140 (N_{min}=135) individuals (Carretta et al. 2018). Photo-identification data collected between 1994 and 2011 on the Western North Pacific population of gray whale summer feeding ground off Sakhalin Island were used to calculate an abundance estimate of 140 whales for the non-calf population size in 2012 (Cooke et al. 2013). The minimum population estimate for the Western North Pacific stock is 135 individual gray whales on the summer feeding ground off Sakhalin Island. The current best growth rate estimate for the Western North Pacific population of gray whale stock is 3.3 percent annually.

There are often observed movements between individuals from the Eastern North Pacific stock and Western North Pacific stock; however, genetic comparisons show significant mitochondrial and nuclear genetic differences between whales sampled from each stock indicating genetically distinct populations (Leduc et al. 2002). A study conducted between 1995 and 1999 using biopsy samples found that Western North Pacific population of gray whales have retained a relatively high number of mitochondrial DNA 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). Brüniche-Olsen et al. (2018) found a high degree of gene flow into the Western North Pacific stock and they determined that the Western North Pacific stock is still genetically diverse at functionally important loci.

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. 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 Ocean, which may indicate that not all gray whales share the same migratory patterns.

9.7.3 Vocalization and Hearing

No data are available regarding Western North Pacific population of gray whale hearing and little regarding communication. The U.S. Navy has recorded short-duration (approximately one second) frequency sweeps at 55 Hertz in the East China Sea, the likely source of which was determined to be Western North Pacific gray whales (Gagnon 2016). These sweeps are often emitted in pairs or triplets with an intersweep interval of approximately three or four seconds. These vocalizations contain multiple harmonics; the first harmonic is the weakest while the second and third harmonics are usually the strongest. Otherwise, we assume that Eastern North Pacific population of gray whale communication is representative of the Western North Pacific population of gray whale and present information stemming from this population. Individuals produce broadband sounds within the 100 Hertz to 12 kiloHertz range (Dahlheim et al. 1984; Jones and Swartz 2002; Thompson et al. 1979). The most common sounds encountered are on feeding and breeding grounds, where "knocks" of roughly 142 decibels re: 1 μPa at 1 meter (source level) have been recorded (Cummings et al. 1968; Jones and Swartz 2002; Thomson and Richardson 1995). However, other sounds have also been recorded in Russian foraging areas, including rattles, clicks, chirps, squeaks, snorts, thumps, knocks, bellows, and sharp blasts at frequencies of 400 Hertz to 5 kiloHertz (Petrochenko et al. 1991). Estimated source levels for these sounds ranged from 167 to 188 decibels re: 1 μPa at 1 meter (Petrochenko et al. 1991). Low frequency (less than 1.5 kiloHertz) "bangs" and "moans" are most often recorded during migration and during ice-entrapment (Carroll et al. 1989; Crane and Lashkari. 1996). Sounds vary by social context and may be associated with startle responses (Rohrkasse-Charles et al. 2011). Calves exhibit the greatest variation in frequency range used, while adults are narrowest; groups with calves were never silent while in calving grounds (Rohrkasse-Charles et al. 2011). Based upon a single captive calf, moans were more frequent when the calf was less than a year old, but after a year, croaks were the predominant call type (Wisdom et al. 1999).

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

9.7.4 Status

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

The Western North Pacific population of gray whales has increased over the last ten years at an estimated rate of 3.3 percent. The Western North Pacific population was thought to be geographically isolated from the Eastern North Pacific population, but recent documentation of some gray whales moving between geographic areas in the Pacific Ocean indicate otherwise. Also, in recent years, gray whales have been sighted in the Eastern Atlantic Ocean and Mediterranean Sea, but it is unknown to which population those animals belong.

9.7.5 Critical Habitat

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

9.7.6 Recovery Goals

NMFS has not prepared a recovery plan for the Western North Pacific population of gray whale. In general, ESA-listed species, which occur entirely outside United States jurisdiction, are not likely to benefit from recovery plans (55 FR 24296; June 15, 1990).

9.8 Humpback Whale – Arabian Sea Distinct Population Segment

The humpback whale is a widely distributed baleen whale found in all major oceans (Figure 60).

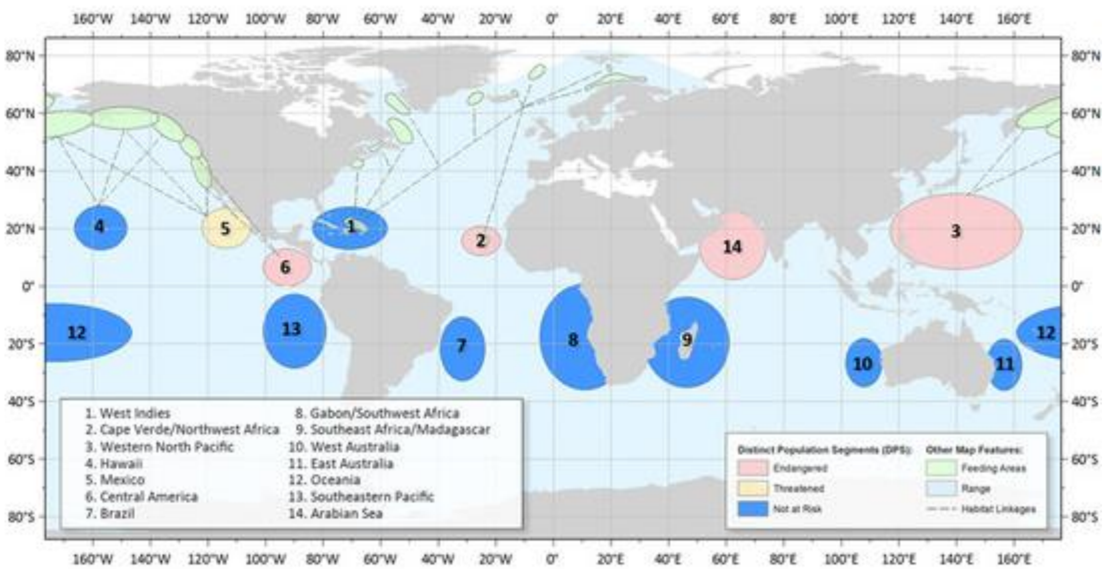

Figure 60. Map identifying 14 distinct population segments with one threatened and four endangered, based on primarily breeding location of the humpback whale, their range, and feeding areas (Bettridge et al. 2015).

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

9.8.1 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).

9.8.2 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 the Arabian Sea 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 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).

9.8.3 Vocalization and Hearing

Humpback whale vocalization is much better understood than is hearing. Different sounds are produced that correspond to different functions: feeding, breeding, and other social calls (Dunlop et al. 2008). Males sing complex sounds while in low-latitude breeding areas in a frequency range of 20 Hertz to 4 kiloHertz with estimated source levels from 144 to 174 decibels (Au and Green 2000; Frazer and Mercado 2000; Richardson et al. 1995b; Winn et al. 1970). Males also produce sounds associated with aggression, which are generally characterized by frequencies between 50 Hertz to 10 kiloHertz with most energy below 3 kiloHertz (Silber 1986; Tyack 1983). Such sounds can be heard up to 9 kilometers (4.9 nautical miles) away (Tyack 1983). Other social sounds from 50 Hertz to 10 kiloHertz (most energy below 3 kiloHertz) are also produced in breeding areas (Richardson et al. 1995b; Tyack 1983). While in northern feeding areas, both sexes vocalize in grunts (25 Hertz to 1.9 kiloHertz), pulses (25 to 89 Hertz) and songs (ranging from 30 Hertz to 8 kiloHertz but dominant frequencies of 120 Hertz to 4 kiloHertz), which can be very loud (175 to 192 decibels re: 1 microPascal (µPa) at 1 meter) (Au and Green 2000; Erbe 2002a; Payne 1985; Richardson et al. 1995b; Thompson et al. 1986). However, humpback whales tend to be less vocal in northern feeding areas than in southern breeding areas (Richardson et al. 1995b).

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

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

"Feeding" calls, unlike song and social sounds are a highly stereotyped series of narrow-band trumpeting calls. These calls are 20 Hertz to 2 kiloHertz, less than one second in duration, and have source levels of 162 to 192 decibels re: 1 µPa-meter (D'Vincent et al. 1985; Thompson et al. 1986). The fundamental frequency of feeding calls is approximately 500 Hertz (D'Vincent et al. 1985; Thompson et al. 1986). The acoustics and dive profiles associated with humpback whale feeding behavior in the northwest Atlantic Ocean has been documented with Digital Acoustic Recording Tags[1] (DTAGs) (Stimpert et al. 2007). Underwater lunge behavior was

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[1] DTAG is a novel archival tag, developed to monitor the behavior of marine mammals, and their response to sound, continuously throughout the dive cycle. The tag contains a large array of solid-state memory and records continuously from a built-in hydrophone and suite of sensors. The sensors sample the orientation of the animal in three dimensions with sufficient speed and resolution to capture individual fluke strokes. Audio and sensor

associated with nocturnal feeding at depth and with multiple boats of broadband click trains that were acoustically different from toothed whale echolocation: Stimpert et al. (2007) termed these sounds "mega-clicks" which showed relatively low received levels at the DTAGs (143 to 154 decibels re: 1 µPa), with the majority of acoustic energy below 2 kiloHertz.

NMFS categorizes humpback whales in the low-frequency cetacean functional hearing group, with an applied frequency range between 7 Hertz and 35 kiloHertz (NMFS 2018). 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.

9.8.4 Status

Humpback whales were originally listed as endangered as a result of past commercial whaling, and the five DPSs that remain listed (Cape Verde Islands/Northwest Africa, Western North Pacific, Central America, Arabian Sea, and Mexico) have likely not yet recovered from this. Prior to commercial whaling, hundreds of thousands of humpback whales existed. Global abundance declined to the low thousands by 1968, the last year of substantial catches (IUCN 2012). Humpback whales may be killed under "aboriginal subsistence whaling" and "scientific permit whaling" provisions of the 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.

recording is synchronous so the relative timing of sounds and motion can be determined precisely Johnson, M. P., and P. L. Tyack. 2003. A digital acoustic recording tag for measuring the response of wild marine mammals to sound. IEEE Journal of Oceanic Engineering 28(1):3-12.

9.8.5 Critical Habitat

No critical habitat has been designated for humpback whales.

9.8.6 Recovery Goals

In response to the current threats facing the species, NMFS developed goals to recover humpback whale populations. These threats will be discussed in further detail in the *Environmental Baseline* section of this consultation. See the 1991 Final Recovery Plan for the humpback whale for the complete downlisting/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.

9.9 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 60). Humpback whales are distinguishable from other whales by long pectoral fins and are typically dark grey with some areas of white. They 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 1991), recent stock assessment reports (Carretta et al. 2016b; Muto et al. 2016; Waring et al. 2016a), the status review (Bettridge et al. 2015), and the final listing were used to summarize the life history, population dynamics and status of the species as follows.

9.9.1 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).

9.9.2 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 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 (Figure 60). 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. 2002). 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. 2019). 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).

9.9.3 Vocalization and Hearing

Humpback whale vocalization is much better understood than is hearing. Different sounds are produced that correspond to different functions: feeding, breeding, and other social calls (Dunlop et al. 2008). Males sing complex sounds while in low-latitude breeding areas in a frequency range of 20 Hertz to 4 kiloHertz with estimated source levels from 144 to 174 decibels (Au and Green 2000; Frazer and Mercado 2000; Richardson et al. 1995b; Winn et al. 1970). Males also produce sounds associated with aggression, which are generally characterized by frequencies between 50 Hertz to 10 kiloHertz with most energy below 3 kiloHertz (Silber 1986; Tyack 1983). Such sounds can be heard up to 9 kilometers (4.9 nautical miles) away (Tyack 1983). Other social sounds from 50 Hertz to 10 kiloHertz (most energy below 3 kiloHertz) are also produced in breeding areas (Richardson et al. 1995b; Tyack 1983). While in northern feeding areas, both sexes vocalize in grunts (25 Hertz to 1.9 kiloHertz), pulses (25 to 89 Hertz) and songs (ranging from 30 Hertz to 8 kiloHertz but dominant frequencies of 120 Hertz to 4 kiloHertz), which can be very loud (175 to 192 decibels re: 1 µPa at 1 meter) (Au and Green 2000; Erbe 2002a; Payne 1985; Richardson et al. 1995b; Thompson et al. 1986). However, humpback whales tend to be less vocal in northern feeding areas than in southern breeding areas (Richardson et al. 1995b).

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

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

"Feeding" calls, unlike song and social sounds are a highly stereotyped series of narrow-band trumpeting calls. These calls are 20 Hertz to 2 kiloHertz, less than one second in duration, and have source levels of 162 to 192 decibels re: 1 μPa-meter (D'Vincent et al. 1985; Thompson et al. 1986). The fundamental frequency of feeding calls is approximately 500 Hertz (D'Vincent et al. 1985; Thompson et al. 1986). The acoustics and dive profiles associated with humpback whale feeding behavior in the northwest Atlantic Ocean has been documented with DTAGs (Stimpert et al. 2007). Underwater lunge behavior was associated with nocturnal feeding at depth and with multiple boats of broadband click trains that were acoustically different from toothed whale echolocation: Stimpert et al. (2007) termed these sounds "mega-clicks" which showed relatively low received levels at the DTAGs (143 to 154 decibels re: 1 μPa), with the majority of acoustic energy below 2 kiloHertz.

NMFS categorizes humpback whales in the low-frequency cetacean functional hearing group, with an applied frequency range between 7 Hertz and 35 kiloHertz (NMFS 2018). 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.

9.9.4 Status

Humpback whales were originally listed as endangered because of past commercial whaling, and the five DPSs that remain listed (Cape Verde Islands/Northwest Africa, Western North Pacific, Central America, Arabian Sea, and Mexico) have likely not yet recovered from this. Prior to commercial whaling, hundreds of thousands of humpback whales existed. Global abundance declined to the low thousands by 1968, the last year of substantial catches (IUCN 2012). Humpback whales may be killed under "aboriginal subsistence whaling" and "scientific permit whaling" provisions of the 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.

9.9.5 Critical Habitat

No critical habitat has been designated for humpback whales.

9.9.6 Recovery Goals

In response to the current threats facing the species, NMFS developed goals to recover humpback whale populations. These threats will be discussed in further detail in the *Environmental Baseline* section of this consultation. See the 1991 Final Recovery Plan for the humpback whale for the complete downlisting/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.

9.10 Humpback Whale – Central America Distinct Population Segment

The humpback whale is a widely distributed baleen whale found in all major oceans (Figure 60). Humpback whales are distinguishable from other whales by long pectoral fins and are typically dark grey with some areas of white. They 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 1991), recent stock assessment reports (Carretta et al. 2016b; Muto et al. 2016; Waring et al. 2016a), the status review (Bettridge et al. 2015), and the final listing were used to summarize the life history, population dynamics and status of the species as follows.

9.10.1 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).

9.10.2 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 Central America 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 Central America DPS is 411. A population growth rate is currently unavailable for the Central America 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 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 just below 500 individuals and so may be subject to genetic risks due to inbreeding and moderate environmental variance (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 60).

9.10.3 Vocalization and Hearing

Humpback whale vocalization is much better understood than is hearing. Different sounds are produced that correspond to different functions: feeding, breeding, and other social calls (Dunlop et al. 2008). Males sing complex sounds while in low-latitude breeding areas in a frequency range of 20 Hertz to 4 kiloHertz with estimated source levels from 144 to 174 decibels (Au and Green 2000; Frazer and Mercado 2000; Richardson et al. 1995b; Winn et al. 1970). Males also produce sounds associated with aggression, which are generally characterized by frequencies between 50 Hertz to 10 kiloHertz with most energy below 3 kiloHertz (Silber 1986; Tyack 1983). Such sounds can be heard up to 9 kilometers (4.9 nautical miles) away (Tyack 1983). Other social sounds from 50 Hertz to 10 kiloHertz (most energy below 3 kiloHertz) are also produced in breeding areas (Richardson et al. 1995b; Tyack 1983). While in northern feeding areas, both sexes vocalize in grunts (25 Hertz to 1.9 kiloHertz), pulses (25 to 89 Hertz) and songs (ranging from 30 Hertz to 8 kiloHertz but dominant frequencies of 120 Hertz to 4 kiloHertz), which can be very loud (175 to 192 decibels re: 1 µPa at 1 meter) (Au and Green 2000; Erbe 2002a; Payne 1985; Richardson et al. 1995b; Thompson et al. 1986). However, humpback whales tend to be less vocal in northern feeding areas than in southern breeding areas (Richardson et al. 1995b).

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

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

“Feeding” calls, unlike song and social sounds are a highly stereotyped series of narrow-band trumpeting calls. These calls are 20 Hertz to 2 kiloHertz, less than one second in duration, and have source levels of 162 to 192 decibels re: 1 µPa-meter (D'Vincent et al. 1985; Thompson et al. 1986). The fundamental frequency of feeding calls is approximately 500 Hertz (D'Vincent et al. 1985; Thompson et al. 1986). The acoustics and dive profiles associated with humpback whale feeding behavior in the northwest Atlantic Ocean has been documented with DTAGs (Stimpert et al. 2007). Underwater lunge behavior was associated with nocturnal feeding at depth and with multiple boats of broadband click trains that were acoustically different from toothed whale echolocation: Stimpert et al. (2007) termed these sounds “mega-clicks” which showed relatively low received levels at the DTAGs (143 to 154 decibels re: 1 µPa), with the majority of acoustic energy below 2 kiloHertz.

NMFS categorizes humpback whales in the low-frequency cetacean functional hearing group, with an applied frequency range between 7 Hertz and 35 kiloHertz (NMFS 2018). 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.

9.10.4 Status

Humpback whales were originally listed as endangered because of past commercial whaling, and the five DPSs that remain listed (Cape Verde Islands/Northwest Africa, Western North Pacific, Central America, Arabian Sea, and Mexico) have likely not yet recovered from this. Prior to commercial whaling, hundreds of thousands of humpback whales existed. Global abundance declined to the low thousands by 1968, the last year of substantial catches (IUCN 2012). Humpback whales may be killed under “aboriginal subsistence whaling” and “scientific permit whaling” provisions of the 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.

9.10.5 Critical Habitat

No critical habitat has been designated for humpback whales.

9.10.6 Recovery Goals

In response to the current threats facing the species, NMFS developed goals to recover humpback whale populations. These threats will be discussed in further detail in the *Environmental Baseline* section of this consultation. See the 1991 Final Recovery Plan for the humpback whale for the complete downlisting/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.

9.11 Humpback Whale – Mexico Distinct Population Segment

The humpback whale is a widely distributed baleen whale found in all major oceans (Figure 60). Humpback whales are distinguishable from other whales by long pectoral fins and are typically dark grey with some areas of white. They 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 1991), recent stock assessment reports (Carretta et al. 2016b; Muto et al. 2016; Waring et al. 2016a), the status review (Bettridge et al. 2015), and the final listing were used to summarize the life history, population dynamics and status of the species as follows.

9.11.1 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).

9.11.2 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 Mexico 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 Mexico DPS is unavailable. A population growth rate is currently unavailable for the Mexico 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 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 2,000 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 60) (81 FR 62259).

9.11.3 Vocalization and Hearing

Humpback whale vocalization is much better understood than is hearing. Different sounds are produced that correspond to different functions: feeding, breeding, and other social calls (Dunlop et al. 2008). Males sing complex sounds while in low-latitude breeding areas in a frequency range of 20 Hertz to 4 kiloHertz with estimated source levels from 144 to 174 decibels (Au and Green 2000; Frazer and Mercado 2000; Richardson et al. 1995b; Winn et al. 1970). Males also produce sounds associated with aggression, which are generally characterized by frequencies between 50 Hertz to 10 kiloHertz with most energy below 3 kiloHertz (Silber 1986; Tyack 1983). Such sounds can be heard up to 9 kilometers (4.9 nautical miles) away (Tyack 1983). Other social sounds from 50 Hertz to 10 kiloHertz (most energy below 3 kiloHertz) are also produced in breeding areas (Richardson et al. 1995b; Tyack 1983). While in northern feeding areas, both sexes vocalize in grunts (25 Hertz to 1.9 kiloHertz), pulses (25 to 89 Hertz) and songs (ranging from 30 Hertz to 8 kiloHertz but dominant frequencies of 120 Hertz to 4 kiloHertz), which can be very loud (175 to 192 decibels re: 1 μPa at 1 meter) (Au and Green 2000; Erbe 2002a; Payne 1985; Richardson et al. 1995b; Thompson et al. 1986). However, humpback whales tend to be less vocal in northern feeding areas than in southern breeding areas (Richardson et al. 1995b).

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

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

“Feeding” calls, unlike song and social sounds are a highly stereotyped series of narrow-band trumpeting calls. These calls are 20 Hertz to 2 kiloHertz, less than one second in duration, and have source levels of 162 to 192 decibels re: 1 µPa-meter (D'Vincent et al. 1985; Thompson et al. 1986). The fundamental frequency of feeding calls is approximately 500 Hertz (D'Vincent et al. 1985; Thompson et al. 1986). The acoustics and dive profiles associated with humpback whale feeding behavior in the northwest Atlantic Ocean has been documented with DTAGs (Stimpert et al. 2007). Underwater lunge behavior was associated with nocturnal feeding at depth and with multiple boats of broadband click trains that were acoustically different from toothed whale echolocation: Stimpert et al. (2007) termed these sounds “mega-clicks” which showed relatively low received levels at the DTAGs (143 to 154 decibels re: 1 µPa), with the majority of acoustic energy below 2 kiloHertz.

NMFS categorizes humpback whales in the low-frequency cetacean functional hearing group, with an applied frequency range between 7 Hertz and 35 kiloHertz (NMFS 2018). 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.

9.11.4 Status

Humpback whales were originally listed as endangered because of past commercial whaling, and the five DPSs that remain listed (Cape Verde Islands/Northwest Africa, Western North Pacific, Central America, Arabian Sea, and Mexico) have likely not yet recovered from this. Prior to commercial whaling, hundreds of thousands of humpback whales existed. Global abundance declined to the low thousands by 1968, the last year of substantial catches (IUCN 2012). Humpback whales may be killed under "aboriginal subsistence whaling" and "scientific permit whaling" provisions of the 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.

9.11.5 Critical Habitat

No critical habitat has been designated for humpback whales.

9.11.6 Recovery Goals

In response to the current threats facing the species, NMFS developed goals to recover humpback whale populations. These threats will be discussed in further detail in the *Environmental Baseline* section of this consultation. See the 1991 Final Recovery Plan for the humpback whale for the complete downlisting/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.

9.12 Humpback Whale – Western North Pacific Distinct Population Segment

The humpback whale is a widely distributed baleen whale found in all major oceans (Figure 60). Humpback whales are distinguishable from other whales by long pectoral fins and are typically dark grey with some areas of white. They 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 1991), recent stock assessment reports (Carretta et al. 2016b; Muto et al. 2016; Waring et al. 2016a), the status review (Bettridge et al. 2015), and the final listing were used to summarize the life history, population dynamics and status of the species as follows.

9.12.1 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).

9.12.2 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 Western North Pacific 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 Western North Pacific DPS is 1,059. A population growth rate is currently unavailable for the Western North Pacific 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 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 60).

9.12.3 Vocalization and Hearing

Humpback whale vocalization is much better understood than is hearing. Different sounds are produced that correspond to different functions: feeding, breeding, and other social calls (Dunlop et al. 2008). Males sing complex sounds while in low-latitude breeding areas in a frequency range of 20 Hertz to 4 kiloHertz with estimated source levels from 144 to 174 decibels (Au and Green 2000; Frazer and Mercado 2000; Richardson et al. 1995b; Winn et al. 1970). Males also produce sounds associated with aggression, which are generally characterized by frequencies between 50 Hertz to 10 kiloHertz with most energy below 3 kiloHertz (Silber 1986; Tyack 1983). Such sounds can be heard up to 9 kilometers (4.9 nautical miles) away (Tyack 1983). Other social sounds from 50 Hertz to 10 kiloHertz (most energy below 3 kiloHertz) are also produced in breeding areas (Richardson et al. 1995b; Tyack 1983). While in northern feeding areas, both sexes vocalize in grunts (25 Hertz to 1.9 kiloHertz), pulses (25 to 89 Hertz) and songs (ranging from 30 Hertz to 8 kiloHertz but dominant frequencies of 120 Hertz to 4 kiloHertz), which can be very loud (175 to 192 decibels re: 1 µPa at 1 meter) (Au and Green 2000; Erbe 2002a; Payne 1985; Richardson et al. 1995b; Thompson et al. 1986). However, humpback whales tend to be less vocal in northern feeding areas than in southern breeding areas (Richardson et al. 1995b).

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

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

“Feeding” calls, unlike song and social sounds are a highly stereotyped series of narrow-band trumpeting calls. These calls are 20 Hertz to 2 kiloHertz, less than one second in duration, and have source levels of 162 to 192 decibels re: 1 µPa-meter (D'Vincent et al. 1985; Thompson et al. 1986). The fundamental frequency of feeding calls is approximately 500 Hertz (D'Vincent et al. 1985; Thompson et al. 1986). The acoustics and dive profiles associated with humpback whale feeding behavior in the northwest Atlantic Ocean has been documented with DTAGs (Stimpert et al. 2007). Underwater lunge behavior was associated with nocturnal feeding at depth and with multiple boats of broadband click trains that were acoustically different from toothed whale echolocation: Stimpert et al. (2007) termed these sounds “mega-clicks” which showed relatively low received levels at the DTAGs (143 to 154 decibels re: 1 µPa), with the majority of acoustic energy below 2 kiloHertz.

NMFS categorizes humpback whales in the low-frequency cetacean functional hearing group, with an applied frequency range between 7 Hertz and 35 kiloHertz (NMFS 2018). 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.

9.12.4 Status

Humpback whales were originally listed as endangered as a result of past commercial whaling, and the five DPSs that remain listed (Cape Verde Islands/Northwest Africa, Western North Pacific, Central America, Arabian Sea, and Mexico) have likely not yet recovered from this. Prior to commercial whaling, hundreds of thousands of humpback whales existed. Global abundance declined to the low thousands by 1968, the last year of substantial catches (IUCN 2012). Humpback whales may be killed under “aboriginal subsistence whaling” and “scientific permit whaling" provisions of the 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.

9.12.5 Critical Habitat

No critical habitat has been designated for humpback whales.

9.12.6 Recovery Goals

In response to the current threats facing the species, NMFS developed goals to recover humpback whale populations. These threats will be discussed in further detail in the *Environmental Baseline* section of this consultation. See the 1991 Final Recovery Plan for the humpback whale for the complete downlisting/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.

9.13 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 (Figure 61).

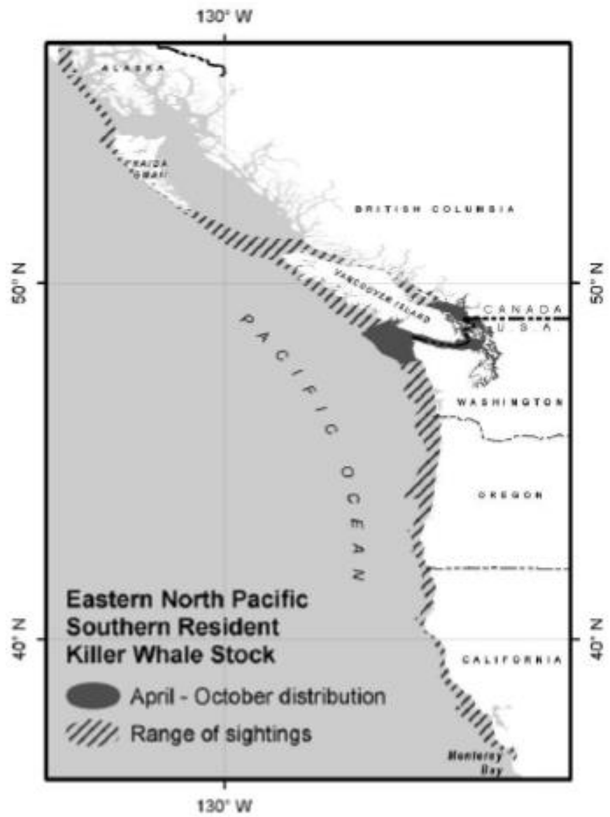

Figure 61. Map identifying the range of the endangered Southern Resident distinct population segment of killer whale. Approximate April through October distribution of the Southern Resident distinct population segment of killer whale (shaded area) and range of sightings (diagonal lines) (Carretta et al. 2016b).

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 2008), the 2016 Status Review (NMFS 2016f) and the recent stock Assessment report (Carretta et al. 2017) to summarize the life history, population dynamics and status of this species, as follows.

9.13.1 Life History

Southern Resident DPS of killer whales are geographically, matrilineally, and behaviorally distinct from other killer whale populations. The Southern Resident DPS includes three large, stable pods (J, K, and L), which occasionally interact (Parsons et al. 2009). Most mating occurs outside natal pods, during temporary associations of pods, or as a result of the temporary dispersal of males (Pilot et al. 2010). Males become sexually mature at ten to 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. They prey upon salmonids, especially Chinook salmon (Hanson et al. 2010).

9.13.2 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 Southern Resident DPS of killer whale.

The most recent abundance estimate for the Southern Resident DPS is 83 whales in 2017 (Carretta et al. 2018), and was previously 81 whales in 2015 (Carretta et al. 2017) (80 whales in 2016[2]). This represents a decline from just a few years ago, when in 2012, there were 85 whales. Population abundance has fluctuated over time with a maximum of approximately 100 whales in 1995 (Carretta et al. 2017), 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 2016f). 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. 2017).

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 (Figure 61).

9.13.3 Vocalization and Hearing

Killer whales have advanced vocal communication and also use vocalizations to aid in navigation and foraging (NMFS 2008). Their vocalizations typically have both a low frequency component (250 Hertz to 1.5 kiloHertz) and a high frequency component (five to 12 kiloHertz) (NMFS 2008). Killer whale vocalizations consist of three main types, echolocation clicks, which are primarily used for navigation and foraging, and tonal whistles and pulse calls, which are thought to be used for communication (NMFS 2008). Individual Southern Resident DPS of killer whale pods have distinct call repertoires, with each pod being recognizable by its acoustic dialect (NMFS 2008). Killer whale hearing is one of the most sensitive of any odontocete, with a

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

hearing range of one to 120 kiloHertz, with the most sensitive range being between 18 and 42 kiloHertz range (Szymanski et al. 1999).

9.13.4 Status

The Southern Resident DPS of killer whale was listed as endangered in 2005 in response to the population decline from 1996 through 2001, small population size, and reproductive limitations (i.e., few reproductive males and delayed calving). Current threats to its survival and recovery include contaminants, vessel traffic, and reduction in prey availability. Chinook salmon populations have declined due to degradation of habitat, hydrology issues, harvest, and hatchery introgression; such reductions may require an increase in foraging effort. In addition, these prey contain environmental pollutants. These contaminants become concentrated at higher trophic levels and may lead to immune suppression or reproductive impairment. The inland waters of Washington and British Columbia support a large whale watch industry, commercial shipping, and recreational boating; these activities generate underwater noise, which may mask whales' communication or interrupt foraging. The factors that originally endangered the species persist throughout its habitat: contaminants, vessel traffic, and reduced prey. The DPS's resilience to future perturbation is reduced as a result of its small population size. The recent decline, unstable population status, and population structure (e.g., few reproductive age males and non-calving adult females) continue to be causes for concern. The relatively low number of individuals in this population makes it difficult to resist or recover from natural spikes in mortality, including disease and fluctuations in prey availability.

9.13.5 Critical Habitat

Critical habitat has been designated for the Southern Resident DPS of killer whale and was previously discussed in Section 7.7.

9.13.6 Recovery Goals

In response to the current threats facing the species, NMFS developed goals to recover the Southern Resident DPS of killer whale population. These threats will be discussed in further detail in the *Environmental Baseline* section of this consultation. See the 2008 Final Recovery Plan for the Southern Resident DPS of killer whale for complete downlisting/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 DPS of 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 Resident DPS 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 DPS 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.

9.14 North Atlantic Right Whale

The North Atlantic right whale is a narrowly distributed baleen whale found in temperate and sub-polar latitudes in the North Atlantic Ocean (Figure 62). 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).

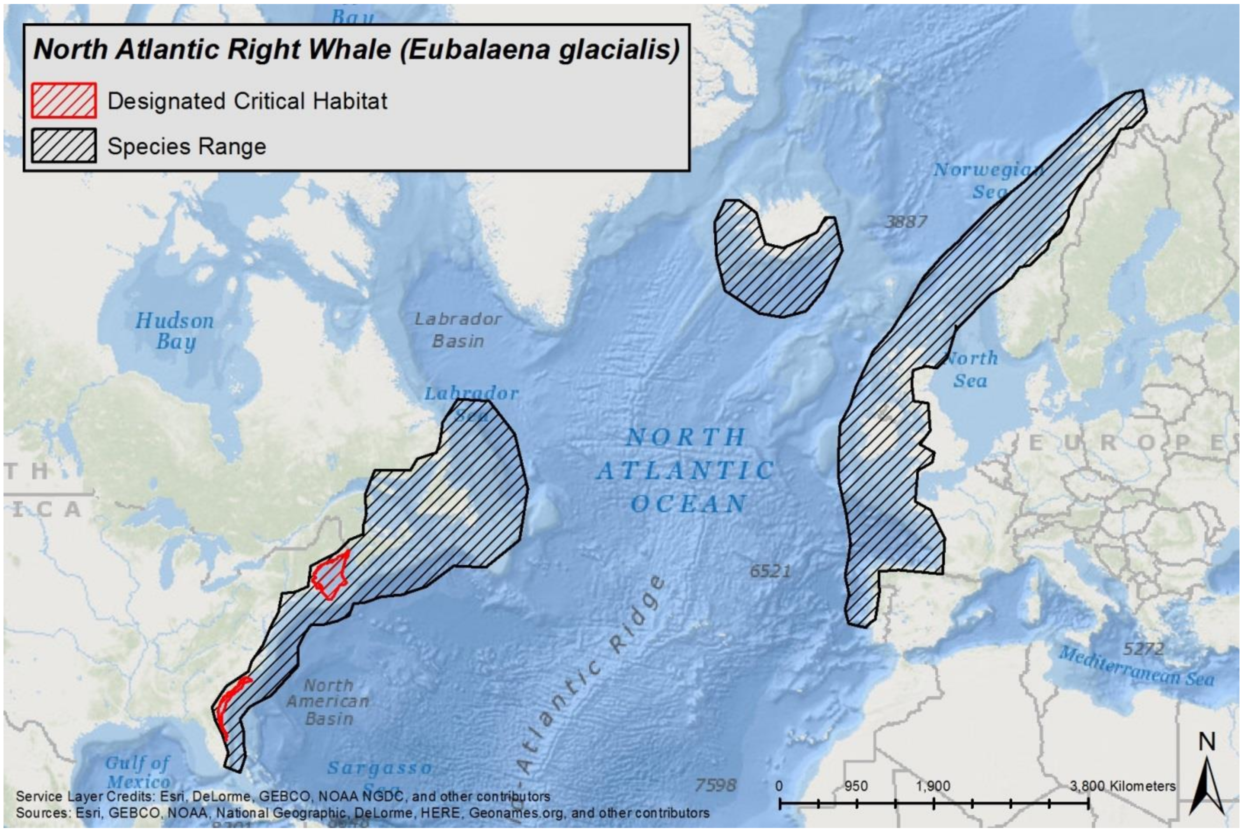

Figure 62: Map identifying the approximate historic range and currently designated U.S. critical habitat of the endangered North Atlantic right whale.

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 (Figure 62). 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 2017d), the most recent stock assessment report (Hayes et al. 2018b), and the scientific literature to summarize the life history, population dynamics, and status of the species as follows.

9.14.1 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. 2017), 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 2017d). 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 2017d; 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).

9.14.2 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 458 individuals (N_{min}=455) (Hayes et al. 2018b). 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. 2017). 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. 2017). 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. 2017). 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. 2017). 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. 2017). 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. 2017), which are increasing in abundance (NMFS 2015a).

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. 2017), 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. 2017). 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[3] (UME), and at least one calf died prior to this in April 2017 (Meyer-Gutbrod et al. 2018; NMFS 2017d). 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.

[3] 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 16th and 17th 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. 2017). 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).

9.14.3 Vocalization and Hearing

North Atlantic right whales vocalize during social interaction and likely to communicate over long distances (McCordic et al. 2016; Parks and Clark 2007; Parks et al. 2011b; Tyson et al. 2007). Calls among North Atlantic right whales are similar to those of other right whale species, and can be classified into six major call types: screams, gunshots, blows, upcalls, warbles, and downcalls (McDonald and Moore 2002; Parks et al. 2011b; Parks and Tyack 2005; Soldevilla et al. 2014). The majority of vocalizations occur in the 200 Hertz to one kiloHertz range with most energy being below one kiloHertz, but there is large variation in frequency depending on the call type (Hatch et al. 2012; Parks and Tyack 2005; Trygonis et al. 2013; Vanderlaan et al. 2003). Source levels range from 137 to 192 decibels re: 1 µPa at 1 meter (rms), with gunshot calls having higher source levels as compared to other call types (Hatch et al. 2012; Parks and Tyack 2005; Trygonis et al. 2013). Some of these levels are low compared to some other baleen whales, which may put North Atlantic right whales at greater risk of communication masking compared to other species (Clark et al. 2009; Hatch et al. 2012). However, recent evidenced suggests that gunshot calls with their higher source levels may be less susceptible to masking compared to other baleen whale sounds (Cholewiak et al. 2018). Individual calls typically have a duration of

0.04 to 1.5 seconds depending on the call type, and bouts of calls can last for several hours (Parks et al. 2012a; Parks and Tyack 2005; Trygonis et al. 2013; Vanderlaan et al. 2003).

Vocalizations vary by demographic and context. Upcalls are perhaps the most ubiquitous call type, being commonly produced by all age and sex classes (Parks et al. 2011b). Other non-stereotyped tonal calls (e.g., screams) are also produced by all age sex classes (Parks et al. 2011b) but have been primarily attributed to adult females (Parks and Tyack 2005). Warbles are thought to be produced by calves and may represent ‘practice’ screams (Parks and Clark 2007; Parks and Tyack 2005). Blows are associated with ventilation and are generally inaudible underwater (Parks and Clark 2007). Gunshots appear to be largely or exclusively male vocalizations and may be a form of vocal display (Parks and Clark 2007; Parks et al. 2005b; Parks et al. 2011b). Downcalls have been less frequently recorded, and while it is not known if they are produced by specific age-sex classes, they have been recorded in various demographic make ups of surface-active groups (Parks and Tyack 2005). A recent study examining the development of calls in North Atlantic right while found age-related changes in call production continue into adulthood (Root-Gutteridge et al. 2018).

All types of right whale calls have been recorded in surface-active groups, with smaller groups vocalizing more than larger groups and vocalization being more frequent in the evening, at night, and perhaps on the calving grounds (Matthews et al. 2001; Matthews et al. 2014; Morano et al. 2012; Parks and Clark 2007; Parks et al. 2012a; Salisbury et al. 2016; Soldevilla et al. 2014; Trygonis et al. 2013). Screams are usually produced within 10 meters (32.8 feet) of the surface (Matthews et al. 2001). Upcalls have been detected nearly year-round in Massachusetts Bay, peaking in April (Mussoline et al. 2012). Individuals remaining in the Gulf of Maine through winter continue to call, showing a strong diel pattern of upcall and gunshot vocalizations from November through January possibly associated with mating (Bort et al. 2015; Matthews et al. 2014; Morano et al. 2012; Mussoline et al. 2012). Upcalls may be used for long distance communication (McCordic et al. 2016), including to reunite calves with mothers (Parks and Clark 2007; Tennessen and Parks 2016). In fact, a recent study indicates they contain information on individual identity and age (McCordic et al. 2016). However, while upcalls are frequently heard on the calving grounds (Soldevilla et al. 2014), they are infrequently produced by mothers and calves here perhaps because the two maintain visual contact until calves are approximately three to four months of age (Parks and Clark 2007; Parks and Van Parijs 2015; Trygonis et al. 2013). North Atlantic right whales shift calling frequencies, particularly those of upcalls, and increase call amplitude over both long and short term periods due to exposure to vessel sound, which may limit their communication space by as much as 67 percent compared to historically lower sound conditions (Hatch et al. 2012; Parks and Clark 2007; Parks et al. 2007a; Parks et al. 2011a; Parks et al. 2012c; Parks et al. 2009; Tennessen and Parks 2016).

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 2018b). 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).

9.14.4 Status

The North Atlantic right whale is listed under the ESA as endangered. Currently, none of its recovery goals (see Section 9.14.6 below) have been met (NMFS 2017d). 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 2013), but entanglement in fishing gear remains a major threat (Kraus et al. 2016), 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 (see Section 9.14.6 below). 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. 2017). 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).

9.14.5 Critical Habitat

Critical habitat has been designated for the North Atlantic right whale and was previously discussed in Section 7.7.

9.14.6 Recovery Goals

In response to the current threats facing the species, NMFS developed goals to recover North Atlantic right whale populations. These threats will be discussed in further detail in the

Environmental Baseline section of this consultation. See the 2005 updated Recovery Plan for the North Atlantic right whale for complete downlisting 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.

9.15 North Pacific Right Whale

North Pacific right whales are found in temperate and sub-polar waters of the North Pacific Ocean (Figure 63).

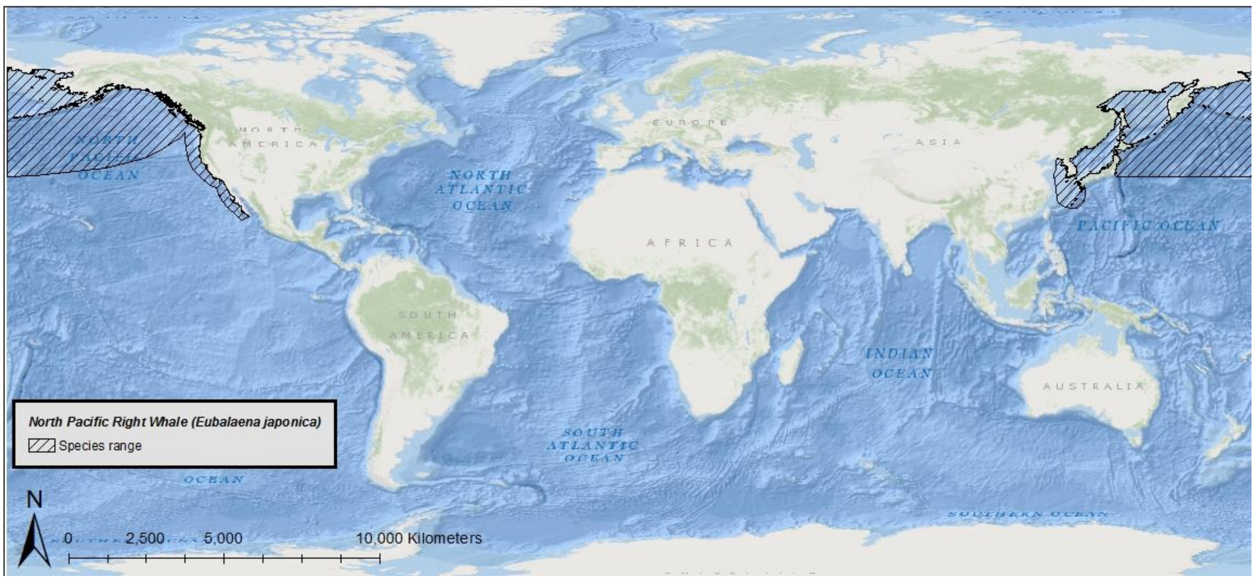

Figure 63. Map identifying the range of the endangered North Pacific right whale.

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 2013a) recent stock assessment reports (Muto et al. 2017), and status review (NMFS 2012a; NMFS 2017e) were used to summarize the life history, population dynamics and status of the species as follows.

9.15.1 Life History

North Pacific right whales can live, on average, 50 or more years. They have a gestation period of approximately one year, and calves nurse for approximately one year. Sexual maturity is reached between nine and 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.

9.15.2 Population Dynamics

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

The North Pacific right whale remains one of the most endangered whale species in the world. Their abundance likely numbers fewer than 1,000 individuals. There are two currently recognized stocks of North Pacific right whales, a Western North Pacific stock that feeds primarily in the Sea of Okhotsk, and an Eastern North Pacific stock that feeds 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. 2018). 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. 2017). Genetic data have identified 23 individuals based on samples collected between 1997 and 2011 (Leduc et al. 2012). The Western North Pacific stock is likely more abundant and was estimated to consist of 922 whales (95 percent confidence intervals 404 to 2,108) based on data collected in 1989, 1990, and 1992 (IWC 2001; Thomas et al. 2016). 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. 2016). 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 63). 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. 2016). 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.

9.15.3 Vocalization and Hearing

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

Given their extremely small population size and remote location, relatively little is known about North Pacific right whale vocalizations (Marques et al. 2011). However, (Crance et al. 2019) recorded North Pacific right whale songs over eight years in five locations throughout the southeastern Bering Sea and classified them into four different song types. These songs mostly consisted of broadband gunshot calls but also contained low-frequency pulsive calls (30 to 240 Hertz), moans (100 to 160 Hertz), and downsweeps (vocalizations starting at 250 Hertz and decreasing to 120 Hertz). Similar to those of other mysticete species, these songs contained units and phrases. The structure of these songs remained relatively consistent through the years the study was conducted. Songs were attributed to males, but it is still unknown if females also produce songs. It was hypothesized that North Pacific right whale songs could play a role in courtship or communicating information, such as fitness, about the animal producing the song.

Regarding North Atlantic right whales, smaller groups vocalize more than larger groups and vocalization is more frequent at night (Matthews et al. 2001). Moans are usually produced within 10 meters (33 feet) of the surface (Matthews et al. 2001). Up calls were detected year-round in Massachusetts Bay except July and August and peaking in April (Mussoline et al. 2012). Individuals remaining in the Gulf of Maine through winter continue to call, showing a strong diel pattern of up call and gunshot vocalizations from November through January possibly associated with mating (Bort et al. 2011; Morano et al. 2012; Mussoline et al. 2012). Estimated source levels of gunshots in non-surface active groups are 201 decibels re: 1 μPa peak-to-peak (Hotchkin et al. 2011). While in surface active groups, females produce scream calls and males produce up calls and gunshot calls as threats to other males; calves (at least female calves) produce warble sounds similar top their mothers' screams (Parks et al. 2003; Parks and Tyack 2005). Source levels for these calls in surface active groups range from 137 to 162 decibels re: 1 μPa-meter (root mean square), except for gunshots, which are 174 to 192 decibels re: 1 μPa-meter (root mean square) (Parks and Tyack 2005). Up calls may also be used to reunite mothers with calves (Parks and Clark 2007).

North Atlantic right whales shift calling frequencies, particularly of up calls, as well as increase call amplitude over both long and short term periods due to exposure to vessel noise (Parks and Clark 2007; Parks et al. 2005a; Parks et al. 2007a; Parks et al. 2011a; Parks et al. 2010; Parks et al. 2012c; Parks et al. 2006), particularly the peak frequency (Parks et al. 2009). North Atlantic right whales respond to anthropogenic sound designed to alert whales to vessel presence by surfacing (Nowacek et al. 2003; Nowacek et al. 2004).

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

9.15.4 Status

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

9.15.5 Critical Habitat

Critical habitat has been designated for the North Pacific right whale and was previously discussed in Section 7.7.

9.15.6 Recovery Goals

In response to the current threats facing the species, NMFS developed goals to recover North Pacific right whale populations. These threats will be discussed in further detail in the *Environmental Baseline* section of this consultation. See the 2013 Final Recovery Plan for the North Pacific right whale for complete downlisting/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.

9.16 Sei Whale

The sei whale is a widely distributed baleen whale found in all major oceans (Figure 64).

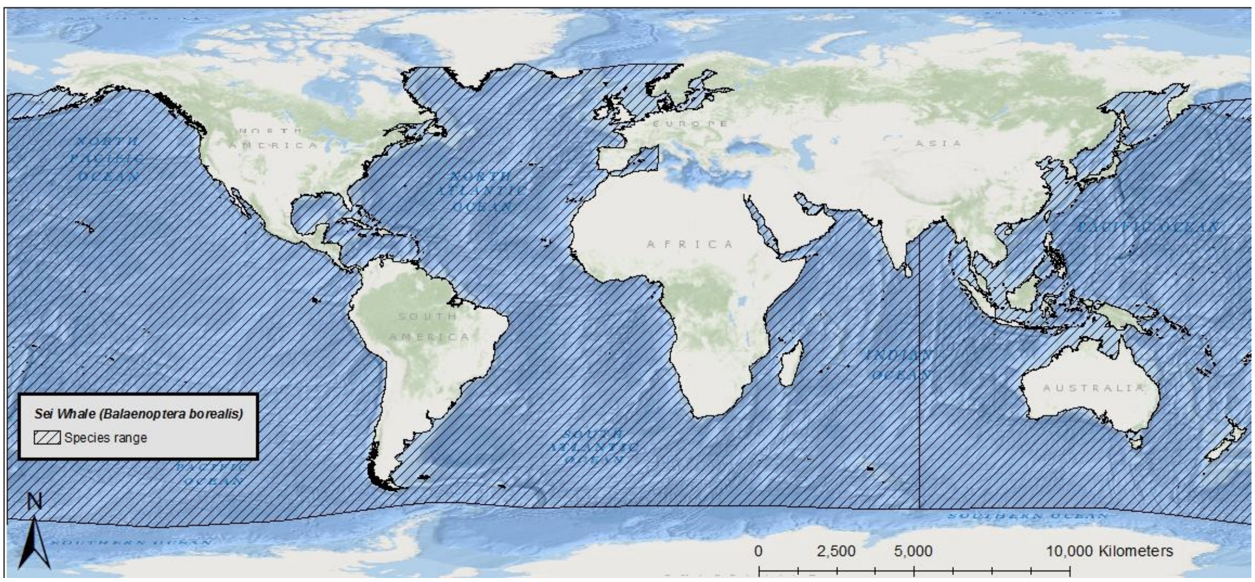

Figure 64. Map identifying the range of the endangered sei whale.

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. 2018; Hayes et al. 2018b; Muto et al. 2018), and status review (NMFS 2012b) were used to summarize the life history, population dynamics, and status of the species as follows.

9.16.1 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.

9.16.2 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 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. 2016). 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 relatively small stocks occur in U.S. waters: Nova Scotia (N=357, N_{min}=236), Hawaii (N=391, N_{min}=204), and Eastern North Pacific (N=519, N_{min}=374). 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 basin, there appears 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.

9.16.3 Vocalizations and Hearing

Data on sei whale vocal behavior is limited, but includes records off the Antarctic Peninsula of broadband sounds in the 100 to 600 Hertz range with 1.5 second duration and tonal and upsweep calls in the 200 to 600 Hertz range of one to three second durations (McDonald et al. 2005). Vocalizations from the North Atlantic Ocean consisted of paired sequences (0.5 to 0.8 seconds, separated by 0.4 to 1.0 seconds) of 10 to 20 short (4 milliseconds) frequency modulated sweeps between 1.5 to 3.5 kiloHertz (Thomson and Richardson 1995). Tremblay et al. (2019) recorded 50 to 30-Hertz triplet and singlet downsweeps and 82 to 34-Hertz downsweeps from sei whales in the western North Atlantic, suggesting that sei whales may produce songs. Source levels of 189 ±5.8 decibels re: 1 μPa at 1 meter have been established for sei whales in the northeastern Pacific Ocean (Weirathmueller et al. 2013).

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 2018b).

9.16.4 Status

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

9.16.5 Critical Habitat

No critical habitat has been designated for the sei whale.

9.16.6 Recovery Goals

In response to the current threats facing the species, NMFS developed goals to recover sei whale populations. These threats will be discussed in further detail in the *Environmental Baseline* section of this consultation. See the 2011 Final Recovery Plan for the sei whale for complete downlisting/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.

9.17 Southern Right Whale

Southern right whales are a large baleen whale species distributed in the Southern Hemisphere worldwide from 20 to 60 degrees South (Figure 65).

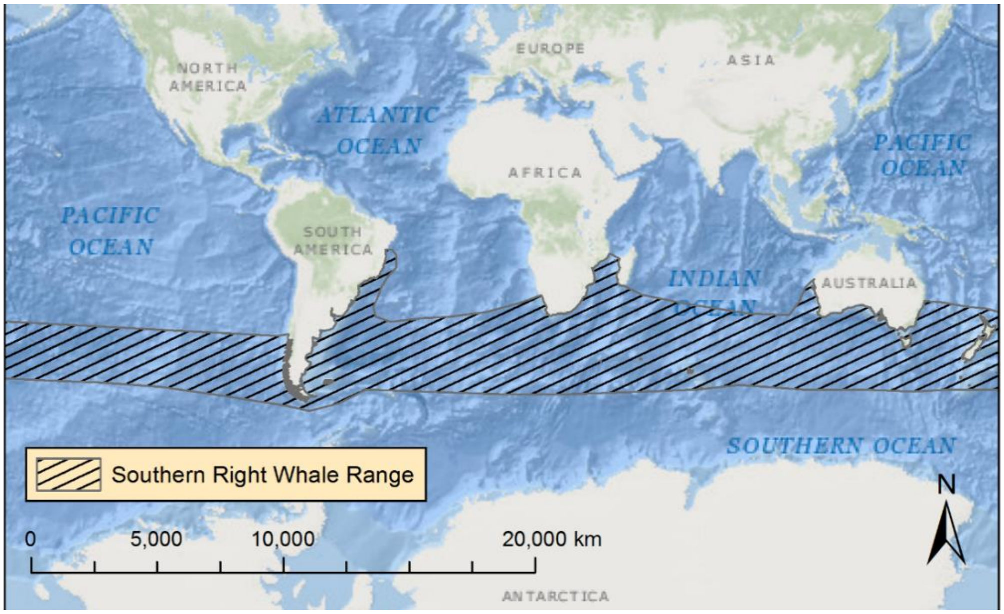

Figure 65. Map identifying the range of the endangered Southern right whale.

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 2015 Status Review (NMFS 2015a) 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.

9.17.1 Life History

The lifespan of Southern right whales is currently unknown but likely similar to North Pacific and North Atlantic right whales, who are believed to live to around 50 years old. Females usually give birth to their first calf between eight and 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.

9.17.2 Population Dynamics

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

In 2010, there were an estimated 15,000 Southern right whales 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 delineate based on geographic region: South Africa, Argentina, Brazil, Peru and Chile, Australia, and New Zealand. Population estimates for all of the breeding populations are not available. There are about 3,500 southern right whales in the Australia breeding population, about 4,000 in Argentina, 4,100 in South Africa, and 2,169 in New Zealand. Other smaller southern right whale populations occur off Tristan da Cunha, South Georgia, Namibia, Mozambique and Uruguay, but not much is known about the population abundance of these groups.

The Australia, South Africa and Argentina breeding stocks of Southern right whales are increasing at an estimated seven percent annually. The Brazil breeding population is increasing, while the Peru and Chile breeding population is estimated to contain only 1 to 49 individuals (Cooke and Zerbini 2018). 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 (Figure 61).

9.17.3 Vocalization and Hearing

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

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

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

9.17.4 Status

Southern right whales underwent severe decline due to whaling during the 18th and 19th centuries (NMFS 2015a). In general, Southern right whale populations appear to be increasing at a robust rate. Nonetheless, the current population estimate (15,000) is still much less than the estimated 60,000 pre-whaling estimate (NHT 2005). Southern right whales are currently subject to many of the same anthropogenic threats other large 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.

9.17.5 Critical Habitat

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

9.17.6 Recovery Goals

NMFS has not prepared a recovery plan for the Southern right whale. In general, ESA-listed species which occur entirely outside United States jurisdiction are not likely to benefit from recovery plans (55 FR 24296; June 15, 1990).

9.18 Sperm Whales

The sperm whale is widely distributed and found in all major oceans (Figure 66).

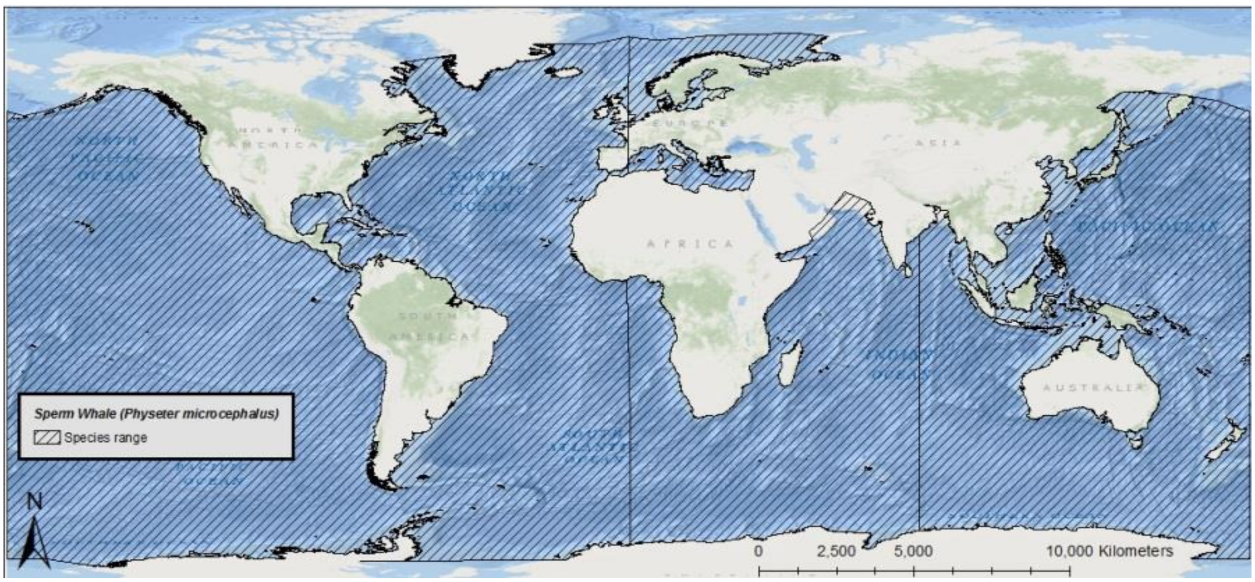

Figure 66. Map identifying the range of the endangered sperm whale.

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. 2018; Hayes et al. 2018b; Muto et al. 2018), and status review (NMFS 2015b) were used to summarize the life history, population dynamics and status of the species as follows.

9.18.1 Life History

The average lifespan of sperm whales is estimated to be at least 50 years (Whitehead 2009). They have a gestation period of one to one and a half years, and calves nurse for approximately two years, 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).

9.18.2 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 763 individuals (N_{min}=560) and the North Atlantic stock, underestimated to consist of 2,288 individuals (N_{min}=1,815). 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 2,106 individuals (N_{min}=1,332), and the Hawaii stock, estimated to consist of 4,559 individuals (N_{min}=3,478). There are insufficient data to estimate the population abundance of the North Pacific stock. We are aware of no reliable abundance estimates specifically for sperm whales in the South Pacific 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.

9.18.3 Vocalizations and Hearing

Sound production and reception by sperm whales are better understood than in most cetaceans. Recordings of sperm whale vocalizations reveal that they produce a variety of sounds, such as clicks, gunshots, chirps, creaks, short trumpets, pips, squeals, and clangs (Goold 1999). Sperm whales typically produce short duration repetitive broadband clicks with frequencies below 100 Hertz to greater than 30 kiloHertz (Watkins 1977) and dominant frequencies between 1 to 6 kiloHertz and 10 to 16 kiloHertz. Another class of sound, "squeals," are produced with frequencies of 100 Hertz to 20 kiloHertz (e.g., Weir et al. 2007). The source levels of clicks can reach 236 decibels re: 1 µPa at 1 meter, although lower source level energy has been suggested at around 171 decibels re: 1 µPa at 1 meter (Goold and Jones 1995; Mohl et al. 2003; Weilgart and Whitehead 1993; Weilgart and Whitehead 1997). Most of the energy in sperm whale clicks is concentrated at around 2 to 4 kiloHertz and 10 to 16 kiloHertz (Goold and Jones 1995; Weilgart and Whitehead 1993). The clicks of neonate sperm whales are very different from typical clicks of adults in that they are of low directionality, long duration, and low frequency (between 300 Hertz and 1.7 kiloHertz) with estimated source levels between 140 to 162 decibels re: 1 µPa at 1 meter (Madsen et al. 2003). The highly asymmetric head anatomy of sperm whales is likely an adaptation to produce the unique clicks recorded from these animals (Norris and Harvey 1972).

Long, repeated clicks are associated with feeding and echolocation (Goold and Jones 1995; Miller et al. 2004; Weilgart and Whitehead 1993; Weilgart and Whitehead 1997; Whitehead and Weilgart 1991). Creaks (rapid sets of clicks) are heard most frequently when sperm whales are foraging and engaged in the deepest portion of their dives, with inter-click intervals and source levels being altered during these behaviors (Laplanche et al. 2005; Miller et al. 2004). Clicks are also used during social behavior and intragroup interactions (Weilgart and Whitehead 1993). When sperm whales are socializing, they tend to repeat series of group-distinctive clicks (codas), which follow a precise rhythm and may last for hours (Watkins and Schevill 1977). Codas are shared between individuals in a social unit and are considered to be primarily for intragroup communication (Rendell and Whitehead 2004; Weilgart and Whitehead 1997). Research in the South Pacific Ocean suggests that in breeding areas the majority of codas are produced by mature females (Marcoux et al. 2006). Coda repertoires have also been found to vary geographically and are categorized as dialects (Pavan et al. 2000; Weilgart and Whitehead 1997). For example, significant differences in coda repertoire have been observed between sperm whales in the Caribbean Sea and those in the Pacific Ocean (Weilgart and Whitehead 1997). Three coda types used by male sperm whales have recently been described from data collected over multiple years: these codas are associated with dive cycles, socializing, and alarm (Frantzis and Alexiadou 2008).

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 μPa^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. 1999a). 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 2018b).

9.18.4 Status

The sperm whale is endangered as a result of past commercial whaling. Although the aggregate abundance worldwide is probably at least several hundred thousand individuals, the extent of depletion and degree of recovery of populations are uncertain. Commercial whaling is no longer allowed, 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.

9.18.5 Critical Habitat

No critical habitat has been designated for the sperm whale.

9.18.6 Recovery Goals

In response to the current threats facing the species, NMFS developed goals to recover sperm whale populations. These threats will be discussed in further detail in the *Environmental*

Baseline section of this consultation. See the 2010 Final Recovery Plan for the sperm whale for complete downlisting/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.

9.19 South Island Hector's Dolphin

The South Island Hector's dolphin is a small delphinid species found only in coastal waters off New Zealand. It is one of two recognized sub-species of Hector's dolphin (the other being Maui dolphins [*Cephalorhynchus hectori maui*]), based on genetic and morphological data, and occurs off the South Island of New Zealand (Figure 67).

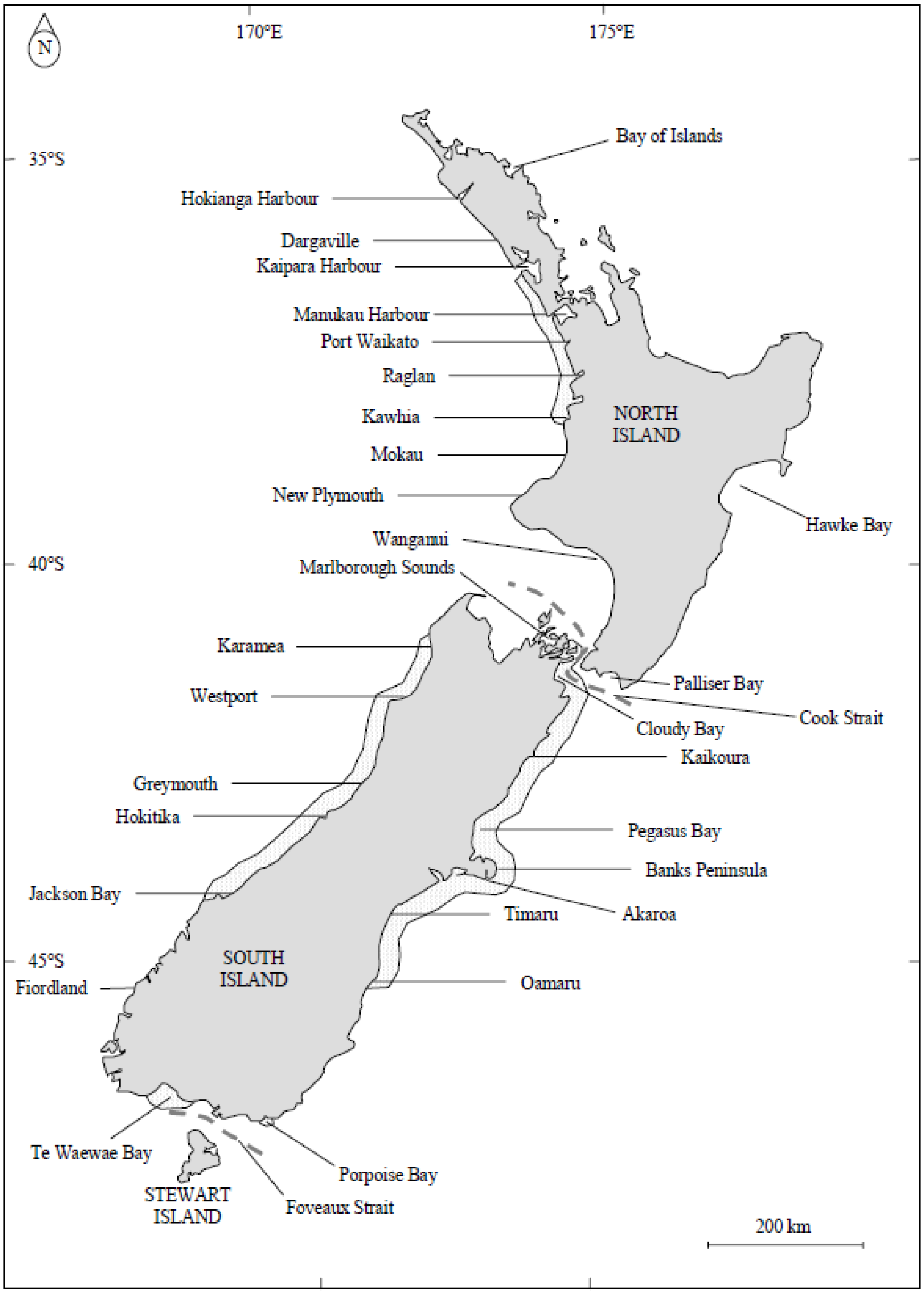

Figure 67. Map identifying the ranges (shaded coastlines) of the threatened South Island Hector's dolphin (South Island) off the coast of New Zealand (Pichler 2002).

South Island Hector's dolphins are small (up to 1.2 meters [4 feet]), have a short and stocky body, no external beak, a rounded dorsal fin and rounded pectoral fins, and relatively large flukes (Manning and Grantz 2016). They have a distinctive and complex black and white coloration pattern. They were listed under the ESA as threatened on September 19, 2017.

Information available from the final rule (82 FR 43701), draft status review (Manning and Grantz 2016), listing documents, and the peer-reviewed literature were used to summarize the life history, population dynamics, and status of the species as follows.

9.19.1 Life History

Female South Island 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 South Island 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. South Island 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).

9.19.2 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 South Island Hector's dolphins.

The earliest reliable population abundance for South Island Hector's dolphins is from 1984/1985, with an estimated 3,274 South Island Hector's dolphins (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).

South Island Hector's dolphins exhibit low genetic diversity compared to more abundant odontocetes (Manning and Grantz 2016). They 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 mitochondrial DNA haplotypes, with each regional population having different predominant haplotypes and exhibiting significant genetic differentiation based on 13-locus microsatellite genotypes (Hamner et al. 2012). There is even some evidence of genetic differentiation within these regional populations (Hamner et al. 2016).

South Island Hector's dolphins are only found in coastal waters off the South Island of New Zealand, inhabiting nearshore environments, typically within 9.3 kilometers (5 nautical miles) of shore, although individuals may be found in waters out to 37 kilometers (20 nautical miles) offshore. Historically, South Island Hector's dolphins are thought to have ranged along entire coastline of the South Island of New Zealand. Today, they 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 South Island 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.

9.19.3 Vocalization and Hearing

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

9.19.4 Status

The South Island Hector's dolphin shows evidence of a population decline, which is thought to be primarily due to bycatch in commercial and recreational gillnets and trawls (Manning and Grantz 2016). While changes in the management of New Zealand fisheries appear to have reduced some of the impacts from this threat, the sub-species is expected to continue to decline as a result of bycatch (Manning and Grantz 2016). Habitat modification and degradation due to development and industrial activities, and disease and tourism also pose a threat to the sub-species (Manning and Grantz 2016). The South Island Hector's dolphin is at moderate risk of extinction and is listed as threatened under the ESA (Manning and Grantz 2016).

9.19.5 Critical Habitat

No critical habitat has been designated for the South Island Hector's dolphin. NMFS cannot designate critical habitat in foreign waters.

9.19.6 Recovery Goals

NMFS has not prepared a recovery plan for the South Island Hector's dolphin. 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).

10 Environmental Baseline

The "environmental baseline" includes the past and present effects of all Federal, state, or private actions and other human activities in the action area, the anticipated effects of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the effects of state or private actions which are contemporaneous with the consultation in process (50 C.F.R. §402.02). In this section, we discuss the environmental baseline within the action area as it applies to species that are likely to be adversely affected by the proposed action.

A number of human activities have contributed to the status of populations of ESA-listed cetaceans in the action area. Some human activities are ongoing and appear to be continue to affect cetacean populations in the action area for this consultation. Some of these activities, most notably commercial whaling, occurred extensively in the past and continue at low levels that no longer appear to significantly affect cetacean populations, although the effects of past reductions in numbers persist today. The following discussion summarizes these impacts, which include climate change, oceanic temperature regimes, whaling and subsistence harvest, vessel interactions (vessel strikes and whale watching), fisheries (fisheries interactions and aquaculture), pollution (marine debris, pesticides and contaminants, and hydrocarbons), aquatic nuisance species, sound (vessel sound and commercial shipping, aircraft, seismic surveys, and marine construction), military activities (U.S. Air Force, U.S. Coast Guard, and U.S. Navy), and scientific research activities.

10.1 Climate Change

There is a large and growing body of literature on past, present, and 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://climate.gov).

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 through 2100 (IPCC 2014). The RCP scenarios drive 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. The 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 (2018) use the RCP scenarios.

The increase of global mean surface temperature change by 2100 is projected to be 0.3 to 1.7 degrees Celsius under RCP2.6, 1.1 to 2.6 degrees Celsius under RCP4.5, 1.4 to 3.1 degrees Celsius under RCP6.0, and 2.6 to 4.8 degrees Celsius under RCP8.5 with the Arctic region warming more rapidly than the global mean under all scenarios (IPCC 2014). The Paris Agreement aims to limit the future rise in global average temperature to 2 degrees Celsius, 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 globally-averaged combined land and ocean surface temperature data, as calculated by a linear trend, show a warming of approximately 1 degree Celsius from 1901 through 2016 (Hayhoe et al. 2018). The *IPCC Special Report on the Impacts of Global Warming* (2018) (IPCC 2018) noted that human-induced warming reached temperatures between 0.8 and 1.2 degrees Celsius above pre-industrial levels in 2017, likely increasing between 0.1 and 0.3 degrees Celsius per decade. 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 (IPCC 2018). Annual average temperatures have increased by 1.8 degrees Celsius 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 (IPCC 2018). Average global warming up to 1.5 degrees Celsius 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 (IPCC 2018).

Several of the most important threats contributing to the extinction risk of ESA-listed species, particularly those with a calcium carbonate skeleton such as corals and mollusks as well as species for which these animals serve as prey or habitat, are related to global climate change. The main concerns regarding impacts of global climate change on coral reefs and other calcium carbonate habitats generally, and on ESA-listed corals and mollusks in particular, are the magnitude and the rapid pace of change in greenhouse gas concentrations (e.g., carbon dioxide and methane) and atmospheric warming since the Industrial Revolution in the mid-19th century. These changes are increasing the warming of the global climate system and altering the carbonate chemistry of the ocean [ocean acidification (IPCC 2014)]. As carbon dioxide concentrations increase in the atmosphere, more carbon dioxide is absorbed by the oceans, causing lower pH and reduced availability of calcium carbonate. Because of the increase in carbon dioxide and other greenhouse gases in the atmosphere since the Industrial Revolution, ocean acidification has already occurred throughout the world's oceans, including in the Caribbean Sea, and is predicted to increase considerably between now and 2100 (IPCC 2014).

The Atlantic Ocean appears to be warming faster than all other ocean basins except perhaps the southern oceans (Cheng et al. 2017). In the western North Atlantic Ocean surface temperatures have been unusually warm in recent years (Blunden and Arndt 2016). A study by (Polyakov et al. 2009) suggests that the North Atlantic Ocean overall has been experiencing a general warming trend over the last 80 years of 0.031±0.0006 degrees Celsius per decade in the upper 2,000 meters (6,561.7 feet) of the ocean. 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 2014) 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 2014).

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 (MacLeod et al. 2005; MacLeod et al. 2005; Robinson et al. 2005; Kintisch 2006; Learmonth et al. 2006; McMahon and Hays 2006; Evans and Bjørge 2013; IPCC 2014). Though predicting the precise consequences of climate change on highly mobile marine species is difficult (Simmonds and Isaac 2007), 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 degrees Celsius (Ackerman 1997). Increases in global temperature could skew future sex ratios toward higher numbers of females (NMFS and USFWS 2015; NMFS and USFWS 2013a, b; NMFS and USFWS 2007 a, b). These impacts will be exacerbated by sea level rise. This loss of 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).

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. 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). Willis-Norton et al. (2015) acknowledged there will be both habitat loss and gain, but overall climate change could result in a 15 percent loss of core pelagic habitat for leatherback turtles in the eastern South Pacific Ocean.

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 (Payne et al. 1986; Payne et al. 1990; Clapham et al. 1999). 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).

This review provides some examples of impacts to ESA-listed species and their habitats that may occur as the result of climate change. While it is difficult to accurately predict the consequences of climate change of a particular species or habitat, a range of consequences are expected that are likely to change the status of the species and the condition of their habitats.

10.2 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).

Since 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. 2006; 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 2007).

10.3 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 plans to resume 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 2017a, b, c).

Table 12. Endangered Species Act-listed cetacean mortalities as the result of whaling since 1985.

Species	Commercial Whaling	Scientific Research	Subsistence
Beluga Whale	-- --	-- --	249
Blue Whale	-- --	-- --	-- --
Bowhead Whale	-- --	-- --	1,650
Bryde's Whale	634	734	-- --
False Killer Whale	-- --	-- --	-- --
Fin Whale	706	310	385
Gray Whale	-- --	-- --	3,907
Humpback Whale	-- --	-- --	123
Killer Whale	-- --	-- --	-- --
North Atlantic Right Whale	-- --	-- --	-- --
North Pacific Right Whale	-- --	-- --	-- --
Sei Whale	-- --	1,563	3
Southern Right Whale	-- --	-- --	-- --
Sperm Whale	388	56	-- --
South Island Hector's Dolphin	-- --	-- --	-- --

Many of the whaling numbers reported represent minimum catches, as illegal or underreported catches are not included. For example, recently 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 Artic, 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.

10.4 Vessel Interactions

Vessels have the potential to affect animals through strikes, sound (Section 10.8.1), 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. 2001; Constantine 2001; Mann et al. 2000; Nowacek 2001; Samuels et al. 2000). 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).

10.4.1 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 (and South Island Hector's dolphins) 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. 2017; Carretta et al. 2016a; Helker et al. 2017; Henry et al. 2016). 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 the action area.

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	NA	NA	NA	0
Bowhead Whale	NA	NA	0	NA	NA
Bryde's Whale	NA	NA	NA	0	NA
False Killer Whale – Main Hawaiian Islands Insular DPS	NA	0	NA	NA	NA
Fin Whale	1.8	NA	0.2	NA	1.6
Gray Whale	0	NA	NA	NA	NA
Humpback Whale– Multiple ESA-listed DPSs	1.1	2.4	0.4	NA	1.8
Killer Whale	0	NA	NA	NA	NA

North Atlantic Right Whale	NA	NA	NA	NA	0.81
North Pacific Right Whale	0	NA	NA	NA	NA
Sei Whale	NA	NA	NA	NA	0.8
Southern Right Whale	NA	NA	NA	NA	NA
Sperm Whale	0.2	NA	0	0	0.2
South Island Hector's Dolphin	NA	NA	NA	NA	NA

DPS=Distinct Population Segment
NA=Not Applicable

10.4.2 Whale Watching

Whale watching is a rapidly-growing business with more than 3,300 operators worldwide, serving 13 million participants in 119 countries and territories (O'Connor et al. 2009). 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 studies have examined the short-term effects of whale watching vessels on marine mammals. (Au and Green 2000; Corkeron 1995; Erbe 2002b; Felix 2001; Magalhaes et al. 2002; Richter et al. 2003; Scheidat et al. 2004; Simmonds 2005; Watkins 1986; Williams et al. 2002). A whale's behavioral responses to whale watching vessels depended on the distance of the vessel from the whale, vessel speed, vessel direction, vessel sound, and the number of vessels. In some circumstances, whales do not appear to respond to vessels, but in other circumstances, whales change their vocalizations, surface time, swimming speed, swimming angle or direction, respiration rates, dive times, feeding behavior, and social interactions. Disturbance by whale watch vessels has also been noted to cause newborn calves to separate briefly from their mother's sides, which leads to greater energy expenditures by the calves (NMFS 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 2006). Christiansen et al. (2014) estimated that 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.

It is difficult to precisely quantify or estimate the magnitude of the risks posed to marine mammals in general from vessel approaches associated with whale watching. Given the proposed research activities will occur within primarily in focal areas (U.S. Navy training and testing activity areas or offshore energy and construction activity areas) of the Western Atlantic Ocean, Gulf of Mexico, Caribbean Sea, Sargasso Sea, Pacific Ocean, and the Gulf of Alaska, but may occur in international and foreign waters at distances to and exceeding 370 kilometers (200 nautical miles), few (if any) whale watching vessels will be expected to co-occur with the proposed actions' research vessels.

10.5 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.

10.5.1 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. 2010). 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. 2016). 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 (and South Island Hector's dolphins) likely to be found in the action area are given in Table 14 below (Hayes et al. 2017; Henry et al. 2017). 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 the action area.

Species	Pacific Stock	Hawaii Stock	Alaska Stock	Gulf of Mexico Stock	Western North Atlantic Stock
Beluga Whale	NA	NA	NA	NA	NA
Blue Whale	0	0	NA	NA	NA
Bowhead Whale	0	NA	0.2	NA	NA
Bryde's Whale	NA	NA	NA	0	NA
False Killer Whale – Main Hawaiian Islands Insular DPS	NA	0.1	NA	NA	NA
Fin Whale	0.2	0	0.2	NA	1.05
Gray Whale	0	NA	NA	NA	NA
Humpback Whale – Multiple ESA-listed DPSs	1.2	1.1	0.6	NA	NA

Killer Whale	0	NA	NA	NA	NA
North Atlantic Right Whale	NA	NA	NA	NA	4.55
North Pacific Right Whale	0	NA	NA	NA	NA
Sei Whale	0	0.2	NA	NA	NA
Southern Right Whale	NA	NA	NA	NA	NA
Sperm Whale	1.7	0.7	2.2	NA	0.46
South Island Hector's Dolphin	2.6	NA	NA	NA	NA

DPS=Distinct Population Segment
NA=Not Applicable

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. 2016b). 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.

10.5.2 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, as discussed above in Sections 10.5 and 10.5.1, respectively. 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).

10.6 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.

10.6.1 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 2014; 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 2014). 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. 2010). 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. (2010) 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).

10.6.2 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. 2016a), 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).

10.6.3 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.

10.7 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. 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).

10.8 Sound

The ESA-listed species 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 species 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. 2006a; Parks 2003; Parks 2009).

Despite the potential for these impacts to affect individual ESA-listed cetaceans, information is not currently available to determine the potential population level effects of anthropogenic sound levels in the marine environment (MMC 2007). 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).

10.8.1 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 2018b) 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: μPa^2-s at 1 meter for fast-moving (greater than 37 kilometers per hour [20 knots]) supertankers to 140 decibels 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 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). For further discussion of military sound on the ESA-listed species considered in this consultation, see Section 10.9.

10.8.2 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 1-3 kilometers 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.

10.8.3 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 that will occur in the Atlantic, Pacific, and Southern Oceans in 2019 and 2020. These are funded by the National Science Foundation. Also, there are 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 include a MMPA incidental take authorization and are each subject to a separate ESA section 7 consultation. Each of these finalized consultations resulted in a “no jeopardy” opinion.

10.8.4 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.

10.9 Military Activities

Within the action area, multiple stressors associated with military activities pose a threat to ESA-listed cetaceans. Military activities are conducted by the U.S. Air Force, U.S. Coast Guard, and U.S. Navy and are discussed further below.

10.9.1 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.

10.9.2 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 2013b). 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 2013c). 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.

10.9.3 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 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 TTS and 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 recently 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 reduces the number of total transmission hours that are currently authorized under the 2017 National Defense Exemption. The U.S. Navy (2018) proposes 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. Thus, SURTASS LFA sonar transmissions will make up a very small part of the human-caused sound pollution in the ocean.

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) proposes 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 2016 SURTASS LFA testing and training activities is anticipated to conclude in August 2019.

10.10 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.

10.10.1 Current Authorized Take by the National Marine Fisheries Service's Permits and Conservation 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 June 5, 2019), there are at least 51 active and pending research and enhancement permits that may affect the ESA-listed cetaceans in the Arctic, Atlantic, Indian, Pacific, and Southern Oceans considered during this programmatic consultation (Table 15). 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 calves, juveniles, and adults. No mortalities are authorized for any animal or any age and no mortalities have been reported from the research permits currently active in the action area. One additional research and enhancement permit authorizes auditory research on stranded cetaceans on the beach or in rehabilitation facilities. An additional 25 ESA/MMPA permits are solely for the import/export/receipt of 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 NMFS Permits and Conservation Division, approximately 40 permits are active for research and enhancement activities on ESA-listed cetaceans at any time. Of those permits, the Marine Mammal Health and Stranding Response Program's research and enhancement permit is outside the scope of this programmatic consultation and has been analyzed in a separate consultation. Based on analyses required under the Paperwork Reduction Act, the NMFS Permits and Conservation Division does not foresee significant changes in the number of permits for cetaceans authorized over time.

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.

Table 15. Active and pending scientific research permits and pending applications for Endangered Species Act-listed cetaceans.

Permit Number	Applicant or Permit Holder	Ocean Basin	Issuance Date	Expiration Date	Extension Date	Research Activities	Rolled into Programmatic?
17312	Scripps Institution of Oceanography	Atlantic, Pacific	September 11, 2013	September 13, 2018	September 13, 2019	Biopsy Sampling, Suction-Cup Tagging	No
16239	Dr. Dan Engelhaupt	Atlantic, Pacific	September 11, 2013	September 30, 2018	October 1, 2019	Biopsy Sampling, Suction-Cup Tagging, Dart/Barb Tagging, Deep-Implantable Tagging	No
17845	Dr. Rachel Cartwright	Pacific	January 25, 2014	January 31, 2019	January 31, 2020	Suction-Cup Tagging	No
14450	Southeast Fisheries Science Center	Atlantic	March 4, 2014	February 28, 2019	February 28, 2020	Biopsy Sampling, Suction-Cup Tagging, Dart/Barb Tagging, Deep-Implantable Tagging	No
14809	Dr. Douglas Nowacek	Atlantic, Pacific, Southern	March 24, 2014	March 31, 2019	March 31, 2020	Biopsy Sampling, Suction-Cup Tagging, Dart/Barb Tagging	No
17344	Dr. Samuel Wasser	Pacific	July 8, 2014	July 15, 2019	NA	NA	Yes
18824	Dr. Briana Witteveen	Pacific	November 19, 2015	December 1, 2020	NA	Biopsy Sampling, Suction-Cup Tagging	No
18636	Iain Kerr	Arctic, Atlantic, Indian, Pacific, Southern	February 17, 2016	February 28, 2021	NA	Biopsy Sampling	No
19091	Southwest Fisheries Science Center	Atlantic, Pacific, Southern	May 17, 2016	May 31, 2021	NA	Biopsy Sampling, Suction-Cup Tagging, Dart/Barb Tagging	No

18890	Alaska Department of Fish and Game	Pacific	June 16, 2016	June 15, 2021	NA	Biopsy Sampling, Suction-Cup Tagging, Dart/Barb Tagging	No
19116	Dr. Brandon Southall	Pacific	July 15, 2016	June 30, 2021	NA	Suction-Cup Tagging	No
18529	Janice Straley	Pacific	August 22, 2016	August 31, 2021	NA	Biopsy Sampling, Suction-Cup Tagging, Dart/Barb Tagging	No
19225	Dr. Jim Darling	Pacific	November 1, 2016	October 31, 2021	NA	Biopsy Sampling, Suction-Cup Tagging, Dart/Barb Tagging	No
19257	Ann Zoidis	Pacific	November 1, 2016	October 31, 2021	NA	Biopsy Sampling, Suction-Cup Tagging	No
19315	Dr. Charles “Stormy” Mayo	Atlantic	October 21, 2016	October 31, 2021	NA	NA	No
19674	Dr. Scott Kraus	Atlantic	October 21, 2016	October 31, 2021	NA	Biopsy Sampling	No
18059	Dr. David Wiley	Atlantic	March 13, 2017	March 1, 2022	NA	Biopsy Sampling, Suction-Cup Tagging	No
20430	Dr. James Harvey	Pacific	March 30, 2017	March 31, 2022	NA	Biopsy Sampling, Suction-Cup Sampling, Dart/Barb Tagging	No
20465	Alaska Fisheries Science Center – Marine Mammal Laboratory	Atlantic, Pacific	May 23, 2017	May 31, 2022	NA	Biopsy Sampling, Suction-Cup Tagging, Dart/Barb Tagging, Deep-Implantable Tagging	No
20527	Dr. D. Ann Pabst	Atlantic	May 26, 2017	May 31, 2022	NA	NA	No

20294	Robert DiGiovannai, Jr.	Atlantic	June 2, 2017	June 1, 2022	NA	NA	No
20311	Pacific Islands Fisheries Science Center	Pacific	June 30, 2017	June 30, 2022	NA	Biopsy Sampling, Suction-Cup Tagging, Dart/Barb Tagging	No
20043	Dr. Whitlow Au	Pacific	July 28, 2017	July 31, 2022	NA	Biopsy Sampling, Suction-Cup Tagging, Dart/Barb Tagging	No
21114	The Whale Museum	Pacific	July 25, 2017	July 31, 2022	NA	NA	No
20605	Dr. Robin Baird	Atlantic, Pacific	July 28, 2017	August 1, 2022	NA	Biopsy Sampling, Suction-Cup Tagging, Dart/Barb Tagging	No
19655	Dr. Adam Pack	Pacific	August 3, 2017	August 4, 2022	NA	Biopsy Sampling, Suction-Cup Tagging	No
20951	Ann Zoidis	Atlantic	September 5, 2017	September 30, 2022	NA	Biopsy Sampling	No
20556	Georgia Department of Natural Resources	Atlantic	November 22, 2017	November 30, 2022	NA	Biopsy Sampling, Suction-Cup Tagging, Dart/Barb Tagging	No
20626	Associated Scientists as Woods Hole	Atlantic	December 22, 2017	December 31,2022	NA	NA	No
19703	Dr. Fred Sharpe	Pacific	March 30, 2018	March 31, 2023	NA	Suction-Cup Tagging	No
21059	Glacier Bay National Park and Preserve	Pacific	March 30, 2018	April 1, 2023	NA	Biopsy Sampling	No

21321	Pacific Whale Foundation	Pacific	April 23, 2018	April 30, 2023	NA	NA	No
21295	Olga von Ziegesar	Pacific	May 8, 2018	May 31, 2023	NA	NA	No
21238	Center for Whale Research	Pacific	June 4, 2018	June 15, 2023	NA	NA	No
21348	Northwest Fisheries Science Center	Pacific	June 5, 2018	June 15, 2023	NA	Biopsy Sampling, Suction-Cup Tagging, Dart/Barb Tagging	No
21371	Northeast Fisheries Science Center	Atlantic	June 4, 2018	June 15, 2023	NA	Biopsy Sampling, Suction-Cup Tagging	No
21678	John Calambokidis	Pacific	November 15, 2018	November 30, 2023	NA	Biopsy Sampling, Suction-Cup Tagging, Dart/Bart Tagging	No
21485	Dr. Jooke Robbins	Atlantic	December 12, 2018	December 31, 2023	NA	Biopsy Sampling	No
21585	Oregon State University Marine Mammal Institute	Arctic, Atlantic, Indian, Pacific, Southern	December 20, 2018	December 31, 2023	NA	Biopsy Sampling, Deep-Implantable Tagging	No
22222	Dr. Tamara McGuire	Pacific	December 17, 2018	December 31, 2023	NA	NA	No
21856	ABR, Inc., Environmental Research and Services	Pacific	February 19, 2019	February 15, 2024	NA	NA	No

20648	Dr. Heidi Pearson	Pacific	Pending	NA	NA	Biopsy Sampling, Suction-Cup Tagging	No
21163	Greg Schorr	Pacific	Pending	NA	NA	Biopsy Sampling, Suction-Cup Tagging, Dart/Barb Tagging, Deep-Implantable Tagging	No
21476	Dr. Lars Bejder	Pacific	Pending	NA	NA	Biopsy Sampling, Suction-Cup Tagging	Yes
21482	Dr. Dan Engelhaupt	Arctic, Atlantic, Indian, Pacific, Southern	Pending	NA	NA	Biopsy Sampling, Suction-Cup Tagging, Dart/Barb Tagging, Deep-Implantable Tagging	No
21938	Southeast Fisheries Science Center	Atlantic	Pending	NA	NA	Biopsy Sampling, Suction-Cup Tagging, Dart/Barb Tagging, Deep-Implantable Tagging	No
22141	Dr. Samuel Wasser	Pacific	Pending	NA	NA	NA	No
22547	Dr. Andrew Trites	Pacific	Pending	NA	NA	NA	Yes
22750	Dr. Rachel Cartwright	Pacific	Pending	NA	NA	NA	Yes
22835	Dr. John Hildebrand	Atlantic, Pacific	Pending	NA	NA	Biopsy Sampling, Suction-Cup Tagging	Yes
22884	Dr. Mark Baumgartner	Atlantic Ocean	Pending	NA	NA	NA	Yes

NA=not available

Table 16. Number of active permits by Endangered Species Act-listed species and distinct population segment and ocean basin as of March 5, 2019.

Species	Atlantic Ocean	Pacific Ocean	Southern Ocean	Worldwide
Beluga Whale – Cook Inlet DPS	NA	5	NA	1
Blue Whale	9	16	0	2
Bowhead Whale	3	4	0	1
False Killer Whale – Main Hawaiian Islands Insular DPS	0	9	0	1
Fin Whale	12	17	0	2
Bryde's Whale – Gulf of Mexico Subspecies	6	NA	NA	0
Gray Whale – Western North Pacific Population	1	2	NA	1
Humpback Whale – Multiple ESA-listed DPSs	NA	25	2	2
Killer Whale – Southern Resident DPS	NA	10	NA	1
North Atlantic Right Whale	12	NA	NA	0
North Pacific Right Whale	NA	14	NA	1
Sei Whale	11	14	0	2
Southern Right Whale	0	2	1	1
Sperm Whale	12	15	1	2
Total	17	28	2	2

DPS=distinct population segment
NA=not available
N=41 permits
Note: Some permits authorize research and enhancement activities in multiple ocean basins, and thus, these numbers do not reflect the total number of permits issued, which is less (N=four).

10.10.2 Historical Authorized Take by the National Marine Fisheries Service's Permits and Conservation Division

NMFS Permits and Conservation Division analyzed the number of ESA-listed cetacean and pinniped takes authorized under ESA section 10 and reported under research permits from June 2009 through June 2017 in order to understand the magnitude of historical take by the program. This timeframe represents at least one five-year permit cycle for all permit holders and the most current research methods and avenues of scientific inquiry. Permits were included in the data set if they were issued in June 2009 or more recently so that a full five-year data set for each permit was available. Most of the permit holders are career scientists conducting long-term studies of a continuing nature on ESA-listed cetacean species. As a result, over time the majority of permits are held by the same researchers or institutions, who require a new permit under the MMPA every five years. Because permits to date in the program are not issued on a fixed schedule, other permits were active in 2009, such as permits issued in a prior year, that were not included in this analysis. These permits were excluded from the data set because they do not reflect current research methods and the researcher's work is more accurately reflected in one of their more recently issued permits in the data set up to June 2017.

A small subset of data also was excluded from the historical take analysis because the authorized methods (e.g., captures conducted prior to a species being listed under the ESA) do not fit within the scope of this programmatic consultation. For the Gulf of Mexico subspecies of Bryde's whale, data available for the species in the Atlantic Ocean from 2009 through 2017 has been included because it is the best available information on the magnitude of past effort for the species in the cetacean research permitting program. For humpback whales, data available for the species in the Atlantic and Southern Oceans were excluded from the historical take analysis to represent the past level of effort only for the updated ESA-listed DPSs going forward in the Pacific Ocean, except where authorized worldwide. For Main Hawaiian Islands insular DPS of false killer whales, data available for a six-year period from 2011 through 2017 was used as they were listed under the ESA in 2012. The final data set included information from 56 permits over an eight-year period and representing 287 individual annual reports.

For the purposes of this data set, "takes" means the number of animals, not necessarily unique individuals, within a population that were authorized under ESA section 10 (and then reported) each year. As a result the cetacean research permitting program may issue "takes" for more animals than there are known individuals, such as in cases of small populations to accommodate research studies that need to survey the population more than once a year. For example, the current best estimate of the Cook Inlet DPS of beluga whales is 312 individuals, but a research permit can authorize over 1,000 takes annually for researchers that conduct multiple surveys per year. "Takes" are essential because in most field situations and for most species, researchers will not know whether they have "taken" the same individual more than once over the course of a year if it was not part of their study design and the target animals may not visible markings or identifiable features.

In addition, prior to June 2017 permit holders were required to count each "approach" and attempts to biologically sample the same animal within a day as a separate take. An "approach" is defined as a continuous sequence of maneuvers involving the research vessel, equipment, or researcher's body, including drifting, directed toward a cetacean or group of cetaceans closer than 100 yards (91.4 meters or 300 feet) for baleen and sperm whales and 50 yards (45.7 meters or 150 feet) for all other cetaceans and pinnipeds. The previous permit condition was:

- Any approach of a cetacean constitutes a take and must be counted and reported regardless of whether an animal reacts.
    - Each additional attempt to perform the suite of procedures during the same approach constitutes a new take and must be counted and reported against that row of takes.
    - Attempts include: misses, successful hits, and hits with no data collected/sample/tag.

To standardize and simplify counting in the field, the NMFS Permits and Conservation Division now require researchers to count all research and enhancement activities during the course of a day as one take, including any subsequent ESA harassment (MMPA Level B harassment) approaches performed on the same known animal. The new permit condition (see Section 19.3 starting at Condition B.5) is:

- For all cetacean approaches in water and attempts to remotely biopsy, tag, and ultrasound, count and report one take per cetacean per day.
    - If all ESA harm (MMPA Level A harassment) biopsy or tagging attempts on a single day are unsuccessful and do not make contact with the animal, count the take against your ESA harassment (MMPA Level B harassment) take row.
    - If any ESA harm (MMPA Level A harassment) attempts on a single day are unsuccessful but do make contact with the animal, count the take for the day against your sampling or tagging take row.

Figure 68 shows how the takes issued annually for permitted research activities was distributed among 14 ESA-listed cetaceans from 2009 through 2017. These annual takes represent an averaging of the eight-year data set, except for Main Hawaiian Islands insular DPS of false killer whales. Humpback whales represent the species with the most takes authorized (26 percent), followed by fin whales (15 percent), and sperm whales (14 percent).

The reported takes by species varies from the distribution of authorized takes (Figure 69). Humpback whales represented the species with the most reported takes at 43 percent of total takes authorized, followed by Southern Resident DPS of killer whales (24 percent) and Cook Inlet DPS of beluga whales (12 percent). No takes were reported over the eight-year period for Western North Pacific population of gray whales or Southern right whales. Only two takes were reported for North Pacific right whales over the eight-year period.

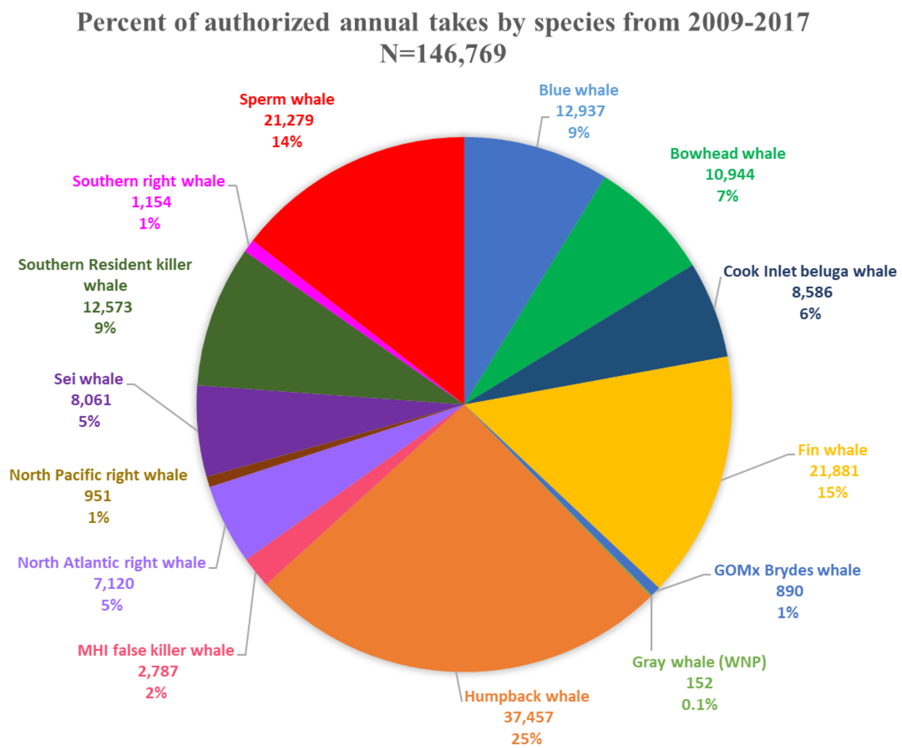

Figure 68. Average annual authorized Endangered Species Act-listed cetacean takes by species and distinct population segment from 2009 through 2017.

Note: Main Hawaiian Islands insular DPS of false killer whale takes represent data from 2011 through 2017 due to the ESA-listing date.

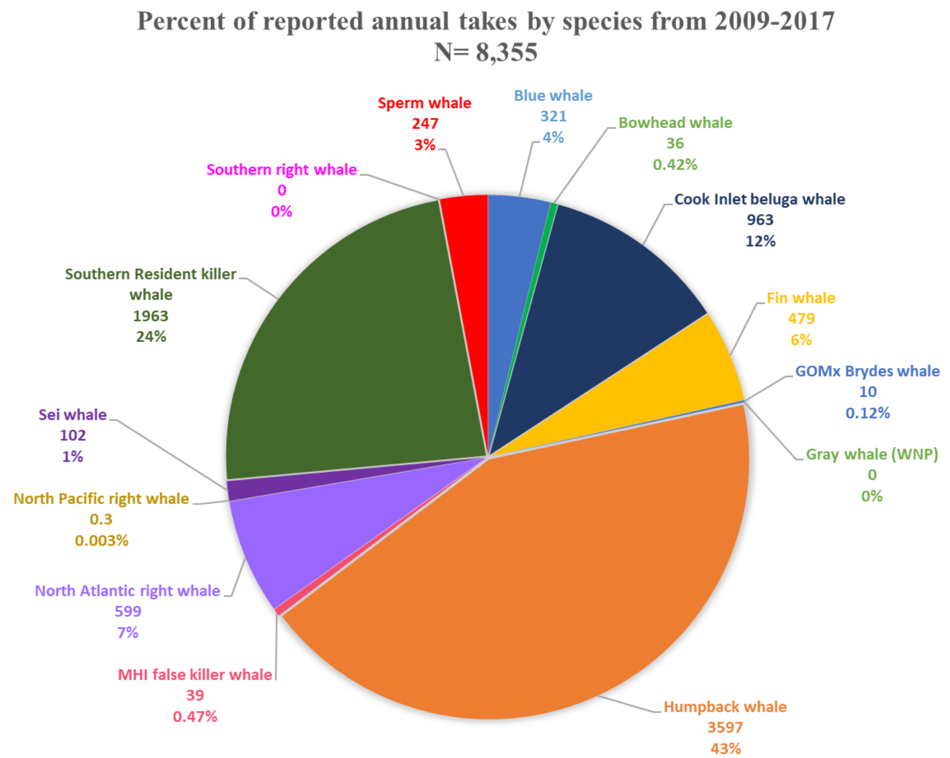

Figure 69. Reported average annual Endangered Species Act-listed cetacean takes by species and distinct population segment from 2009 through 2017.

Note: Main Hawaiian Islands insular DPS of false killer whale takes represent data from 2011 through 2017 due to the ESA-listing date.

Figure 70 illustrates the annual number of cetacean takes authorized and reported from 2009 through 2017 overall, and by study platform. On average, approximately 8,355 ESA-listed cetaceans were reported as taken within the cetacean research permitting program in any given year across all species, research methods, and activities combined. The reported takes represented only 5.7 percent of the authorized takes. An average of 1,697 cetaceans were taken during aerial surveys (3.7 percent of authorized takes and primarily include manned aerial surveys, although some unmanned aircraft systems may be included) and 6,658 cetaceans were taken during vessel-based research activities (6.6 percent of authorized takes), annually. In some cases, vessel-based research activities include take for the close approach by research vessel for the operations of unmanned aircraft systems; however, close approach by research vessel is not always necessary for unmanned aircraft system operations. The majority of authorized takes were for vessel surveys (69 percent) versus 31 percent of takes authorized for aerial surveys.

NMFS Permits and Conservation Division does not expect the level of effort for aerial surveys versus vessel surveys to change in the future. However, take numbers under the ESA for these efforts may decrease in the future based on NMFS recent interim harassment guidance under the ESA as they apply to research activities involving aerial and vessel surveys that only result in

MMPA Level B harassment and do not involve pursuit of the animal(s). In addition, as discussed above, prior to June 2017 permit holders were required to count each "approach" as defined in the permit by research vessel to the same animal within a day as a separate take. To standardize and simplify counting in the field, NMFS Permits and Conservation Division now requires researchers to count all research and enhancement activities during the course of a day as one take, including any subsequent MMPA Level B harassment approaches performed on the same known animal. This will bring take numbers more in line with animals' numbers.

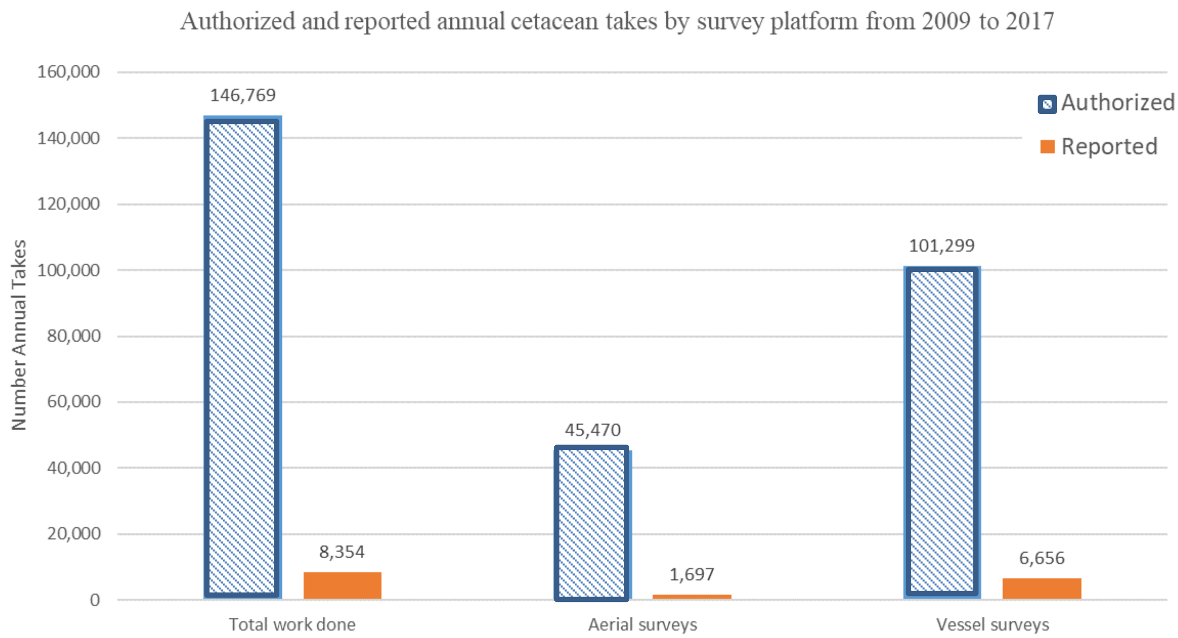

Figure 70. Annual Endangered Species Act-listed cetacean takes authorized versus reported from 2009 through 2017 overall, and by study platform.

For take from vessel surveys, NMFS Permits and Conservation Division has further analyzed the data into ESA harm and harassment (MMPA Level A and Level B harassment) (Figure 71). On average, 81 percent of annual vessel survey takes authorized are for research and enhancement activities that may result in MMPA Level B harassment, while only 19 percent of authorized takes are for research activities that may result in ESA harm (MMPA Level A harassment) (biopsy sampling or tagging). An average of 466 (±282 standard deviation, range 120 to 878) animals were reported as taken by biopsy sampling and/or tagging procedures, annually. The number of researchers and their proposed research and enhancement activities remain relatively consistent over time; and thus, NMFS Permits and Conservation Division does not expect the frequency of these research and enhancement activities to significantly change in the foreseeable future.

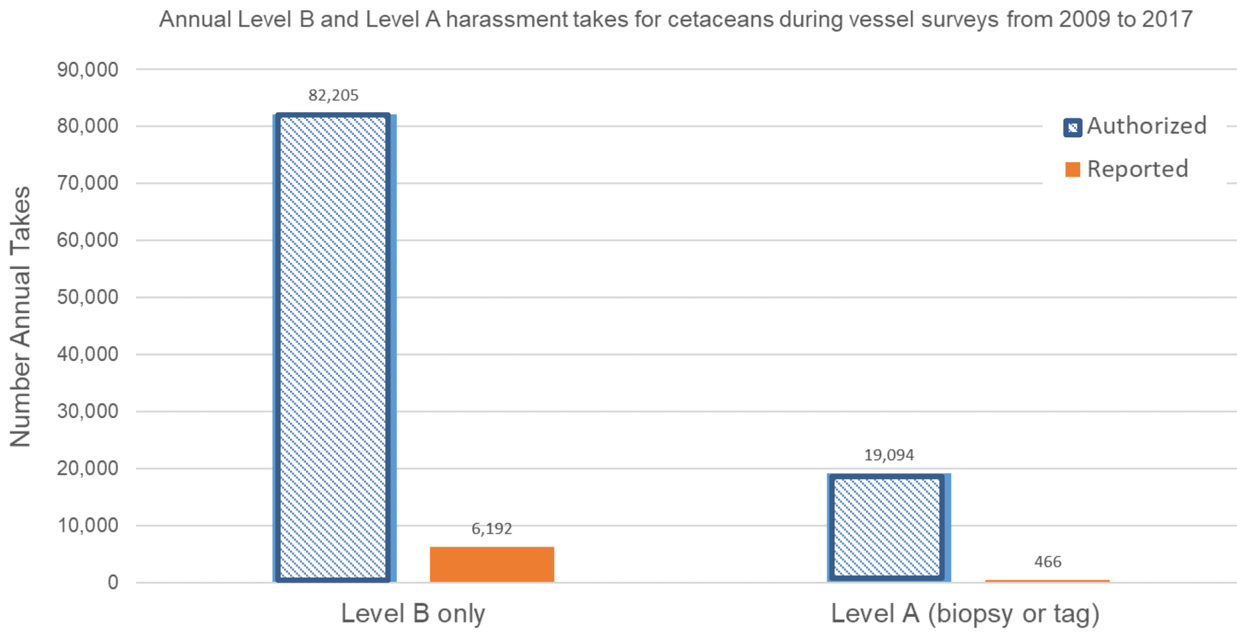

Figure 71. Annual authorized versus reported Endangered Species Act-listed cetacean takes from Marine Mammal Protect Act Level A and Level B harassment research and enhancement activities during vessel surveys from 2009 through 2017.

The ESA harm (MMPA Level A harassment) research methods are further separated into biopsy sampling and tagging (Figure 72 and Figure 73). On average, 386 ± 214 (range 112 to 702) cetaceans are biopsy sampled (2.4 percent of authorized takes), and 154 ± 105 (range 49 to 347) cetacean are tagged 1.1 percent of authorized takes), annually.

Most permits with ESA harm (MMPA Level A harassment) take authorize more than one ESA harm (MMPA Level A harassment) research method for target cetaceans. For instance, a researcher may wish to biopsy sample or tag ten animals. Rather than authorizing ten animals to be taken by each research method separately (for a total of 20 ESA harm [MMPA Level A harassment] takes), the research methods can be combined in one take row. This provides the researcher flexibility in how they are able to acquire needed sample sizes while minimizing the amount of total take authorized for the species. For this reason, the number of takes authorized for a given ESA harm (MMPA Level A harassment) research method should not be summed across research methods. The same is true for researchers who wish to internationally biopsy sample and tag the same animal. In other words, the data for this “take” appears in both columns (for biopsy sampling and tagging) in Figure 72 but is reported as one take for the entire encounter in the annual report. To be conservative, NMFS Permits and Conservation Division assume for such reported takes that all authorized procedures for a given line of take in the permit take table were performed.

Authorized levels of take during this 2009 through 2017 timeframe for cetacean research activities were highly likely an overestimate by applicants of how many animals may be seen during surveys annually as a worst-case scenario, and planned surveys based on anticipated funding. In addition, prior to June 2017, permit holders were required to count unsuccessful attempts for ESA harm (MMPA Level A harassment) research methods (biopsy sampling and tagging) that make contact with the animal. This inflated some permit holders ESA harm (MMPA Level A harassment) take numbers based on their sampling or tagging success rates. Such high numbers are not expected in the future based on the NMFS Permits and Conservation Division's new guidance to count and report one take per day for the same animal as described above. In other words, all attempts to approach, biopsy sample, and tag an animal over the course of a day, will be counted as one take.

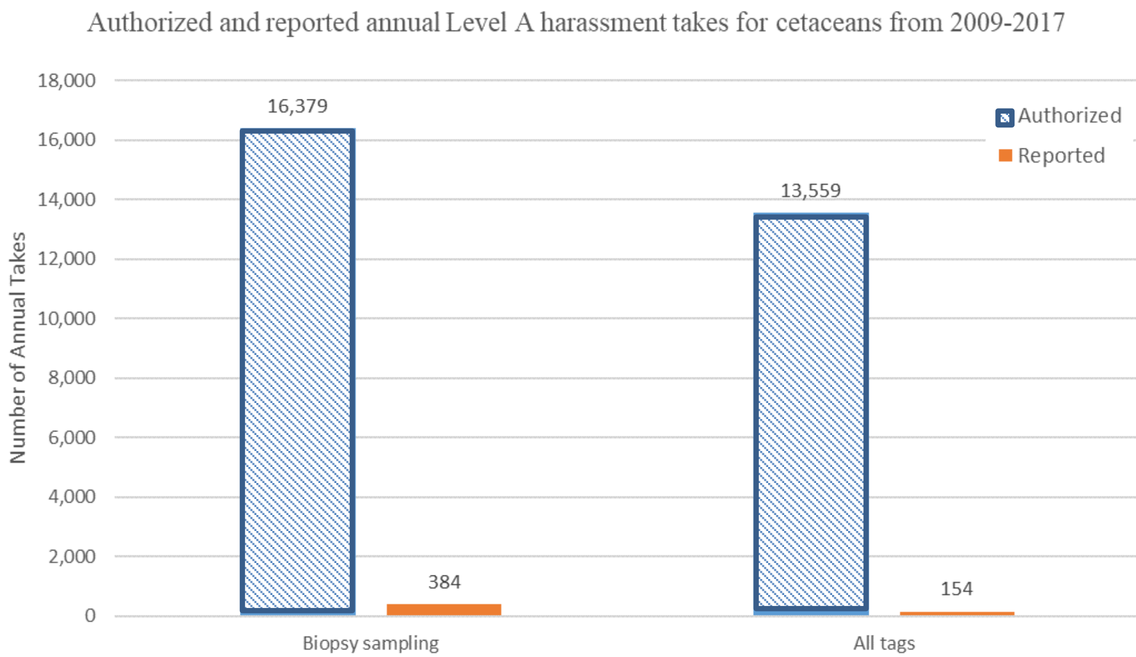

Figure 72. Annual takes authorized versus reported for Endangered Species Act-listed cetacean biopsy sampling and tagging from 2009 through 2017.

Annual tagging take data are split into the three tag types authorized (Figure 73). An annual average of 138 (±96.6, range 43 to 325) suction-cup tags, 54 (±46, range 7 to 136) dart/barb tags, and 48 (±36.1, range 13 to 99) deep-implantable tags were authorized for all cetaceans, annually.

As noted above, in many cases, the number of tagging takes authorized for a species may occur by multiple tag types, For instance, a researcher may request to tag ten cetaceans with suction-cup, dart/barb, or deep-implantable tags, or any combination of the three types. Rather than authorizing ten cetaceans to be tagged by each type individually (30 total ESA harm [MMPA Level A harassment] takes by tagging), multiple tag types were often authorized on a single row of the take table. Therefore, as an example, if a permit authorized five takes for suction-cup tagging and dart/barb tagging on the same take row, that data of five takes is presented in each tag type's issued take bars (12,968 suction-cup tags and 2,089 dart/barb tags) in Figure 73. For this reason, tagging takes cannot be separated by individual tag type, and the number of takes issued for individual tag types in Figure 73 should not be summed across types. Rather, each set of authorized and reported take data by tag type should be interpreted as a worst-case scenario.

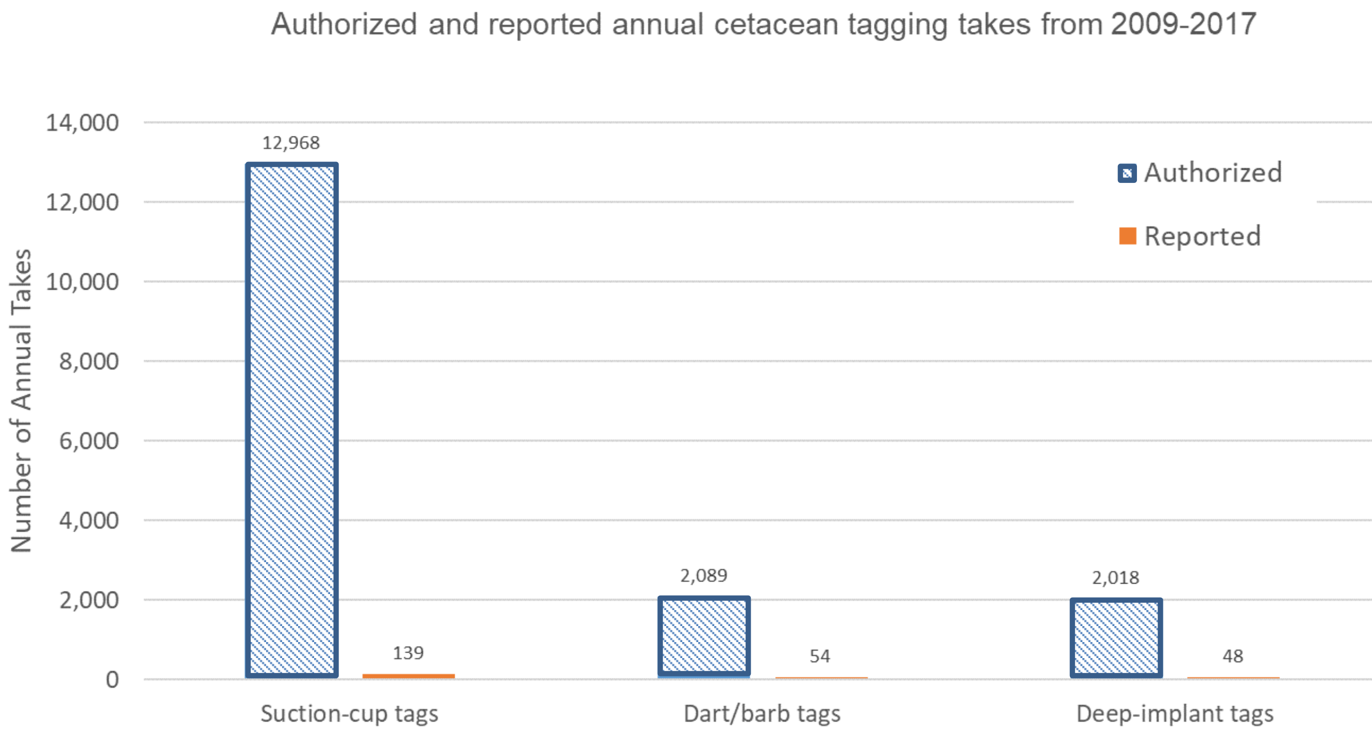

Figure 73. Annual average tagging takes by tag type authorized versus reported for all Endangered Species Act-listed cetaceans combined from 2009 through 2017.

The average number of deep-implantable tags by species are shown in Table 17. The species that were not authorized for this type of tag do not appear in the Table 17. The species with the highest number of deep-implantable tags reported were humpback whales (N=13.8 ± 15.9 tags, range 0 to 46), representing the updated ESA-listed DPSs worldwide, as noted above. No deep-implantable tags were reported from 2009 through 2017 for Western North Pacific population of gray whales, sei whales, and Southern right whales. In all cases, on average researchers used 5.4 percent or less than their authorized takes for deep-implantable tags annually. This may be due to changes in resources, other logistics (e.g., weather), and the ability to find animals suitable for tagging purposes. The number of researchers and their proposed research and enhancement activities remain relatively consistent over time; and thus, NMFS Permits and Conservation Division do not expect the frequency of these research and enhancement activities to significantly change in the foreseeable future.

Table 17. Average annual deep-implantable tagging takes versus reported for Endangered Species Act-listed cetacean species from 2009 through 2017. Data represents the annual average takes ± standard deviation.

Species	Authorized Takes		Reported Takes		Percent of Authorized Takes Requested
	Annual Average (± standard deviation)	Range	Annual Average (± standard deviation)	Range	
Blue Whale	227.5 ± 104.0	75 to 375	12.4 ± 13.6	0 to 29	5.4%
Bowhead Whale	279.6 ± 86.2	130 to 415	3.1 ± 2.4	0 to 7	1.2%
Bryde's Whale – Gulf of Mexico Subspecies	75 ± 80.2	0 to 150	0.1 ± 0.4	0 to 1	0.2%
Fin Whale	333.4 ± 178.1	75 to 572	5.9 ± 6.2	0 to 14	1.8%
Gray Whale – Western North Pacific Population	18.0 ± 19.2	0 to 36	0	-- --	-- --
Humpback Whale – Multiple ESA-listed DPSs	380.6 ± 198.3	150 to 625	13.8 ± 15.9	0 to 46	3.6%
North Pacific Right Whale	50.6 ± 30.1	14 to 84	0.5[1]	0 to 3	0.98%
Sei Whale	138.1 ± 74.1	35 to 235	0	-- --	-- --
Southern Right Whale	78.8 ± 84.8	0 to 180	0	-- --	-- --
Sperm Whale	449.4 ± 214.4	230 to 765	12.6 ± 12.8	0 to 31	2.8%

[1]Four North Pacific right whales were tagged in 2009 through 2010 under an annual report not included in this dataset, but are included here for historical purposes.

10.10.3 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 2017a, b). 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.

10.11 Impact of the Baseline on Endangered Species Act-Listed Species

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 9, 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* and *Status of Species Likely to be Adversely Affected* sections (Sections 8 and 9) of this consultation.

11 EFFECTS OF THE ACTION

Section 7 regulations define “effects of the action” as the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 C.F.R. §402.02). Indirect effects are those that are caused by the proposed action and are later in time, but are reasonably certain to occur. This effects analysis section is organized following the stressor, exposure, response, and risk assessment framework.

In this section, we describe the potential stressors associated with the proposed action that are likely to adversely affect ESA-listed cetaceans, the probability of individuals of ESA-listed cetaceans being exposed to these stressors based on the best scientific and commercial evidence available, and the probable responses to those individuals (given probable exposures) based on the available evidence. As described in Section 11.4, for any responses that would be expected to reduce an individual’s fitness (i.e., growth, survival, annual reproductive success, or lifetime reproductive success), the assessment would consider the risk posed to the viability of the population(s) those individuals comprise and to the ESA-listed cetaceans those populations represent. For this consultation, we are particularly concerned about behavioral and stress-based physiological disruptions and potential unintentional mortality that may result in animals that fail to feed, reproduce, or survive because these responses could have population-level consequences. The purpose of this assessment and, ultimately, of this consultation is to determine if it is reasonable to expect the proposed action to have effects on ESA-listed cetaceans that could appreciably reduce their likelihood of surviving and recovering in the wild.

11.1 Stressors Associated with the Proposed Action

Stressors are any physical, chemical, or biological entity that may induce an adverse response either in an ESA-listed species or their designated critical habitat. The issuance of scientific researcher permits will authorize several methods for research activities that may expose ESA-listed cetaceans within the action area to a variety of stressors. Each research activity presents a unique set of stressors, as further detailed below. Given the directed nature of the proposed research, all research and enhancement activities directed only at non-ESA-listed species (except active acoustic playbacks) are not expected to present any stressors to the ESA-listed cetaceans found in the action area, and so these research and enhancement activities are not considered further in this consultation (see Section 3.7).

The potential stressors we expect to likely adversely affect ESA-listed species as a result of the proposed action are active acoustics (i.e., playbacks), biopsy sampling, and tagging, and are discussed below.

Active acoustic playbacks will present the stressors of acoustic disturbance and close approaches. Biopsy sampling can present the additional stressor of interaction with scientific equipment, if cetaceans happen to approach researchers during sampling. Biopsy sampling can also carry the stressor of a closer vessel approach than is typical for other vessel survey activities (except tagging), direct physical contact with the animal, a minor puncture wound, and tissue collection. Suction-cup tagging will present the additional stressors of a very close approach and direct physical contacts to apply suction-cup tags and then the continued attachment of tags. Dart/barb, bolt/pin, and deep-implantable tagging will present the additional stressors of a very close approach and puncture wounds and then the continued attachment of tags.

11.2 Mitigation to Minimize or Avoid Exposure

As a condition of their permit, researchers will be required to follow specific protocols to avoid, minimize, and mitigate the unintended detrimental effects that may result from research and enhancement activities. Specific permit conditions to mitigate adverse effects on both target and non-target ESA-listed species are described for each activity in Section 3.7 above, with more details provided in Section 19.3. We evaluate the potential effects of the stressors associated with the proposed action in full consideration of these mitigation measures. In addition to standard protocols, a permit condition will require each researcher to consider additional precautionary measures that can be taken to further minimize impacts on individual ESA-listed cetaceans.

Mitigation to minimize or avoid exposure of ESA-listed species to adverse effects is a core principle of the NMFS Permits and Conservation Division's mission to "protect and conserve marine mammals and threatened and endangered species by providing special exceptions for take, import, and export that maximize recovery value and minimize individual and cumulative impacts as directed under ESA section 10(a)(1)(A) and its regulations." Specific mitigation criteria the NMFS Permits and Conservation Division considers when issuing permits include: (1) whether alternative non-endangered species or population stocks can and should be used; (2) how the research is not unnecessarily duplicative of other work; (3) how the applicant will coordinate research and enhancement activities with other permit holders; and (4) how the applicant will minimize impacts of the research and enhancement activities in particular to avoid or minimize mortality.

In addition to the minimization and avoidance measures in the research permit or specified as a condition of the permit, the NMFS Permits and Conservation Division has proposed an adaptive management approach that will continuously update and improve the mitigation measures. The mitigation measures included in cetacean research permits authorized under the program can be modified by the NMFS Permits and Conservation Division at any time based on investigation into a researcher reported incident of take, new information regarding potential impacts of authorized research and enhancement activities, or demonstrated improvements to the standard protocols for cetacean research.

The NMFS Permits and Conservation Division recognize that additional techniques for research methods may become available as they evolve with technological advances accepted by the research community. Therefore, NMFS Permits and Conservation Division can authorize under this programmatic consultation additional procedures or variations of research methods as they become available provided they do not have adverse effects beyond those considered in this consultation or result in fitness-level consequences, or an increased risk of serious injury or mortality. If NMFS Permits and Conservation Division develops recommendations or best practices for research and enhancement activities targeting cetaceans, the standard mitigation measures and permit requirements will be revised to be consistent with such recommendations to minimize impacts to the extent possible. The NMFS Permits and Conservation Division does not expect new research methods or changes in protocols to result in a level of impact not evaluated as part of this programmatic consultation.

The NMFS Permits and Conservation Division will require that the qualifications of individuals conducting the research and enhancement activities under scientific research permits are commensurate with their roles and responsibilities. In accordance, the only personnel authorized to conduct the research and enhancement activities will be the principal investigators and co-investigators listed in the permit applications, and research assistants. We anticipate that requiring that the research and enhancement activities be conducted by experienced personnel will further minimize impacts to the ESA-listed cetaceans that may be exposed to stressors, as these individuals should be able to recognize adverse responses and cease to modify their research and enhancement activities accordingly.

11.3 Exposure Analysis

The *Exposure Analysis* identifies, as possible, the number, age (or life stage), and gender of the ESA-listed individuals that are likely to be exposed to the stressors and the population(s) of the sub-population(s) those individuals belong.

In this section, we quantify the likely exposure of ESA-listed species to the research and enhancement activities and associated stressors that may result from the proposed action (Section 11.1). The number of animals that may be taken during research and enhancement activities that are not expected to result in fitness level impacts in NMFS Permits and Conservation Division's cetacean research permitting program as a whole will be unlimited. The NMFS Permits and Conservation Division will only be limiting the authorized number of deep-implantable tags. Table 18 specifies the NMFS Permits and Conservation Division's documented exposure to ESA-listed cetaceans associated with all forms of take from 2009 through 2017. Here, "takes" means the number of animals, not necessarily unique individuals, within a population that were authorized (and then reported) each year. A small proportion of these takes involved biopsy sampling and tagging, levels of which are compared in Table 19. Tagging takes are broken down by tag type in Table 20. Finally, deep-implantable tags are further broken down by species in Table 21. Certain permits were excluded from the data set because they did not reflect current research methods and the researchers' work is more accurately reflected in one of their more recently issued permits in the data set up to June 2017. A small subset of data was also excluded from the analysis because the authorized methods (e.g., captures conducted prior to a species' ESA-listing status) do not fit within the scope of this programmatic consultation. In accordance with our regulations (50 C.F.R. §402), here we evaluate whether or not these levels of exposure are reasonably certain to continue in the future.

Table 18: Average annual authorized and reported Endangered Species Act-listed cetacean takes by species from 2009 through 2017.

Species	Annual Authorized Takes	Annual Reported Takes
Beluga Whale – Cook Inlet DPS	8,586	963
Blue Whale	12,937	321
Bowhead Whale	10,944	36
Gulf of Mexico Bryde's Whale – Gulf of Mexico Subspecies	890	10
False Killer Whale – Main Hawaiian Islands Insular DPS	2,787	39
Fin Whale	21,881	479
Gray Whale – Western North Pacific Population	152	0
Humpback Whale	37,457	3597
Killer Whale – Southern Resident DPS	12,573	1,963
North Atlantic Right Whale	7,120	599
North Pacific Right Whale	951	0.3
Sei Whale	8,061	102
Southern Resident Killer Whale	12,573	1,963
Southern Right Whale	1,154	0
Sperm Whale	21,279	247

DPS=distinct population segment

Note: The Main Hawaiian Islands insular DPS of false killer whale takes represent data from 2011 through 2017 due to the Endangered Species Act-listing date for this species.

Table 19: Annual average authorized and reported takes for Endangered Species Act-listed cetacean biopsy sampling and tagging from 2009 through 2017.

Stressor	Annual Authorized Takes	Annual Reported Takes
Biopsy Sampling	16,379	386
Tagging	13,559	154

Table 20: Annual average tagging takes by tag type authorized versus reported for all Endangered Species Act-listed cetaceans combined from 2009 through 2017.

Tag Type	Annual Authorized Takes	Annual Reported Takes
Suction-Cup	12,968	139
Dart/Barb	2,089	54
Deep-Implantable	2,018	48

Table 21: Average annual deep-implant tagging takes authorized versus reported for Endangered Species Act-listed cetacean species from 2009 through 2017.

Species	Authorized Takes		Reported Takes		Percent of Authorized Takes Reported
	Annual Average (± standard deviation)	Range	Annual Average (± standard deviation)	Rang e	
Blue Whale	227.5 ± 104.0	75 to 375	12.4 ± 13.6	0 to 29	5.4%
Bowhead Whale	270.6 ± 86.2	130 to 415	3.1 ± 2.4	0 to 7	1.2%
Bryde's Whale – Gulf of Mexico Subspecies	75 ± 80.2	0 to 150	0.1 ± 0.4	0 to 1	0.2%
Fin Whale	333.4 ± 178.1	75 to 572	5.9 ± 6.2	0 to 14	1.8%
Gray Whale – Western North Pacific Population	18.0 ± 19.2	0 -to36	0	-- --	-- --
Humpback Whale	380.6 ± 198.3	150 to 625	13.8 ± 15.9	0 to 46	3.6%
North Pacific Right Whale	50.6 ± 30.1	14 to 84	0.5 [1]	0 to 3	0.98%
Sei Whale	138.1 ± 74.1	35 to 235	0	-- --	-- --
Southern Right Whale	78.8 ± 84.8	0 to 180	0	-- --	-- --
Sperm Whale	449.4 ± 214.4	230 to 765	12.6 ± 12.8	0 to 31	2.8%

[1] Four North Pacific right whales were tagged in 2009 through 2010 under an annual report not included in this dataset, but are included here for historical purposes.
Note: Data represents the annual average takes plus/minus standard deviation.

For research and enhancement activities on humpback whales that will be authorized under scientific research permits, estimates of the number of individuals to be sampled are based on the location in which 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 22 and Table 23), we rely on NMFS internal guidance as derived from NMFS (2016b, g) and Wade (2017). For Alaska, British Columbia, Washington, Oregon, and California, which in Wade (2017) is composed of several small sub-locations, we use the percentage estimates from Wade (2017) 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 (2017) (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. We also include the percentage estimates from Wade (2017) for each humpback whale DPS near Kamchatka, Russia, as the action area includes this region of the Pacific Ocean.

Table 22. 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 (2017).

Summer Feeding Areas	Western North Pacific Distinct Population Segment	Hawaii Distinct Population Segment	Mexico Distinct Population Segment	Central America Distinct Population Segment
Kamchatka	100%	0%	0%	0%
Aleutian Islands, Bering Sea, Chukchi Sea, Beaufort Sea	2.1%	86.8%	11%	0%
Gulf of Alaska	0.4%	87.2%	12%	0%
Southeast Alaska, Northern British Columbia	0%	96.1%	3.8%	0%
Southern British Columbia, Washington	0%	63.5%	27.9%	8.7%
Oregon, California	0%	0%	32.7%	67.2%

Table 23: 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 (2017).

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	5.4%	0%	0%	0%
Aleutian Islands, Bering Sea, Chukchi Sea, Beaufort Sea	94.6%	71.1%	55.2%	0%
Gulf of Alaska	0%	1.2%	11.1%	0%
Southeast Alaska, Northern British Columbia	0%	15.2%	2%	0%
Southern British Columbia, Washington	0%	1.6%	3.3%	7.4%
Oregon, California	0%	0%	28.4%	92.6%

To determine the exposure 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 24). 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 25).

Table 24. 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 25. 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) *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 26).

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 27).

Table 26: 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 27: 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%

Given the NMFS Permits and Conservation Division's issuance and counting of takes as well as the researchers' inability to identify each individual animal in the field in real time, the permitted annual number of authorized takes represents the maximum number of individuals that may be exposed to the proposed research and enhancement activities annually, although it is possible that individuals can be exposed more frequently in a given year for research and enhancement activities under scientific research permits. The NMFS Permits and Conservation Division directs researchers to count and report one take per cetacean per day including all approaches and procedure attempts, regardless of whether a behavioral response to the permitted activity is observed. For example, if researchers sample an animal one day it will count as one individual taken under the ESA/MMPA permit. If the same individual were sampled on another day that same year without the researchers realizing it, it will be counted as a different individual taken under the ESA/MMPA permit. This will result in fewer individuals being annually exposed to the proposed research and enhancement activities. This scenario also illustrates that researchers may unintentionally sample the same individual more than once in a single year, and thus may not be able to adhere to their allotted takes per individual. However, given the nature of fieldwork (unpredictability, reliance on equipment and personnel availability, and good weather operations, etc.), the vast action area of scientific research permits, and the range of most ESA-listed cetaceans, it is likely that many, if not all animals will only be sampled once or at most two or three times over the five-year permit timeline. For fairly small residential populations such as Cook Inlet DPS of beluga whales, Gulf of Mexico subspecies of Bryde's whales, Main Hawaiian Islands insular DPS of false killer whales, Southern Resident DPS of killer whales, or South Island Hector's dolphins, there is an increased possibility that the same animal may be intentionally or unintentionally sampled more than once or multiple times in a given year. However, in these circumstances, researchers typically have well-established photo-identification catalogs and are able to readily identify the animals in the field and avoid repeat sampling, if necessary.

According to the NMFS Permits and Conservation Division, the number of researchers and their proposed biopsy sampling and tagging activities remain relatively consistent over time. Thus, we do not expect the frequency of these research activities to significantly change in the foreseeable future.

Authorized levels of take from 2009 through 2017 for cetacean research activities were high, likely an overestimate by applicants of how many animals may be seen during surveys annually as a worst case scenario, and planned surveys based on anticipated funding. In addition, prior to June 2017 permit holders were required to count unsuccessful attempts for procedures that make contact with the animal, including biopsy sampling and tagging. This inflated some permit holders' ESA harm (MMPA Level A harassment) take numbers based on their biopsy sampling or tagging success rates. Such high numbers are not expected in the future based on the NMFS Permits and Conservation Division's new take guidance to count and report one take per day for the same animal, as described above.

The number of animals that may be taken during research and enhancement activities that are not expected to result in fitness level impacts in the NMFS Permits and Conservation Division's program as a whole will be unlimited. This includes all research and enhancement activities as proposed on wild and captive animals, except deep-implantable tags. Invasive procedures such as biopsy sampling, dart/barb, and bolt/pin tagging may have adverse impacts to targeted cetaceans, however with the proper mitigation measures in place, fitness-level impacts from these research activities are not expected and thus take numbers are not proposed to be limited (species and age-class restrictions will apply to dart/barb tagging, see Table 28). Permits for research and enhancement activities on captive animals in public display or rehabilitation facilities may also be unlimited. Permits for research on parts alone, such as for cell line development, will not authorize the take of live animals, and the numbers of parts could also be unlimited.

As outlined in Table 28, some ESA harm (MMPA Level A harassment) take methods would be limited in the NMFS Permits and Conservation Division's program by age-class or based on an animal's apparent physical condition. These measures serve as a safe guard to avoid serious injury, mortality, or other fitness-related impacts (e.g., reproductive success) to the target species and populations. The NMFS Permits and Conservation Division proposes to limit the species that may receive deep-implantable tags and the number of takes authorized for these species annually. Should new information become available indicating that other methods could have fitness-level impacts that cannot be mitigated or avoided and that the NMFS Permits and Conservation Division sees value to permitting, a similar approach would be taken to finding a way to limit the magnitude of effort and therefore impact to the target species and populations. This would be evaluated on a case-by-case basis in discussion with the NMFS ESA Interagency Cooperation Division.

Table 28. Limits on research methods by age class, reproductive state, and compromised status of target animals ("Yes" = allowed).

Research Method	Age Class				Reproductive Status[1]			Compromised Status[2]
	Neonate Calf	Non-Neonate Calf	Juvenile	Adult	Mother with Neonate Calf	Mother with Non-Neonate Calf	Obviously Pregnant Female	
Remote Ultrasound	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Biopsy or Skin Sampling	Yes	Yes	Yes	Yes	Yes	Yes	Yes[3]	Yes
Suction-Cup Tagging	No	Yes	Yes	Yes	Yes[3]	Yes	Yes	Yes
Dart/Barb or Bolt/Pin Tagging	No	Yes[3]	Yes	Yes	Yes[3]	Yes	Yes[3]	No
Deep-Implantable Tagging	No	Yes[3]	Yes	Yes	Yes[3]	Yes	No	No

[1]Additional permit terms and conditions for mother-calf pairs still apply.
[2]Compromised status includes thin/skinny, excessive lesions or parasites, behaving abnormally, or known compromised individuals.
[3]Allowed in some cases (e.g., biopsy and tagging).

Deep-implantable tags will not be authorized for some species or age-classes, and the number of deep-implantable tags for those species that may be tagged will be limited (see Table 1). The NMFS Permits and Conservation Division proposes to authorize deep-implantable tags annually to no more than ten percent of the best available abundance estimate at the species, DPS, or population level. However, the number of tags authorized annually almost never translates to that many cetaceans actually being tagged each year (see Table 20 and Table 21); therefore, it is expected that the number of deployed and reported tags will not exceed five percent of the species, DPS, or population level annually. These limits will be evaluated annually and may need to be adjusted as new information becomes available (see Section 3.16 for details on monitoring and implementation). Funding agencies require applicants be permitted in order to apply for funds. It is the policy of the NMFS Permits and Conservation Division's cetacean research permitting program that researchers have a need to request a certain number of takes in order to be eligible and competitive for funding. Having adequate resources and eligibility for funding is a regulatory requirement for permit applicants. Table 29 below includes historical data for authorized versus actual takes from deep-implantable tags. In larger populations, the five or ten percent is a relatively large number and not likely to occur (i.e., more than 800 tags). In very small populations, the five or ten percent is a small number and it is more difficult to manage takes depending on the number of permitted researchers. The ten percent authorized limit is most applicable to managing the very small populations. As mentioned in Section 3.9, this limit will be evaluated annually by the NMFS Permits and Conservation Division. Flexibility is needed in authorizing take with the understanding that actual take rarely meets the authorized limit.

Table 29: Status of species and proposed deep-implantable tag limits for National Marine Fisheries Service Permits and Conservation Division's cetacean research permitting program for U.S. stocks or distinct population segments (except Southern right whales and Western North Pacific stock of North Pacific right whales).

Common Name	Stock or DPS	Combined Abundance Estimate (Nbest)[1]	Number of Deep-Implantable Tags Authorized (10% of Nbest)	Number of Deep-Implantable Tags Reported (5% of Nbest)	Historical Annual Deep-Implantable Tags Reported[2]	Historical Annual Deep-Implantable Tags Authorized[1]
Blue Whale	Western North Atlantic, Eastern North Pacific, and Central North Pacific Stocks	2,220	222	111	12.4 ± 13.6 (0 to 29)	227.5 ± 104.0 (75 to 375)
Bowhead Whale	Western Arctic Stock	16,892	1,689	845	3.1 ± 2.4 (0 to 7)	270.6 ± 86.2 (130 to 415)
	Spitsbergen Stock	250	25	13		
	Sea of Okhotsk Stock	200	20	10		
Fin Whale	Western North Atlantic, Northeast Pacific, CA/OR/WA, and Hawaii Stocks	13,969	1,396	698	5.9 ± 6.2 (0 to 14)	333.4 ± 178.1 (75 to 572)
Gray Whale	Western North Pacific Stock	140	14	7	0	18.0 ± 19.2 (0 to 36)
Humpback Whale	All DPSs Combined	5,076	508	254	13.8 ± 15.9 (0 to 46)	380.6 ± 198.3 (150 to 625)
	Central America DPS	411	41	21		
	Mexico DPS	3,264	326	163		
	Western North Pacific DPS	1,059	106	53		
	Cape Verde/NW Africa DPS	260	26	13		
	Arabian Sea DPS	82	8	4		

North Pacific Right Whale	Eastern North Pacific Stock	31	3	2	0.5 [3] (0 to 3)	50.6 ± 30.1 (14 to 84)
	Western North Pacific Stock	500	50	25		
Southern Right Whale	Worldwide (excluding Chile-Peru)	15,000	1,500	750	0	78.8 ± 84.8 (0 to 180)
	Chile-Peru Stock	49	5	3		
Sperm Whale	North Atlantic, Gulf of Mexico, North Pacific, CA/OR/WA Stock, and Hawaii Stocks	9,607	961	480	12.6 ± 12.8 (0 to 31)	449.4 ± 214.4 (230 to 765)

[1] N_{min} was used when N_{best} was unavailable. Stocks of animals with unknown N_{best} or N_{min} were not included in the combined total.
[2] Historical data from 2009 through 2017 as described in Section 10.10.2. Annual average ± standard deviation (range).
[3] Four North Pacific right whales were tagged in 2009 through 2010 under an annual report not included in this dataset, but are included here for historical purposes.
CA/OR/WA=California/Oregon/Washington
DPS=Distinct Population Segment
Note: The historical numbers of authorized and reported deep-implant tags from 2009 through 2017 are included for reference.

The deep-implantable tag limits are calculated at the combined species (stock or DPS) level with the exception of the North Pacific right whale, bowhead, and Southern right whales. The NMFS Permits and Conservation Division will authorize tag limits at the stock level for North Pacific right whales. Tag limits will also be considered at the stock level for the Spitsbergen stock and Sea of Okhotsk stock of bowhead whales and the Chile-Peru stock of Southern right whales. Like the North Pacific right whale, these stocks are believed to be small populations. For all other species, because the individual stocks are not known to be biologically meaningful and the fact that permit holders often need takes allocated range-wide for a species (e.g., throughout an ocean basin), the limits are quantified and managed at the species level.

The NMFS Permits and Conservation Division is currently proposing to authorize up to ten percent of current abundance estimates for deep-implant tagging of ESA-listed cetaceans; however, this limit could change over time. Each year, the NMFS Permits and Conservation Division will evaluate the annual reports and any new information on the effects of deep-implantable tags to ensure they are not having fitness-level impacts at the authorized level for each species, stock, or DPS. For example, if new information from the tagging community or in annual reports indicates that tags are not having any fitness-level impacts, annual limits may be increased. Conversely, if the data indicates that fitness-level impacts are occurring, annual limits for deep-implantable tags may be decreased. The ten percent authorized limit for a given species may be increased or decreased based on an evaluation of the health of that population, population size, and their decision matrix criteria. In all of these scenarios, the NMFS Permits and Conservation Division would inform the NMFS ESA Interagency Cooperation Division prior to implementing any changes to the number of deep-implantable tags authorized annually to ensure that the percent change is still within the scope of the programmatic consultation (i.e., although the percent may change, a change in the effects is not anticipated) to determine if reinitiation is required.

11.4 Response Analysis

The *Response Analysis* evaluates the available evidence to determine how individuals of those ESA-listed species are likely to respond given their probable exposure. Given the exposure detailed above, here we describe the range of responses among ESA-listed cetaceans that may result from the stressors associated with the research and enhancement activities that will be authorized under scientific research permits. These include stressors associated with the following activities: active acoustic playbacks, biopsy sampling, and tagging. Based on a review of available information, this consultation determined which of these possible stressors will be discountable or insignificant and which may lead to lethal, sub-lethal (or physiological), or behavioral responses that might reduce the fitness of individuals. Our response analysis considers and weighs evidence of adverse consequences, as well as evidence suggesting the absence of such consequences. In cases where data specific to a species (e.g., North Atlantic right whales) are unavailable, we rely on data from other species, including cetaceans, particularly large whales (i.e., mysticetes and sperm whales). We recognize that there can be species' specific responses, and even within species all individual animals do not respond to each stressor in the same way (e.g., Noren and Mocklin 2012). Examining the range of responses large cetaceans exhibit to research activities allows us to incorporate the uncertainty that stems from intra- and inter-species response heterogeneity, and makes use of the best available science.

In general, all the research and enhancement activities described in Section 3.7 have the potential to cause some sort of disturbance. Responses by animals to human disturbance are similar to their responses to potential 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 a "fight or flight" response to more serious physiological changes resulting from chronic exposure to stressors. Stress responses can also lead to interruptions of essential behavioral or physiological events, alteration of an animal's time budget, or some combination of these responses (Frid and Dill 2002; Romero 2004; Sapolsky et al. 2000; Walker et al. 2005). Further, 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).

The mammalian stress response 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 adrenaline (epinephrine), glucocorticosteroids, and others (Busch and Hayward 2009; Gulland et al. 1999; St. Aubin and Geraci 1988; St. Aubin et al. 1996; Thomson and Geraci 1986). These hormones can subsequently cause short-term weight loss, the liberation of glucose into the blood stream, impairment of the immune and nervous systems, elevated heart rate, body temperature, blood pressure, and alertness, and other responses (Busch and Hayward 2009; Cattet et al. 2003; Dickens et al. 2010; Dierauf and Gulland 2001a; Dierauf and Gulland 2001b; Elftman et al. 2007; Fonfara et al. 2007; Kaufman and Kaufman 1994; Mancia et al. 2008; Noda et al. 2007; Thomson and Geraci 1986). 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 hormonal 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 (Dierauf and Gulland 2001b). Mammalian stress levels can vary by age, sex, season, and health status (Hunt et al. 2006; Keay et al. 2006; Peters 1983). In addition, smaller mammals tend to react more strongly to stress than larger mammals (Hunt et al. 2006; Keay et al. 2006; Peters 1983).

In sum, the common underlying stressor of a human disturbance caused by the research and enhancement activities that will occur under scientific research permits may lead to a variety of stress-related responses. However, given the relatively short duration of the research and enhancement activities (a few seconds to several hours) relative to marine mammal life histories (e.g., life expectancies of 15 to over 100 years), we do not anticipate these responses to result in negative fitness consequences. In addition, to possibly causing a stress-related response, each research activity is likely to produce unique responses as detailed further below. For unintentional disturbance that may result when animals are associated with individuals targeted for directed research, we expect responses to be similar to, or in most cases less than, those described below for each research method, and above for general human disturbances.

11.4.1 Active Acoustic Playbacks

Acoustic disturbance as a result of playback experiments can interrupt essential behaviors of ESA-listed cetacean species such as foraging and breeding. The researchers will implement monitoring and mitigation measures (see Section 3.7.3.2) to avoid exposing ESA-listed cetaceans to playbacks that may result in PTS (ESA harm or MMPA Level A harassment).

Marine mammal hearing is not suspected to be above 160 kiloHertz, but 200 kiloHertz is often used as the cutoff for high-frequency cetaceans. Specifically for low-frequency cetaceans, such as mysticetes, the generalized hearing range is estimated to range from 7 Hertz to 35 kiloHertz (NOAA 2018b). Blue whales, being low-frequency cetaceans, are thought to have a hearing range between 7 Hertz to 35 kiloHertz, but no empirical data exists on blue whale hearing (NOAA 2018b). Fin whales are also low-frequency cetaceans, thought to have a 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 (Cranford and Krysl 2015). No direct data exists on the hearing range of North Pacific right whales, but is predicted to be from 10 Hertz to 22 kiloHertz with functional ranges probably between 15 Hertz to 18 kiloHertz (Parks et al. 2007b). Sei whales are also low frequency cetaceans and thought to have a hearing range of 7 Hertz to 35 kiloHertz (NOAA 2018b). The generalized hearing range for mid-frequency cetaceans (e.g. belugas and false killer whales), is thought to be between 150 Hertz to 160 kiloHertz, although data from Thomas et al. (1998) indicate a narrow range for false killer whales of 16 to 64 kiloHertz. Sperm whales are considered to be part of the mid-frequency hearing group and have a hearing range of 2.5 to 60 kiloHertz and highest sensitivity to frequencies between 5 to 20 kiloHertz (Carder and Ridgway 1990). The generalized hearing range for high-frequency cetaceans (e.g., Hector's dolphins) is thought to be between 275 Hertz and 160 kiloHertz (NOAA 2018b). Given the total range of cetacean hearing from 7 Hertz to 160 kiloHertz, certain frequencies (approximately 20 Hertz to 40 kiloHertz) that may be used during the playback windows for scientific research permits are likely audible to certain ESA-listed cetaceans in Table 10. Playback signals may potentially include narrow band noise, 1/3 octave band noise, pure tones, frequency modulated tones, intermittent tones, and amplitude modulated tones.

Potential effects of underwater sound from playbacks on marine mammals include injury, threshold shift, masking and behavioral disturbance (e.g., Nowacek et al. 2007; Richardson et al. 1995c; Southall et al. 2007).

Non-auditory physiological effects or injuries that theoretically could occur in marine mammals exposed to strong underwater sound include stress, neurological effects, and other types of organ or tissue damage (Cox et al. 2006; Southall et al. 2007). Such effects, if they occur at all, will be limited to short distances around the sound source and to activities that extend over a prolonged period. When marine mammals are exposed to high intensity sound repeatedly or for prolonged periods they may also experience auditory physiological effects such as hearing threshold shift, which is the loss of hearing sensitivity at certain frequency ranges (Finneran et al. 2005; Finneran et al. 2002; Kastak et al. 1999b; Schlundt et al. 2000). Threshold shift can be permanent (i.e., PTS), in which case the loss of hearing sensitivity is not recoverable, or temporary (i.e., TTS), in which case the animal's hearing threshold will recover over time (Southall et al. 2007). Marine mammals depend on acoustic cues for vital biological functions (e.g., orientation, communication, finding prey, avoiding predators). The impacts of a TTS depends on the frequency and duration of a TTS, as well as the biological context in which it occurs. A TTS of limited duration, occurring in a frequency range that does not coincide with that used for recognition of important acoustic cues, will have little to no effect on an animal's fitness. A PTS, in the unlikely event it occurred, will constitute injury, but a TTS is not considered injury (Southall et al. 2007). Such effects, if they occur at all, will be limited to short distances around the sound source and to research activities that extend over a prolonged period. The NOAA Ocean Noise Strategy Roadmap also provides a summary of expected responses (available online at: https://cetsound.noaa.gov/Assets/cetsound/documents/Roadmap/ONS_Roadmap_Final_Complete.pdf).

Masking, the inability of a subject to recognize the occurrence of an acoustic stimulus as a result of the interference of another acoustic stimulus, may also result from active acoustic playbacks (Clark et al. 2009). Introduced underwater sound may, through masking, reduce the effective communication distance of a marine mammal species if the frequency of the sound source is close to that used as a signal by the marine mammals, and if the anthropogenic sound is present for a significant amount of the time (Richardson et al. 1995d). Masking can interfere with detection of acoustic signals such as communication calls, echolocation sounds, and environmental sounds important to marine mammals. Therefore, under certain circumstances, marine mammals whose acoustic sensors or environment are being severely masked could be impaired from continuing normal behavior patterns. The degree of masking increases with increasing noise levels and is dependent on how long increased levels last. A noise that is just-detectable over ambient levels is unlikely to actually cause any substantial masking, whereas a louder, prolonged noise may mask sounds over a wider frequency range. In addition, a continuous sound source will have more potential for masking than an intermittent sound source.

Any masking that can occur from playbacks will be temporary, lasting only as long as the playback event. Playbacks will not result in prolonged periods of time when masking can occur, reducing the likelihood of the proposed action causing masking that can result in any meaningful impacts to ESA-listed cetaceans.

Cetaceans may exhibit behavioral responses to sound generated by active acoustic playbacks (e.g., Dahl et al. 2015). Such responses can range from startle responses, changes in behavioral state (e.g., from resting to traveling), to habitat displacement. Observed responses of wild marine mammals to loud pulsed sound sources (typically seismic airguns or acoustic harassment devices, but also including pile-driving) have been varied but often consist of avoidance behavior or other behavioral changes suggesting discomfort (Morton and Symonds 2002; Nowacek et al. 2007; Thorson and Reyff 2006; Wartzok et al. 2003). Responses to continuous sound (e.g., vibratory pile-driving), have not been documented as well as responses to pulsed sounds. Potential behavioral responses of marine mammals to anthropogenic sound will depend on the frequency, duration, temporal pattern, and amplitude of the sound as well as the animal's prior experience with the sound and the context in which the sound is encountered (i.e., what the animal is doing at the time of the exposure or how close the animal is to the sound source). For example, animals that are resting may show greater behavioral change in response to disturbing sound levels than animals that are highly motivated to remain in an area for feeding (NRC 2003; Richardson et al. 1995c; Wartzok et al. 2003). Animals may also habituate to a sound source. This can occur when an animal's response to a stimulus wanes with repeated exposure, usually in the absence of unpleasant associated events (Wartzok et al. 2003).

Responses to active acoustic playbacks 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).

Any instances of behavioral disruption have the potential to interrupt life functions such as feeding, resting, traveling, or socializing. Disruptions of such functions resulting from reactions to stressors such as sound are more likely to be significant and impact an animal's growth, reproduction, or survival if they last for prolonged periods relative to an animal's life history or recur on subsequent days. A behavioral response lasting less than one day and not recurring on subsequent days is not considered particularly severe (Southall et al. 2007) and will not be expected to impact an animal's fitness.

Some cetaceans may elect to remain in the area where behavioral disturbance is expected despite the sound levels due to sufficient impetus to remain in that area to continue foraging in the presence of a desired prey field. While these animals may be exposed to sound for longer durations, we do not expect they will experience significant energetic costs associated with avoidance or foregone prey, as they will continue to feed. Unless the increased duration of exposure leads to some injury or physical effect that can lead to reductions in fitness, this situation is not likely to lead to significant effects. However, we determined the risks of auditory injury or any other physical effects that can affect an individual's fitness are highly unlikely given that animals will have to remain in close proximity to playbacks for a significant period of time, the short duration of playbacks, and mitigation measures that will be implemented by researchers during playbacks.

Southall et al. (2007) synthesized data from many past behavioral studies and observations to determine the likelihood of behavioral reactions to specific sound level exposures. While in general, the louder the sound source the more intense the behavioral response, it was clear that the proximity of a sound source and the animal's experience, motivation, and conditioning were also critical factors influencing the response (Ellison et al. 2012; Southall et al. 2007). Most low-frequency cetaceans (mysticetes) observed in studies avoided sound sources starting at levels of greater than or equal to 160 decibels re: 1 µPa. Mid-frequency cetaceans generally tolerated non-impulsive sounds in excess of 170 decibels re: 1 µPa before showing behavioral reactions, such as avoidance or erratic swimming. Several experiments have measured sound exposures that cause a temporary decrease in the sensitivity of hearing (TTS) in captive cetaceans and pinnipeds (Finneran 2013; Finneran 2015; Kastak and Schusterman 1999; Kastak et al. 1999a; Kastak et al. 1999b; Ridgway et al. 1997; Schlundt et al. 2000). The threshold for pain for sounds is usually considered to occur above the sound exposures that produce threshold shifts, and several other considerations suggest that the maximum exposure criteria here protect against the potential for active acoustic playbacks can cause pain.

NMFS applies certain acoustic thresholds to develop impact zones for injury and behavior responses around a sound source to limit marine mammal exposure to harmful levels of sound (NOAA 2016). In August 2016, NOAA released its *Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing*, which provided guidance on thresholds for predicting auditory injury (i.e., PTS) (NOAA 2016), and was revised in 2018 (NOAA 2018b). The technical guidance also provided guidance on thresholds for predicting the onset of less severe auditory effects (i.e., TTS). For impulsive sounds (e.g., impact pile-driving), dual metric acoustic thresholds were derived, one for cumulative sound exposure level and one for peak sound level. For non-impulsive or continuous sounds (e.g., vibratory pile-driving), only a cumulative sound exposure level threshold was derived. In developing the technical guidance, NOAA compiled, interpreted, and synthesized scientific information currently available on the effects of anthropogenic sound on marine mammals. In association with the technical guidance, NMFS released a companion spreadsheet that provides a set of tools and weighting factor adjustments to allow NMFS or action agencies with different levels of exposure modeling capabilities to be able to apply NMFS' acoustic thresholds. As described further in the technical guidance, the thresholds and weighting factor adjustments vary by hearing group (i.e. low, mid, and high-frequency cetaceans). Researchers, or the NMFS reviewers, will use this spreadsheet to predict the range of PTS for target and non-target marine mammals (see Section 19.5).

Since 1997, NMFS has used generic sound exposure thresholds (i.e., not specific to a particular hearing group) to determine whether an activity produces underwater sounds that might result in behavioral disturbance of marine mammals (70 FR 1871). NMFS uses the following conservative thresholds of underwater sound pressure levels, expressed in root mean square, from broadband sounds that can cause behavioral disturbance:

- Impulsive sound (e.g., impact pile-driving) – 160 decibels re: 1 μPa (rms); and
- Non-impulsive sound (e.g., vibratory pile-driving) – 120 decibels re: 1 μPa (rms).

It should be noted that these behavioral disturbance thresholds, particularly for non-impulsive sounds, are conservative, and in many cases, animals will not be disturbed if exposed at these received levels. For example, as indicated above, Southall et al. (2007) found that cetaceans were more likely to exhibit a behavioral response starting at levels of greater than or equal to 160 decibels re: 1 μPa, 40 decibels higher than the 120 decibels threshold for non-impulsive sound. Additionally, several authors have noted that the context in which the sound is encountered (i.e., what the animal is doing at the time of the exposure and the distance the animal is from the source) is important in determining whether or not an animal will respond behaviorally and whether or not that response will be meaningful. For these reasons, our analysis of the potential for behavioral disturbance to adversely affect ESA-listed marine mammals is not solely based on potential received sound levels, but also the duration of potential exposure, animal behavior, and whether behavioral disturbance caused by the research and enhancement activities will be expected to result in meaningful consequences to the animal.

For active acoustic playbacks authorized under scientific research permits, the sound source level will be adjusted so that the received level for the animal is less than the onset of PTS for all cetacean species (i.e., all hearing groups) following current NMFS acoustic thresholds (NOAA 2018b). A playback series will usually be limited to minutes in duration, but may rarely exceed one hour. However, the potential impacts of all experimental designs pertaining to active acoustic playbacks will be considered prior to playback commencement, as described in Section 3.7.3.2.

Based on the technical guidance, exposures are expected at sound levels at or above thresholds for auditory injury, but exposures at sound levels that may elicit less severe auditory effects or behavioral responses can occur (NOAA 2018b). Adverse effects to cetaceans from active acoustic playbacks will be limited and mitigated by the measures outlined in Section 3.7.3.2 to ensure that the received sound level for any target or non-target marine mammals in the study area does not result in ESA harm (MMPA Level A harassment), such as onset of PTS. This will be achieved in the cetacean research permitting program by taking the following measures:

- Applying NMFS' revised technical guidance (NOAA 2018a) when assessing requests;
- Consulting with the Office of Protected Resource's bioacoustician (e.g., Dr. Amy Scholik-Schlomer) on each request; and
- Calculating a conservative exclusion zone based for the most sensitive marine mammal

hearing group (e.g., high-frequency cetaceans) in the area.

As a requirement of the permit, researchers must stop the trial if any marine mammal approaches the calculated exclusion zone for its respective hearing group or the most sensitive marine mammal hearing group (i.e., high-frequency cetaceans) to prevent the potential for the onset of ESA harm (MMPA Level A harassment), such as PTS. Because the exclusion zones are calculated for the most sensitive hearing groups that may be present (typically high-frequency cetaceans such as South Island Hector's dolphin), this is a very conservative approach and the chance that any exposure could result in PTS is highly unlikely to occur. Additional measures will be required in the permit depending on the behavior of target animals, the complexity of the sound source and the proposed playback design.

In conclusion, even if ESA-listed cetaceans are temporarily disturbed and/or displaced from localized areas due to avoidance of underwater playback sound, individual animals will not experience energetic costs that lead to measurable or biologically meaningful impacts that can affect the fitness of individuals with respect to survival, growth, and reproduction. We expect the effects of disturbance and avoidance from the proposed active acoustic playbacks to be temporary and inconsequential. For these reasons, we do not expect active acoustic playbacks to create the likelihood of injury to ESA-listed cetaceans by annoying individuals to such an extent as to significantly disrupt normal behavioral patterns, which include, but are not limited to, breeding, feeding, or sheltering. In NMFS' interim guidance on the ESA term "harass," a significant disruption in normal behavior patterns is defined as a change in the animal's behavior that can increase the risk of injury. An injury in the context of analyzing behavioral responses can be a physical injury or a physiological or other impact that will reasonably be expected to negatively affect the animal's growth, health, reproductive success or ability to survive. As indicated above, behavioral disturbances resulting from short-term active acoustic playbacks will not reasonably be expected to increase the risk of injury to ESA-listed cetaceans. Thus, we do not anticipate the unique stressors associated with active acoustic playbacks to affect the fitness of individual cetaceans.

11.4.2 Biopsy Sampling

Under scientific research permits, researchers will be authorized to collect a variety of biological samples, including biopsies. Stressors associated with biopsy sampling include close approaches, direct animal contact, minor puncture wounds, and tissue collection.

Biopsy sampling will result in stressors from a minor puncture wound and tissue collection, and requires a very close approach. In general, it is difficult to distinguish between animals' reactions to these different stressors without explicit studies designed to isolate the response to individual stressors, which to our knowledge have not been conducted. As such, below we describe the range of responses, both physiological and behavioral, to the overall procedure of biopsy sampling, and where data are available, indicate possible responses to specific stressors.

Cetaceans also exhibit a wide range of behavioral responses to biopsy sampling (reviewed in Noren and Mocklin 2012), and in some cases these are indistinguishable from those described below for penetrating tags (Reisinger et al. 2014). Most researchers report either no behavioral response or minor behavioral responses including changes in dive behavior, heading, or speed, and startle responses and tail flicks (Noren and Mocklin 2012). On occasion, researchers report similar low-level responses from animals nearby those being biopsied and to darts entering the water, suggesting that some observed responses are a general startle response and not necessarily due to being contacted by the biopsy dart (Gorgone et al. 2008; Noren and Mocklin 2012). From past research documented in annual reports, various researchers have observed responses to biopsy sampling ranging from no visible response to a ‘startled’ reaction sometimes followed by an animal swimming away or diving. On rare occasions (zero to six percent of animals biopsied), researchers have reported more severe behavioral responses such as flight response, breaching, multiple tail slaps, and/or numerous trumpet blows (Noren and Mocklin 2012). These more severe responses appear to coincide with instances where biopsy tips struck an unintended body part (e.g., dorsal fin) or when tips remain lodged in the animal (Berrow et al. 2002; Gauthier and Sears 1999; Weinrich et al. 1991; Weinrich et al. 1992). When darts remain in animals, however, they do not appear to result in mortality, infection, or lasting behavioral changes (Barrett-Lennard et al. 1996; Clapham and Mattila 1993; Parsons et al. 2003).

For all of these responses, it is important to keep in mind that in many cases it is hard to distinguish the behavioral response to biopsy sampling from the response to the close vessel approach (Pitman 2003). Regardless, in most instances, animals return to pre-biopsy sampling/close approach behavior quickly, usually within 30 seconds to three minutes (Noren and Mocklin 2012). In fact, biopsied individuals do not appear to avoid vessels during subsequent biopsy attempts (within one week to five months), and in many cases show the same or a lesser response to the second biopsy sampling event (Best et al. 2005; Noren and Mocklin 2012).

Responses vary by species, biopsy tip dimensions, the draw weight of the sampling method, and the distance from which animals are sampled but most animals heal quickly, often within a month or less, and show no signs of infection (Noren and Mocklin 2012). In fact, for at least some large cetacean species (e.g., Southern right whale) immediately after sampling takes place, biopsy sites are hardly noticeable (Reeb and Best 2006). This is perhaps not surprising given that cetaceans have high rates of cell proliferation that enable them to heal from large shark-inflicted wounds within months (Corkeron et al. 1987; Dwyer and Visser 2011; Lockyer and Morris 1990).

A higher proportion of odontocetes respond to the biopsy sampling compared to mysticetes (Noren and Mocklin 2012). In some cases (Best et al. 2005), but not others (Weinrich et al. 1991), mothers and calves appear to be more sensitive to biopsy sampling than other age groups. Migrating humpback whales appear to be less responsive than those on the feeding grounds (Clapham and Mattila 1993; Weinrich et al. 1991). But on the feeding grounds, foraging humpback whales are less likely to respond than resting humpback whales (Weinrich et al. 1992).

Beyond the wound itself, biopsy sampling could cause a physiological stress response similar to that described in the beginning of this section, even if the biopsy dart does not successfully penetrate the animal's tissue. Such a response may involve the release of stress hormones, short-term weight loss, susceptibility to gastrointestinal parasitism, the liberation of glucose into the blood stream, impairment of the immune and nervous system, an elevated heart rate, body temperature, blood pressure, and alertness, muscle damage, and death. However, given the small size of wounds created by biopsy sampling and the short duration over which the sampling occurs, stress responses to remote biopsy sampling are likely minimal.

Finally, biopsy sampling could result in serious injury or death. However, in over 40 years of researchers collecting biopsy samples from cetaceans, we are aware of only one example of such an event: a common dolphin death following biopsy sampling in 2000 (Bearzi 2000). Several possible explanations exist for why this particular animal died including a dart stopper malfunction, the location of the biopsy wound, the thinness of the animal's blubber, the handling of the animal, and possibly this animal having a predisposition to catatonia and death during stressful events (Bearzi 2000). It is important to note that due to this animal's unusually thin blubber layer, the biopsy tip penetrated the animal's muscle, which is not the intent of most researcher's biopsy sampling efforts.

While the above discussion indicates a range of physiological responses to biopsy sampling, only minor wounds and low-level stress responses are anticipated as the result of biopsy sampling that will be conducted under scientific research permits. This is because all biopsy dart tips used will be (1) thoroughly sterilized before sampling, thus minimizing any chance of infection, (2) only penetrate approximately 2.6 to 4 centimeters (1 to 1.6 inches), less than the typical thickness of most large cetacean's blubber (five to 10 centimeters, Lockyer et al. 1985). Biopsy dart tips will be fitted with an encircling cushioned stop to ensure recoil and prevent deeper penetration, and so will not penetrate any individual's muscle based on the anticipated thickness of the blubber layer of species to be sampled. Thus, biopsy dart tips are not expected to result in serious injury or death.

The biopsy sampling may cause temporary stress, pain, wounding, and injury, with the potential for behavioral responses. The potential for serious injury and/or long-term effects on individuals from biopsy sampling is minimal. The biopsy darts will not contain any hazardous materials, and the penetration depth of the dart relative to the blubber depth and minimization measures (see *Description of the Proposed Action* [Section 3] and *Mitigation to Minimize or Avoid Exposure* [Section 11.2]) employed to prevent deeper penetration make it highly unlikely that serious injury (ESA harm) will occur to target individuals.

Given the above overview of possible behavioral responses of cetaceans to biopsy sampling, and the mitigation measures proposed by the NMFS Permits and Conservation Division (Sections 3 and 11.2), we expect ESA-listed cetaceans to behaviorally respond to biopsy sampling by exhibiting short-term, minor to moderate changes in behavior. However, we do not expect these behavioral responses will significantly disrupt their normal behavioral patterns to an extent that it will create the likelihood of injury or impact any individuals' fitness.

In summary, of the large number of cetaceans that have been biopsy sampled in recent decades (probably in the tens of thousands), there has been only one documented case of an immediate fitness consequence associated with biopsy sampling (Bearzi 2000). Other studies have utilized remote biopsy methods to successfully collect samples from small cetaceans with no observed strong reactions from the animals (Liu et al. 2019). While studies on the delayed, long-term impacts of biopsy sampling are lacking, the available data suggests no effects to fitness (Best et al. 2005; Noren and Mocklin 2012). Also, the NMFS science centers, academic institutions, and other organizations have not observed any known injuries or other significant effects from biopsy sampling during the past 20 years. As such, we expect biopsy sampling to result in minor wounds, low-level stress responses, and temporary behavior changes, but we do not expect any individuals to experience reductions in fitness. Note that there is further discussion of effects from biopsy sampling and tagging below.

11.4.3 Tagging

Researchers will be authorized to tag several ESA-listed cetaceans (i.e., Cook Inlet DPS of beluga whales, blue whales, bowhead whales, Gulf of Mexico subspecies of Bryde's whales, Main Hawaiian Islands insular DPS of false killer whales, fin whales, Western North Pacific population of gray whales, Arabian Sea DPS of humpback whales, Cape Verde/Northwest Africa DPS of humpback whales, Central America DPS of humpback whales, Mexico DPS of humpback whales, Western North Pacific DPS of humpback whales, Southern Resident DPS of killer whales, North Atlantic right whales, North Pacific right whales, sei whales, Southern right whales, sperm whales, and South Island Hector's dolphins) with either suction-cup, dart/barb, bolt/pin, or deep-implantable tags. Tagging carries the stressors and responses associated with very close approach (to within 2 meters [6.6 feet]), the initial attachment of the tag, and the continued attachment of tags, all of which have the potential to adversely affect cetaceans. Attachment of the tag will involve physical contact if a suction-cup tag is used or puncture wounds if dart/barb, bolt/pin, or deep-implantable tags are used. Responses to these stressors may be physiological and/or behavioral in nature and likely differ depending on the tag attachment type. Transmitters on tags will be above the generalized hearing range of low-frequency cetaceans (7 Hertz to 53 kiloHertz) and mid-frequency (150 Hertz to 160 kiloHertz) cetaceans (i.e., VHF transmitters are 148 to 174 megaHertz, satellite transmitters are 401.65 MegaHertz). We find that the effects of this stressor (transmitter on tags) are insignificant to ESA-listed cetaceans (i.e., Cook Inlet DPS of beluga whales, blue whales, bowhead whales, Gulf of Mexico subspecies of Bryde's whale, Main Hawaiian Islands insular DPS of false killer whales, fin whales, Western North Pacific population of gray whales, Arabian Sea DPS of humpback whales, Cape Verde Islands/Northwest Africa DPS of humpback whales, Central America DPS of humpback whales, Mexico DPS of humpback whales, Western North Pacific

DPS of humpback whales, Southern Resident DPS of killer whales, North Atlantic right whales, North Pacific right whales, sei whales, Southern right whales, sperm whales, and South Island Hector's dolphins), and thus the transmitter on suction-cup, dart/barb, bolt/pin, or deep-implantable tags may affect, but is not likely to adversely affect these species and will not be discussed further in this consultation. Below we detail the range of physiological and behavioral responses to tags deployment and operations based on the timing of the response, from the initial tag deployment until the tag detaches.

11.4.3.1 Initial Tag Attachment

Cetaceans are likely to respond behaviorally to very close approaches for tag attachment in a similar way as previously described for other close approaches. However, given the closer proximity of these approaches (to within 2 meters [6.6 feet]), we anticipate greater responses likes those noted for research activities including biopsy sampling such as momentary changes in swimming speed and orientation, diving, changes to surface and foraging behavior, and changes in respiratory patterns.

Concurrent with this response will be a response to the physical application of the suction-cup tag, or in the case of dart/barb, bolt/pin, and deep-implantable tags, tag penetration and puncture wounds. However, current research examining how cetaceans respond to tag attachments, regardless of type, does not usually distinguish between an animal's response to a very close approach and the tag attachment. Possible reasons for this include: (1) such responses are indistinguishable to researchers, (2) no proper controls exist to make such a distinction given that researchers generally do not approach very close unless they are also tagging, and (3) such a distinction is not warranted as cetaceans themselves may not differentiate between the two stressors. As such, below we describe what is known about how cetaceans respond behaviorally to the initial tag deployment, which includes the response to both the very close approach and the physical attachment of the tag.

Previous studies have found that cetaceans respond to suction-cup tag deployment (and missed attempts) in a variety of ways. In humpback whales, Goodyear (1989a, b) observed quickened dives, high back arches, tail swishes (31 percent), or no reaction (69 percent) to suction-cup tag deployments. One breach was observed in roughly 100 taggings and no damage to skin was found (Goodyear 1989a, b). Baird et al. (2000) observed only low (e.g., tail arch or rapid dive) to medium (e.g., tail flick) level reactions by humpback whales in response to suction-cup tag deployments. Baumgartner and Mate (2003) reported that strong reactions of North Atlantic right whales to suction-cup tag deployments were uncommon, and that 71 percent of the 42 whales closely approached for suction-cup tagging showed no observable reaction (22 of the 28 that were successfully tagged and eight of the 14 that were unsuccessfully tagged). The remaining North Atlantic right whales reacted by lifting their heads or flukes, rolling, back arching, beating their flukes, or performing head lunges. In a review of the effects of marking and tagging on marine mammals, Walker et al. (2012) found that cetaceans exhibited short-term behavioral responses to suction-cup tag deployments including changes in frequency of leaps and group speed, flinching, tail slapping, rapid swimming, and rapid surfacing attempts, but no long-term fitness consequences. To our knowledge, there are no studies indicating a physiological response to the attachment of suction-cup tags, but we believe a short-term, minor stress response as described at the beginning of Section 11.4 is possible.

The behavioral responses cetaceans exhibit to the application of invasive tags, such as dart/barb, and deep-implantable tags, are similar to those described for suction-cup tags and very close approaches (Walker et al. 2012). Furthermore, despite the difference in depth of penetration and size between dart/barb and deep-implantable tags, behavioral responses to deployment of dart/barb and deep-implantable tags, do not appear to drastically differ between the two tag types (Mate et al. 2007; Mate et al. 2016; Robbins et al. 2016; Szesciorka et al. 2016; Walker et al. 2012). These responses include head lifts, fluke lifts, exaggerated fluke beats on diving, quick dives, or increased swimming speeds. Less frequent behavioral responses include fluke slaps, head lunges, fluke swishes, defecation, decreased surfacing rates, disaffiliation with a group of whales, evasive swimming behavior, cessation of singing, breaching, bubble blowing, or rapid acceleration (Mate et al. 2007; Mate et al. 2016; Szesciorka et al. 2016; Walker et al. 2012). We are not aware of any published reports on the responses of cetaceans during remote deployment of bolt/pin tags on cetaceans because they are currently only authorized for non-ESA-listed species; however, we expect the responses to be the same as the application of dart/barb tags.

Given that dart/barb, bolt/pin, and deep-implantable tags penetrate the animal's tissue, a physiological response is expected. Anticipated reactions to these puncture wounds include minor pain, cell damage, and possible local inflammation, swelling, bleeding, blood clotting, hemorrhaging, and bruising (Mate et al. 2016; NMFS 2017a; Robbins et al. 2016; Szesciorka et al. 2016; Walker et al. 2012; Weller 2008). However, since dart/barb tags will be designed to not penetrate beyond the blubber layer or entirely through the dorsal fin, and the size of the puncture wounds will be small, very little bleeding, and no hemorrhaging, blood clotting, or bruising is expected to occur from these types of tags. While implantable tags create larger wounds and penetrate deeper (to the muscle-blubber interface), and so increase the risk of these more pronounced physiological responses (van der Hoop et al. 2013), current evidence suggests such responses are rare, even for deeper penetrating implantable tags (Mate et al. 2016; NMFS 2017a; NMFS 2017b; Robbins et al. 2016; Szesciorka et al. 2016; Walker et al. 2012; Weller 2008). In addition, a stress response to the deployment of invasive tags is possible, but the available data indicates such a response will be short-term and minimal (Eskesen et al. 2009). If the penetrating tips of tags were contaminated, a viral, fungal, or bacterial infection is possible (Haulena 2016; NMFS 2016e; Weller 2008). However, given that researchers at the NMFS science centers, academic institutions, and other organizations will thoroughly sterilize all tags prior to deployment, infection is unlikely (see Section 3.7.5.3 for sterilization procedures). That said, tag sterilization does not preclude the possibility that a pathogen on the cetacean's skin could enter the body upon tag insertion (Weller 2008).

There is also a possibility that some dart/barb or deep-implantable tags may break upon impact or soon after, leaving parts of these tags (e.g., petals) in the animal with no tag attached. Future tag breakage is less likely given that recent tag modifications made by researchers have greatly reduced or eliminated tag breakage (Robbins et al. 2016; Szesciorka et al. 2016). Researchers have noted tag breakage and have consulted with tag manufacturers to modify tags in an effort to reduce and hopefully eliminate such tag breakage. Even if such an event were to occur, we do not anticipate the response to this initial tag breakage to be any different from that described above. However, as discussed below, when tag breakage results in tag parts remaining in animals, there may be adverse impacts beyond the initial tagging event. In the permit applications, the researchers at NMFS science centers, academic institutions, and other organizations state that similar behavioral responses to initial tag deployments as those described above are noted based on work conducted under previous permits.

The NMFS Permits and Conservation Division has authorized researchers to further refine the dart tag attachment design specifically for North Atlantic right whales in order to maximize tag duration while minimizing impacts for this species. Updated tags are planned for use focusing on healthy males aged nine months and older. While these tag refinements are being implemented, the NMFS Permits and Conservation Division is temporarily suspending dart tagging of reproductive-age female North Atlantic right whales until the efficacy of the tag attachments and post-tagging monitoring reports can be further evaluated. As described above, available evidence suggests that the current tag design and required mitigation will prevent adverse impacts. However, given the precarious status of North Atlantic right whales and the fact that reproductive females are the most critical demographic in the context of population growth and recovery (Hayes et al. 2018a; Pace et al. 2017; van der Hoop et al. 2017), additional caution is warranted while tag refinements are being implemented. The NMFS Permits and Conservation Division will further assess use of dart/barb tags on adult females.

Remote deployment of bolt/pin tags on the dorsal fin or body of cetaceans is not widely used so there are no data on the expected responses; however, we expect the responses to be the same, or less than currently authorized dart/barb tags. More data on deployment of these tags on cetaceans in the next several years is expected as researchers begin to use them in the field. This is because the bolt/pin tags with entry and exit wounds and a single attachment pin are less likely to break and cause long-term effects, as there are no barbs or petals to break off and remain embedded in the animal. If the external tag component breaks off, the single attachment pin is expected to slide out of the tissue. We do not anticipate that the initial tag deployment or continued tag attachment will affect the fitness of individual whales. A phased-in approach for the authorization of these types of tags on ESA-listed cetaceans may be used to closely evaluate and monitor the impacts (see Sections 3.7.5.7 and 3.16.3).

Based on this and the available information presented above, we expect behavioral responses to initial tag attachments (including unsuccessful attempts) to consist of brief, low-level to moderate behavioral responses. As a result, we do not anticipate any physiological responses to the initial attachment of suction-cup tags other than those associated with a minor stress response. For dart/barb, bolt/pin, and deep-implantable tags, a range of physiological responses is possible, but the initial deployment of tags is not expected to result in serious injury. Based on all of these responses, we do not anticipate that the initial tag attachment will affect the fitness of individual cetaceans. The potential consequences of continued tag attachment is discussed further below.

11.4.3.2 Continued Tag Attachment

Once tagged, cetaceans may respond both behaviorally and physiologically to the continued attachment of tags as well as hydrodynamic drag. Captive bottlenose dolphins have been shown to decrease swim speed and fluking frequency as drag from non-invasive tags was increased, suggesting that they may change their behavior to conserve energy with increasing drag loads (van der Hoop et al. 2018). However, in suction-cup tagged humpback whales, Baird et al. (2000) observed pre-tagging behavior within minutes and no long-term or strong reactions. Baumgartner and Mate (2003) reported that suction-cup tagged North Atlantic right whales resumed normal foraging dives within two dives post tag attachment, indicating that the continued attachment of the tag had little effect on their behavior. This is not surprising given that the heaviest tags weigh only a fraction of a percent of the weight of a cetacean, and they have hydrodynamic designs to minimize drag (Aguilar 2009; Horwood 2009). In terms of size and weight, the tags proposed for use under scientific research permits, are approximately equal to or less than the weight (see Section 3.7.5.1) of the tags previously authorized for use by the researchers at NMFS science centers, academic institutions, and other organizations, and will be expected to create the same or less hydrodynamic drag. In addition, the proportion of the tags to the animal's size and weight is such that the energetic demand on the animal will likely be insignificant. For deep-implantable tags, which penetrate deep and stay on longer than the dart/barb and bolt/pin tags, researchers also note that cetaceans appear to return to baseline behavior within minutes of the initial tagging event. Blue and humpback whales tagged with implantable tags, appear to resume feeding soon after being tagged (Mate et al. 2007; Robbins et al. 2016). Robbins et al. (2016) reported that the median time it took humpback whales in the Gulf of Maine to recover behaviorally from being tagged with implantable tags was nine minutes. However, recovery times for some individuals were longer, lasting at least 4.5 hours for one individual, which appeared to be related to tag design flaws and the placement of the tag lower on the animal's body than is desired (Robbins et al. 2016).

This suggests that under some circumstances, at least some individuals (and/or species) exhibit more extended behavioral responses to tagging. However, all but one animal in the study observed on subsequent days appeared to resume the species' typical behavior recovery times (Robbins et al. 2016). Thus, for most species and circumstances, behavioral response to continued attachment of tags is expected to be minor and short-term. These behavioral responses, for most species and circumstances, are in line with those described by researchers at the NMFS science centers, academic institutions, and other organizations in their applications and annual reports from previous research activities.

While similar long-term behavioral responses are expected for the different tag types, tags differ in the long-term physiological responses they are likely to elicit. For suction-cup tags, almost no physiological response is expected. While the continued attachment of suction-cup tags could cause inflammation and hyperemia at the attachment site, such responses will be short-term and minimal (NMFS 2017a). For suction-cup tags, we expect that individuals will return to baseline behavior within a few minutes of attachment. We also anticipate little to no physiological response to the continued attachment of the suction-cup tag. As a result, we do not anticipate the continued attachment of suction-cup tags will affect the fitness of individual cetaceans. In contrast, dart/barb, bolt/pin, and deep-implantable tags maintain long-term (months) penetration within the animal, which may lead to a variety of short-term or chronic responses including pain, tissue damage, inflammation, swelling, and/or depression, change in skin pigmentation and/or skin loss, tissue extrusion, exudate, serious injury, infection, changes in reproduction, or even death.

The available data on the physiological responses of cetaceans to the continued attachment of invasive tags are primarily limited to short-term effects, as few studies have attempted to follow up on tagged individuals weeks, months, or years after tagging. In general, wounds from invasive tags heal with only minor scarring and indentation (Best et al. 2015; Calambokidis 2015; Hanson et al. 2008; NMFS 2016a; Norman et al. in review; Robbins et al. 2016; Szesciorka et al. 2016).

Long-term impacts remain difficult to gauge (Mate et al. 2007). Several studies have examined long-term impacts of invasive tags and have not found any. In a study on false killer and pilot whales, researchers found no significant different in survival (Baird et al. 2013). One recent study investigating long-term impacts from dart/barb tags on cetaceans in Hawaii found little evidence of any impacts on survival or reproduction (Andrews et al. 2015), although the power to detect significant differences was very low. In studying the effects of implantable tags, which are more invasive than the dart/barb and bolt/pin tags proposed here, on Southern right whales, Best et al. (2015) found similar calving rates between tagged and un-tagged females. Thus, in most instances where researchers have attempted to document long-term impacts of invasive tagging on fitness, they have failed to detect any negative effects. However, we are aware of three recent studies that suggest older tag designs may result in negative long-term fitness consequences.

Gendron et al. (2014) monitored the wound site of a broken subdermal attachment from an invasive satellite tag, somewhat similar to the dart/barb tags being proposed here, on an adult female blue whale over a period of 16 years (1995 through 2011). In 2005, ten years after tag deployment, the tag attachment remained embedded in the animal, with swelling less than 60 centimeters (23.6 inches) 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 animal was last seen in 2011 with a scar (closed wound) present at the tag site. The animal's calving history showed three calves, two were observed prior to, and one after, the swelling period (1999 through 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).

In a 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 female's 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 suggests 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 that lead to tag breakage and parts of the tag being left inside the animal after the tag detached. This flaw was recently addressed with fully integrated implantable tags, and more recent data using these tags does not currently show the same negative effect on reproduction (NMFS 2017b; Robbins et al. 2016).

In examining the health effects and long-term impacts of implantable tags on large cetaceans in the Pacific Ocean, 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, but effects of tagging on gray whale survival appear to be possible.

Importantly, two of these studies involved implantable tags, and all involved much older tag technologies than will be used by researchers at the NMFS science centers, academic institutions, and other organizations under scientific research permits. In recent years, many advances in tag technology have been made both to improve data collection and to minimize and avoid adverse impacts to tagged animals. These include smaller tag designs, stronger materials, fully-integrated designs, improved sterilization techniques, and better tag application methods, all of which are incorporated in tags and tag deployment methods that will be used under scientific research permits. With these improvements, the chances of long-term adverse effects are greatly reduced (Mate et al. 2007; NMFS 2016a; Robbins et al. 2016; Szesciorka et al. 2016). However, even with these advances impacts to fitness can still occur, as exemplified by the recent death of an individual from the Southern Resident DPS of killer whale.

In 2016, the death of an individual from the Southern Resident DPS of killer whale, L95, was reported following attachment of a dart/barb tag under Permit No. 16163. An expert veterinary panel concluded that a fungal infection developed at the tag site, as determined by gross dissection, radiographs, magnetic resonance imaging and histopathology, although the Southern Resident DPS of killer whale presented in moderate to advanced decomposition at the time of necropsy (Haulena 2016; NMFS 2016e). This fungal infection contributed to illness in the animal and most likely contributed to its death. There were several factors in this case that may have predisposed this animal to a fungal infection at the tagging site including incomplete disinfection of the tag after seawater contamination, retention of the tag petals which may have allowed for formation of a biofilm or direct pathogen, placement of the tag lower on the body and near large bore vessels which increased the chance of fungal dissemination through the blood system, poor body condition, and possible immunosuppression.

The case of L95 is an important reminder that all invasive tags carry some risk of death, even if minimal. However, the circumstances that led to L95's death are extremely unlikely to occur under scientific research permits for several reasons. First, the researchers will follow stringent sterilization methods as described in the application and the permit's terms and conditions. Second, the researchers will not attempt to tag any individual that appears to be obviously emaciated, in poor health, demonstrating behavioral reactions that suggest a compromised status, or showing unusual wounds. Third, the researchers will use the latest tag technologies, such as the deep-implantable tags to minimize chances of tag breakage. Drag from externally-mounted tags can be modeled with computational fluid dynamics, a tool which can be used to develop more hydrodynamic tags for research (Kyte et al. 2019; Zhang et al. 2019). Finally, researchers will only be authorized to use invasive tags on large cetaceans, for which to date there are no records of tag-related mortalities (although see the Calambokidis (2015) study on gray whales discussed above). Given these mitigation measures, we find it highly unlikely that the use of invasive tags will result in the death of any individual cetacean.

In summary, we expect ESA-listed cetaceans (e.g., Cook Inlet DPS of beluga whales, blue whales, bowhead whales, Gulf of Mexico subspecies of Bryde's whale, Main Hawaiian Islands insular DPS of false killer whales, fin whales, Western North Pacific population of gray whales, Arabian Sea DPS of humpback whales, Cape Verde Islands/Northwest Africa DPS of humpback whales, Central America DPS of humpback whales, Mexico DPS of humpback whales, Western North Pacific DPS of humpback whales, Southern Resident DPS of killer whales, North Atlantic right whales, North Pacific right whales, sei whales, Southern right whales, sperm whales, and South Island Hector's dolphins) to show minor to no behavioral response to the continued attachment of tags. For suction-cup tags, we also anticipate little to no physiological response to the continued attachment of the tag. For dart/barb, bolt/pin, and deep-implantable tags, we anticipate most wounds will heal with little to no complication and minimal scarring, with only a few animals exhibiting prolonged healing and scarring. Given recent advances in tagging technologies and the mitigation measures proposed by the NMFS Permits and Conservation Division and the researchers, we find it unlikely that mortality or a reduction in fitness will result from invasive tagging. However, as indicated by the above review, mortality and fitness impacts have been documented in the literature for older tag designs and under extenuating circumstances (e.g., L95). Thus, we find that effects to fitness to ESA-listed cetaceans (e.g., Cook Inlet DPS of beluga whales, blue whales, bowhead whales, Gulf of Mexico subspecies of Bryde's whale, Main Hawaiian Islands insular DPS of false killer whales, fin whales, Western North Pacific population of gray whales, Arabian Sea DPS of humpback whales, Cape Verde Islands/Northwest Africa DPS of humpback whales, Central America DPS of humpback whales, Mexico DPS of humpback whales, Western North Pacific DPS of humpback whales, Southern Resident DPS of killer whales, North Atlantic right whales, North Pacific right whales, sei whales, Southern right whales, sperm whales, and South Island Hector's dolphins) from the invasive tags proposed here are not likely to occur.

11.5 Risk Analysis

In this section, we assess the consequences of the responses of the individuals that have been exposed to the stressors we have identified as adversely impacting ESA-listed cetaceans, the populations those individuals represent, and the species those populations comprise. Whereas the *Response Analysis* (Section 11.4) identified the potential responses of ESA-listed species to the proposed action, this section summarizes our analysis of the expected risk to individuals, populations, and species given the expected exposure to those stressors (as described in Section 11.3) and the expected responses to those stressors (as described in Section 11.4).

We measure risk to individuals of threatened and endangered species based upon effects on the individual's "fitness," which may be indicated by changes to the individual's growth, survival, annual reproductive fitness, and lifetime reproductive success. When we do not expect ESA-listed animals exposed to an action's effects to experience reductions in fitness, we will not expect the action to have adverse consequences on the viability of the populations those individual 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 will conclude that the action is not likely to adversely affect listed species. If, however, we conclude that individual animals are likely to experience reductions in fitness, we will assess the consequences of those fitness reductions on the population(s) that those individuals belong to.

As noted in the *Response Analysis*, none of the research activities and associated mitigation measures to minimize exposure and associated responses as proposed, are expected to reduce the long-term fitness of any individual ESA-listed cetacean (Cook Inlet DPS of beluga whales, blue whales, bowhead whales, Gulf of Mexico subspecies of Bryde's whale, Main Hawaiian Islands insular DPS of false killer whales, fin whales, Western North Pacific population of gray whales, Arabian Sea DPS of humpback whales, Cape Verde Islands/Northwest Africa DPS of humpback whales, Central America DPS of humpback whales, Mexico DPS of humpback whales, Western North Pacific DPS of humpback whales, Southern Resident DPS of killer whales, North Atlantic right whales, North Pacific right whales, sei whales, Southern right whales, sperm whales, and South Island Hector's dolphins). As such, the proposed implementation of a program for the issuance of permits for research and enhancement activities on cetaceans is not expected to present any risk to populations, DPSs, or species listed under the ESA.

12 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 C.F.R. §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.

This section attempts to identify the likely future environmental changes and their impact on ESA-listed or proposed species and their critical habitats in the action area. This section is not meant to be a comprehensive socio-economic evaluation, but a brief outlook on future changes in the environment. Projections are based upon recognized organizations producing best-available information and reasonable rough-trend estimates of change stemming from these data. However, all changes are based upon projections that are subject to error and alteration by complex economic and social interactions.

We expect that those aspects described in the *Environmental Baseline* (Section 10) will continue to impact ESA-listed resources into the foreseeable future. We expect anthropogenic effects that include climate change, oceanic temperature regimes, whaling and subsistence harvesting, vessel interactions (vessel strikes and whale watching), fisheries (fisheries interactions and aquaculture), pollution (marine debris, pesticides and contaminants, and hydrocarbons), aquatic nuisance species, sound producing activities (vessel sound and commercial shipping, aircraft, seismic surveys, and marine construction), military activities, and scientific research and enhancement activities, to continue into the future for marine mammals. Many of these activities would involve a federal nexus and thus be subject to future ESA section 7 consultation. An increase in these activities could result in an increased effect on ESA-listed species; however, the magnitude and significance of any anticipated effects remain unknown at this time. The best scientific and commercial data available provide little specific information on any long-term effects of these potential sources of disturbance on ESA-listed cetacean populations. Therefore, NMFS expects that the levels of interactions between human activities and marine mammals described in the *Environmental Baseline* will continue at similar levels into the foreseeable future. Movements towards the reduction of vessel strikes and fisheries interactions or greater protections of ESA-listed cetaceans from these anthropogenic effects may aid in abating the downward trajectory of some populations and lead to recovery of other populations.

During this consultation, we searched for information on future state, tribal, local, or private (non-Federal) actions reasonably certain to occur in the action area. We conducted electronic searches of *Google* and other electronic search engines for other potential future state or private activities that are likely to occur in the action area. We are not aware of any non-Federal actions that are likely to occur in the action areas during the foreseeable future that were not considered in the *Environmental Baseline* (Section 10) of this consultation.

13 INTEGRATION AND SYNTHESIS

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 11) to the *Environmental Baseline* (Section 10) and the *Cumulative Effects* (Section 12) to formulate the agency's biological and conference opinion as to whether the proposed action is likely to: (1) reduce appreciably the likelihood of both the survival and recovery of a ESA-listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) reduce the value of designated or proposed critical habitat for the conservation of the species. These assessments are made in full consideration of the *Status of the Species Likely to be Adversely Affected* (Section 9). For this consultation, the effects were determined not likely to adversely affect designated critical habitat; therefore only the risk to ESA-listed cetaceans (i.e., Cook Inlet DPS of beluga whales, blue whales, bowhead whales, Gulf of Mexico subspecies of Bryde's whales, Main Hawaiian Islands insular DPS of false killer whales, fin whales, Western North Pacific population of gray whales, Arabian Sea DPS of humpback whales, Cape Verde Islands/Northwest Africa DPS of humpback whales, Central America DPS of humpback whales, Mexico DPS of humpback whales, Western North Pacific DPS of humpback whales, Southern Resident DPS of killer whales, North Atlantic right whales, North Pacific right whales, sei whales, Southern right whales, sperm whales, and South Island Hector's dolphins) are described in this section.

The following discussions separately summarize the probable risks the proposed action poses to threatened and endangered species and critical habitat that are likely to be exposed to the stressors associated with the proposed implementation of a program for the issuance of permits for research and enhancement activities on cetaceans. These summaries integrate the exposure profiles presented previously with the results of our response analyses for each of the proposed action considered in this consultation.

13.1 Cetacean Research Permitting Program: Summary

As discussed throughout this programmatic consultation, there are several key components of the NMFS Permits and Conservation Division's Program that are designed to minimize adverse effects on individual cetacean species and to mitigate risks to the survival and recovery of cetacean populations.

ESA regulations require that all research and enhancement permits issued by the NMFS Permits and Conservation Division must meet specific regulatory issuance criteria. These include: (1) the permit will be used in a manner consistent with the ESA goal of ESA-listed species conservation and will not be used to the disadvantage of species; (2) the research is bona fide and necessary for the survival and recovery of species; (3) a surrogate (non-ESA-listed) species cannot be used instead; (4) the permit holder has the necessary expertise, facilities, or other resources to achieve research objectives; and (5) the validity and need for the proposed research is reviewed by other researchers and species experts. These criteria are designed to reduce adverse affects and risk by decreasing the likelihood that ESA-listed species will be exposed to stressors from research activities that are either duplicative, extraneous or will not result in information (e.g., data, published papers) that can be used for the conservation of ESA-listed species.

13.2 Cetaceans

The following discussions separately summarize the probable risks the proposed action poses to threatened and endangered cetacean species that are likely to be exposed to the stressors associated with the implementation of the cetacean research permitting program. These summaries integrate the exposure profiles presented previously with the results of our response analyses for each of the actions considered in this consultation.

13.3 Beluga Whale – Cook Inlet Distinct Population Segment

No reduction in the distribution of Cook Inlet DPS of beluga whales from the Pacific Ocean are expected because of the research and enhancement activities proposed for authorization under the NMFS Permits and Conservation Division's cetacean research permitting program.

Cook Inlet DPS of beluga whales experienced a decline in abundance of nearly 50 percent between 1994 and 1998. Although this rapid decline stopped after hunting was regulated in 1998, beluga numbers have not increased (Hobbs et al. 2008). In the past, there have been both natural and anthropogenic sources of mortality or injury of Cook Inlet DPS of beluga whales. Although the cause of death for most Cook Inlet DPS of beluga whales 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 DPS of beluga whale recovery (NMFS 2016d).

No reduction in numbers is anticipated as part of the proposed action. Therefore, no reduction in reproduction is expected as a result of the proposed action. Because we do not anticipate a reduction in numbers or reproduction of Cook Inlet DPS of beluga whales as a result of the proposed research and enhancement activities, a reduction in the species' likelihood of survival is not expected.

The 2016 Cook Inlet Beluga Recovery Plan (NMFS 2016d) contains complete demographic and threat-based downlisting and delisting criteria. A general summary of the criteria is provided in Table 30 below.

Table 30: Criteria for considering reclassification (from endangered to threatened, or from threatened to not listed) for Cook Inlet distinct population segment of beluga whales.

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

The 2016 Recovery Plan for the Cook Inlet DPS of beluga whale lists recovery objectives for the DPS. The following recovery objectives are relevant to the impacts of the proposed action:

- Determine stock structure of blue whale populations occurring in United States waters and elsewhere.
- Estimate the size and monitor trends in abundance of blue whale populations.
- Identify and protected habitat essential to the survival and recovery of blue whale populations.
- Reduce or eliminate human-caused injury and mortality of blue whales.
- Minimize detrimental effects of directed vessel interactions with blue whales.
- Maximize efforts to acquire scientific information from dead stranded, and entangled blue whales.
- Coordinate state, federal, and international efforts to implement recovery actions for blue whales.

We do not expect mortalities of Cook Inlet DPS of beluga whales from the proposed action. Although the effects analysis was done by separating the activities into distinct stressors, many of which alone are not likely to adversely affect individual Cook Inlet DPS of beluga whales, the stressors often occur together (e.g., an animal cannot be tagged without being approached by a research vessel). Considering the totality of the research and enhancement activities, individual animals may experience stress, minor injury from active acoustic playbacks, biopsy sampling, or tagging, or alter its behavior in some way. Under the proposed action, Cook Inlet DPS of beluga whales (not necessarily individuals) will be subject to research and enhancement activities each year. Effects to individual Cook Inlet DPS of beluga whales are expected to be short term (generally hours or days). Any injury from biopsy sampling is expected to heal within weeks. Suction-cup tags are not expected to cause a hindrance to swimming because of the small size and mass of the tag compared to those of a Cook Inlet DPS of beluga whale. Behavioral and physiological responses that may be exhibited by Cook Inlet DPS of beluga whales upon tagging are expected to return to baseline within minutes of tag attachment. None of the research and enhancement activities are expected to result in any fitness consequence for individual Cook Inlet DPS of beluga whales.

Because no mortalities or effects on the distribution of the Cook Inlet DPS of beluga whale population is expected as a result of the proposed action, we do not anticipate the proposed research and enhancement activities will impede the recovery objectives for Cook Inlet DPS of whales. In conclusion, we believe the effects associated with the proposed action are not expected to cause a reduction in the likelihood of survival and recovery of Cook Inlet DPS of beluga whales in the wild.

13.4 Blue Whale

No reduction in the distribution of blue whales from the Arctic, Atlantic, Indian, Pacific, and Southern Oceans are expected because of the research and enhancement activities proposed for authorization under the NMFS Permits and Conservation Division's cetacean research permitting program.

The blue whale is endangered as a result of past commercial whaling. In the North Atlantic Ocean, at least 11,000 blue whales were taken from the late 19th to mid-20th centuries. In the North Pacific Ocean, at least 9,500 whales were killed between 1910 and 1965. Commercial whaling no longer occurs, but blue whales are affected by anthropogenic noise, 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. There are three stocks of blue whales designated in U.S. waters: the Eastern North Pacific Ocean (approximately 1,647 individuals [minimum number of individuals N_{min}=1,551]), the Central Pacific Ocean (approximately 133 individuals [N_{min}=63]), and Western North Atlantic Ocean (N_{min}=440). Current estimates indicate a growth rate of just under three percent per year for the Eastern North Pacific stock. An overall population growth rate for the species or growth rates for the two other individual U.S. stocks are not available at this time. 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.

No reduction in numbers is anticipated as part of the proposed action. Therefore, no reduction in reproduction is expected as a result of the proposed action. Because we do not anticipate a reduction in numbers or reproduction of blue whales as a result of the proposed research and enhancement activities, a reduction in the species' likelihood of survival is not expected.

The Final Recovery Plan for the blue whale lists recovery objectives for the species. The following recovery objectives are relevant to the impacts of the proposed action:

- Determine stock structure of blue whale populations occurring in United States waters and elsewhere.
- Estimate the size and monitor trends in abundance of blue whale populations.
- Identify and protected habitat essential to the survival and recovery of blue whale populations.
- Reduce or eliminate human-caused injury and mortality of blue whales.
- Minimize detrimental effects of directed vessel interactions with blue whales.
- Maximize efforts to acquire scientific information from dead stranded, and entangled blue whales.
- Coordinate state, federal, and international efforts to implement recovery actions for blue whales.

We do not expect mortalities of blue whales from the proposed action. Although the effects analysis was done by separating the activities into distinct stressors, many of which alone are not likely to adversely affect individual blue whales, the stressors often occur together (e.g., an animal cannot be tagged without being approached by a research vessel). Considering the totality of the research and enhancement activities, individual animals may experience stress, minor injury from active acoustic playbacks, biopsy sampling, or tagging, or alter its behavior in some way. Under the proposed action, blue whales (not necessarily individuals) will be subject to research and enhancement activities each year. Effects to individual blue whales are expected to be short term (generally hours or days). Any injury from biopsy sampling is expected to hear within weeks. Tags are not expected to cause a hindrance to swimming because of the small size and mass of the tag compared to those of a blue whale. Behavioral and physiological responses that may be exhibited by blue whales upon tagging are expected to return to baseline within minutes of tag attachment. None of the research and enhancement activities are expected to result in any fitness consequence for individual blue whales.

Because no mortalities or effects on the distribution of blue whale populations are expected as a result of the proposed action, we do not anticipate the proposed research and enhancement activities will impede the recovery objectives for blue whales. In conclusion, we believe the effects associated with the proposed actions are not expected to cause a reduction in the likelihood of survival and recovery of blue whales in the wild.

13.5 Bowhead Whale

No reduction in the distribution of bowhead whales from the Arctic, Atlantic, and Pacific Oceans are expected because of the research and enhancement activities proposed for authorization authorized under the NMFS Permits and Conservation Division’s cetacean research permitting program.

The bowhead whale is endangered because of past commercial whaling. Prior to commercial whaling, thousands of bowhead whales existed. Global abundance declined to 3,000 by the 1920's. Bowhead whales may be killed under "aboriginal subsistence whaling" provisions of the International Whaling Commission. 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.

There are currently four or five recognized stocks of bowhead whales, 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. Current estimates indicate approximately 16,892 (N_{min}=16,091) 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.

No reduction in numbers is anticipated as part of the proposed action. Therefore, no reduction in reproduction is expected as a result of the proposed action. Because we do not anticipate a reduction in numbers or reproduction of bowhead whales as a result of the proposed research and enhancement activities, a reduction in the species' likelihood of survival is not expected.

There is currently is no recovery plan available for the bowhead whale.

We do not expect mortalities of bowhead whales from the proposed action. Although the effects analysis was done by separating the activities into distinct stressors, many of which alone are not likely to adversely affect individual bowhead whales, the stressors often occur together (e.g., an animal cannot be tagged without being approached by a research vessel). Considering the totality of the research and enhancement activities, individual animals may experience stress, minor injury from active acoustic playbacks, biopsy sampling, or tagging, or alter its behavior in some way. Under the proposed action, bowhead whales (not necessarily individuals) will be subject to research and enhancement activities each year. Effects to individual bowhead whales are expected to be short term (generally hours or days). Any injury from biopsy sampling is expected to heal within weeks. Tags are not expected to cause a hindrance to swimming because of the small size and mass of the tag compared to those of a bowhead whale. Behavioral and physiological responses that may be exhibited by bowhead whales upon tagging are expected to return to baseline within minutes of tag attachment. None of the research and enhancement activities are expected to result in any fitness consequence for individual bowhead whales. None of the research and enhancement activities are expected to result in any fitness consequence of individual bowhead whales.

Because no mortalities or effects on the distribution of bowhead whale populations are expected as a result of the proposed action, we do not anticipate the proposed research and enhancement activities will impede the recovery of bowhead whales. In conclusion, we believe the effects associated with the proposed action are not expected to cause a reduction in the likelihood of survival and recovery of bowhead whales in the wild.

13.6 Bryde's Whale – Gulf of Mexico Subspecies

No reduction in the distribution of Gulf of Mexico subspecies of Bryde's whales from the Atlantic Ocean are expected because of the research and enhancement activities proposed for authorization under the NMFS Permits and Conservation Division's cetacean research permitting program.

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 Gulf of Mexico subspecies of Bryde'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 Gulf of Mexico subspecies of Bryde's whales' ability to communicate. Vessel traffic from commercial shipping and the oil and gas industry also poses a risk of vessel strike for Gulf of Mexico subspecies of Bryde's whales. Entanglement from fishing gear is also a threat, and several fisheries operate within the range of the species. The *Deepwater Horizon* oil spill severely impacted Bryde's whales in the Gulf of Mexico, with an estimated 17 percent of the population killed, 22 percent of females exhibiting reproductive failure, and 18 percent of the population suffering adverse health effects (DWHTrustees 2016). Because the Gulf of Mexico subspecies of Bryde's whale population is so small size and has low genetic diversity, it is highly susceptible to further perturbations.

No reduction in numbers is anticipated as part of the proposed action. Therefore, no reduction in reproduction is expected as a result of the proposed action. Because we do not anticipate a reduction in numbers or reproduction of Gulf of Mexico subspecies of Bryde's whales as a result of the proposed research and enhancement activities, a reduction in the species' likelihood of survival is not expected.

There is currently is no recovery plan available for the Gulf of Mexico subspecies of Bryde's whale.

We do not expect mortalities of Gulf of Mexico subspecies of Bryde's whales from the proposed action. Although the effects analysis was done by separating the activities into distinct stressors, many of which alone are not likely to adversely affect individual Gulf of Mexico subspecies of Bryde's whales, the stressors often occur together (e.g., an animal cannot be tagged without being approached by a research vessel). Considering the totality of the research and enhancement activities, individual animals may experience stress, minor injury from active acoustic playbacks, biopsy sampling, or tagging, or alter its behavior in some way. Under the proposed action, Gulf of Mexico subspecies of Bryde's whales (not necessarily individuals) will be subject to research and enhancement activities each year. Effects to individual Gulf of Mexico subspecies of Bryde's whales are expected to be short term (generally hours or days). Any injury from biopsy sampling is expected to heal within weeks. Tags are not expected to cause a hindrance to swimming because of the small size and mass of the tag compared to those of a Gulf of Mexico subspecies of Bryde's whale. Behavioral and physiological responses that may be exhibited by Gulf of Mexico subspecies of Bryde's whales upon tagging are expected to return to baseline within minutes of tag attachment. None of the research and enhancement activities are expected to result in any fitness consequence for individual Gulf of Mexico subspecies of Bryde's whales. None of the research and enhancement activities are expected to result in any fitness consequence of individual Gulf of Mexico subspecies of Bryde's whales.

Because no mortalities or effects on the distribution of Gulf of Mexico subspecies of Bryde's whale population are expected as a result of the proposed action, we do not anticipate the proposed research and enhancement activities will impede the recovery objectives for Gulf of Mexico sub-species of Bryde's whales. In conclusion, we believe the effects associated with the proposed action are not expected to cause a reduction in the likelihood of survival and recovery of Gulf of Mexico subspecies of Bryde's whales in the wild.

13.7 False Killer Whale – Main Hawaiian Islands Insular Distinct Population Segment

No reduction in the distribution of Main Hawaiian Islands insular DPS of false killer whales from the Pacific Ocean is expected because of the research and enhancement activities proposed for authorization under the under the NMFS Permits and Conservation Division's cetacean research permitting program.

Recent, unpublished estimates of abundance for two time periods, 2000 through 2004 and 2006 through 2009, were 162 and 151 respectively. The minimum population estimate for the Main Hawaiian Islands insular DPS of false killer whale is the number of distinct individuals identified during the 2011 through 2014 photo-identification studies, or 92 false killer whales (Baird et al. 2015).

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

No reduction in numbers is anticipated as part of the proposed action. Therefore, no reduction in reproduction is expected as a result of the proposed action. Because we do not anticipate a reduction in numbers or reproduction of Main Hawaiian Islands insular DPS of false killer whales as a result of the proposed research and enhancement activities, a reduction in the species' likelihood of survival is not expected.

There is currently no recovery plan available for the Main Hawaiian Islands insular DPS of false killer whale.

We do not expect mortalities of Main Hawaiian Islands insular DPS of false killer whales from the proposed action. Although the effects analysis was done by separating the activities into distinct stressors, many of which alone are not likely to adversely affect individual Main Hawaiian Islands insular DPS of false killer whales, the stressors often occur together (e.g., an animal cannot be tagged without being approached by a research vessel). Considering the totality of the research and enhancement activities, individual animals may experience stress, minor injury from active acoustic playbacks, biopsy sampling, or tagging, or alter its behavior in some way. Under the proposed action, Main Hawaiian Islands insular DPS of false killer whales (not necessarily individuals) will be subject to research and enhancement activities each year. Effects to individual Main Hawaiian Islands insular DPS of false killer whales are expected to be short term (generally hours or days). Any injury from biopsy sampling is expected to heal within weeks. Tags are not expected to cause a hindrance to swimming because of the small size and mass of the tag compared to those of a Main Hawaiian Islands insular DPS of false killer whales. Behavioral and physiological responses that may be exhibited by Main Hawaiian Islands insular DPS of false killer whales upon tagging are expected to return to baseline within minutes of tag attachment. None of the research and enhancement activities are expected to result in any fitness consequence for individual Main Hawaiian Islands insular DPS of false killer whales. None of the research and enhancement activities are expected to result in any fitness consequence of individual Main Hawaiian Islands insular DPS of false killer whales.

Because no mortalities or effects on the distribution of the Main Hawaiian Islands insular DPS of false killer whale population are expected as a result of the proposed action, we do not anticipate the proposed research and enhancement activities will impede the recovery for Main Hawaiian Islands insular DPS of false killer whales. In conclusion, we believe the effects associated with the proposed action are not expected to cause a reduction in the likelihood of survival and recovery of Main Hawaiian Islands insular DPS of false killer whales in the wild.

13.8 Fin Whale

No reduction in the distribution of fin whales from the Arctic, Atlantic, Indian, Pacific, and Southern Oceans are expected because of the research and enhancement activities proposed for authorization under the NMFS Permits and Conservation Division's cetacean research permitting program.

Of the three to seven stocks in the North Atlantic Ocean (approximately 50,000 individuals), one occurs in U.S. waters, where the best estimate of abundance is 1,618 individuals (N_{min}=1,234); however, this may be an underrepresentation as the entire range of stock was not surveyed (Palka 2012b). There are three stocks in U.S. Pacific Ocean waters: Northeast Pacific [minimum 1,368 individuals], Hawaii (approximately 58 individuals [N_{min}=27]) and California/Oregon/Washington (approximately 9,029 [N_{min}=8,127] individuals) (Nadeem et al. 2016). The International Whaling Commission also recognizes the China Sea stock of fin whales, found in the Northwest Pacific Ocean, 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. 2016).

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

No reduction in numbers is anticipated as part of the proposed action. Therefore, no reduction in reproduction is expected as a result of the proposed action. Because we do not anticipate a reduction in numbers or reproduction of fin whales as a result of the proposed research and enhancement activities, a reduction in the species' likelihood of survival is not expected.

The 2010 Final Recovery Plan for the fin whale lists recovery objectives for the species. The following recovery objectives are relevant to the impacts of the proposed action:

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

We do not expect any mortalities of fin whales from the proposed action. Although the effects analysis was done by separating the activities into distinct stressors, many of which alone are not likely to adversely affect individual fin whales, the stressors often occur together (e.g., an animal cannot be tagged without being approached by a research vessel). Considering the totality of the research and enhancement activities, individual animals may experience stress, minor injury from active acoustic playbacks, biopsy sampling, or tagging, or alter its behavior in some way. Effects to individual fin whales are expected to be short term (generally hours to days). Any injury from biopsy sampling is expected to heal within weeks. Tags are not expected to cause a hindrance to swimming because of the small size and mass of the tag compared to those of a fin whale. Behavioral and physiological responses that may be exhibited by fin whales upon tagging are expected to return to baseline within minutes of attachment. None of the research and enhancement activities are expected to result in any fitness consequence for individual fin whales.

Because no mortalities or effects on the distribution of fin whale populations are expected as a result of the proposed action, we do not anticipate the proposed research and enhancement activities will impede the recovery objectives for fin whales. In conclusion, we believe the effects associated with the proposed action are not expected to cause a reduction in the likelihood of survival and recovery of fin whales in the wild.

13.9 Gray Whale – Western North Pacific Population

No reduction in the distribution of the Western North Pacific population of gray whales from the Arctic, Atlantic, and Pacific Oceans are expected because of the research and enhancement activities proposed for authorization under the NMFS Permits and Conservation Division's cetacean research permitting program.

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

The Western North Pacific population of gray whales has increased over the last ten years at an estimated rate of 3.3 percent. The Western North Pacific population was thought to be geographically isolated from the Eastern North Pacific population , but recent documentation of some gray whales moving between geographic areas in the Pacific Ocean indicate otherwise. Also, in recent years, gray whales have been sighted in the Eastern Atlantic Ocean and Mediterranean Sea, but it is unknown to which population those animals belong.

Photo-identification data collected between 1994 and 2011 on the Western North Pacific population of gray whale summer feeding ground off Sakhalin Island were used to calculate an abundance estimate of 140 whales for the non-calf population size in 2012 (Cooke et al. 2013). The minimum population estimate for the Western North Pacific stock is 135 individual gray whales on the summer feeding ground off Sakhalin Island. The current best growth rate estimate for the Western North Pacific population of gray whale stock is 3.3 percent annually.

No reduction in numbers is anticipated as part of the proposed action. Therefore, no reduction in reproduction is expected as a result of the proposed action. Because we do not anticipate a reduction in numbers or reproduction of Western North Pacific population of gray whales as a result of the proposed research and enhancement activities, a reduction in the species' likelihood of survival is not expected.

There is currently no recovery plan for the Western North Pacific population of gray whale.

We do not expect any mortalities of the Western North Pacific population of gray whales from the proposed action. Although the effects analysis was done by separating the activities into distinct stressors, many of which along are not likely to adversely affect individual Western North Pacific population of gray whales, the stressors often occur together (e.g., an animal cannot be tagged without being approached by a research vessel). Considering the totality of the research and enhancement activities, individual animals may experience stress, minor injury from active acoustic playbacks, biopsy sampling, or tagging, or alter its behavior in some way. Effects to individual Western North Pacific population of gray whales are expected to be short term (generally hours or days). Any injury from biopsy sampling is expected to heal within weeks. Tags are not expected to cause a hindrance to swimming because of the small size and mass of the tag compared to those of a gray whale. Behavioral and physiological responses that may be exhibited by Western North Pacific population of gray whales upon tagging are expected to return to baseline within minutes of tag attachment. None of the research and enhancement activities are expected to result in any fitness consequence for individual Western North Pacific population of gray whales.

Because no mortalities or effects on the distribution of the Western North Pacific population of gray whale are expected as a result of the proposed action, we do not anticipate the proposed research and enhancement activities will impede the recovery for Western North Pacific population of gray whales. In conclusion, we believe the effects associated with the proposed actions are not expected to cause a reduction in the likelihood of survival and recovery of Western North Pacific population of gray whales in the wild.

13.1 Humpback Whale – Arabian Sea Distinct Population Segment

No reduction in the distribution of Arabian Sea DPS of humpback whales from the Indian Ocean are expected because of the research and enhancement activities proposed for authorization under the NMFS Permits and Conservation Division's cetacean research permitting program.

Humpback whales were originally listed as endangered as a result of past commercial whaling, and the five DPSs that remain listed (Cape Verde Islands/Northwest Africa, Western North Pacific, Central America, Arabian Sea, and Mexico) have likely not yet recovered from this. Prior to commercial whaling, hundreds of thousands of humpback whales existed. Global abundance declined to the low thousands by 1968, the last year of substantial catches (IUCN 2012). Humpback whales may be killed under "aboriginal subsistence whaling" and "scientific permit whaling" provisions of the 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. The species' large population size and increasing trends indicate that it is resilient to current threats, but the Arabian Sea DPS of humpback whale still faces a risk of extinction.

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

No reduction in numbers is anticipated as part of the proposed action. Therefore, no reduction in reproduction is expected as a result of the proposed action. Because we do not anticipate a reduction in numbers or reproduction of Arabian Sea DPS of humpback whales as a result of the proposed research and enhancement activities, a reduction in the species' likelihood of survival is not expected.

The 1991 Final Recovery Plan for the humpback whale lists recovery objectives for the species. The following recovery objectives are relevant to the impacts of the proposed action:

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

We do not expect any mortalities of the Arabian Sea DPS of humpback whales from the proposed action. Although the effects analysis was done by separating the activities into distinct stressors, many of which along are not likely to adversely affect individual Arabian Sea DPS of humpback whales, the stressors often occur together (e.g., an animal cannot be tagged without being approached by a research vessel). Considering the totality of the research and enhancement activities, individual whales may experience stress, minor injury from biopsy sampling or tagging, or alter its behavior in some way. Effects to individual Arabian Sea DPS of humpback whales are expected to be short term (generally hours or days). Any injury from biopsy sampling is expected to heal within weeks. Tags are not expected to cause a hindrance to swimming because of the small size and mass of the tag compared to those of a Arabian Sea DPS of humpback whale. Behavioral and physiological responses that may be exhibited by Arabian Sea DPS of humpback whales upon tagging are expected to return to baseline within minutes of tag attachment. None of the research and enhancement activities are expected to result in any fitness consequence for individual Arabian Sea DPS of humpback whales.

Because no mortalities or effects on the distribution of Arabian Sea DPS of humpback whales are expected as a result of the proposed action, we do not anticipate the proposed research and enhancement activities will impede the recovery objectives for Arabian Sea DPS of humpback whales. In conclusion, we believe the effects associated with the proposed action are not expected to cause a reduction in the likelihood of survival and recovery of Arabian Sea DPS of humpback whales in the wild.

13.2 Humpback Whale – Cape Verde Islands/Northwest Africa Distinct Population Segment

No reduction in the distribution of Cape Verde Islands/Northwest Africa DPS of humpback whales from the Atlantic Ocean are expected because of the research and enhancement activities proposed for authorization under the NMFS Permits and Conservation Division's cetacean research permitting program.

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 whale is unknown (81 FR 62259). A population growth rate is currently unavailable for the Cape Verde Islands/Northwest Africa DPS of humpback whales.

No reduction in numbers is anticipated as part of the proposed action. Therefore, no reduction in reproduction is expected as a result of the proposed action. Because we do not anticipate a reduction in numbers or reproduction of Cape Verde Islands/Northwest Africa DPS of humpback whales as a result of the proposed research and enhancement activities, a reduction in the species' likelihood of survival is not expected.

The 1991 Final Recovery Plan for the humpback whale lists recovery objectives for the species. The following recovery objectives are relevant to the impacts of the proposed actions:

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

We do not expect any mortalities of the Cape Verde Islands/Northwest Africa DPS of humpback whales from the proposed action. Although the effects analysis was done by separating the activities into distinct stressors, many of which along are not likely to adversely affect individual Cape Verde Islands/Northwest Africa DPS of humpback whales, the stressors often occur together (e.g., an animal cannot be tagged without being approached by a research vessel). Considering the totality of the research and enhancement activities, individual animals may experience stress, minor injury from active acoustic playbacks, biopsy sampling, or tagging, or alter its behavior in some way. Under the proposed action, Cape Verde Islands/Northwest Africa DPS of humpback whales (not necessarily individuals) will be subject to research and enhancement activities each year. Effects to individual Cape Verde Islands/Northwest Africa DPS of humpback whales are expected to be short term (generally hours or days). Any injury from biopsy sampling is expected to heal within weeks. Tags are not expected to cause a hindrance to swimming because of the small size and mass of the tag compared to those of a Cape Verde Islands/Northwest Africa DPS of humpback whale. Behavioral and physiological responses that may be exhibited by Cape Verde Islands/Northwest Africa DPS of humpback whales upon tagging are expected to return to baseline within minutes of tag attachment. None of the research and enhancement activities are expected to result in any fitness consequence for individual Cape Verde Islands/Northwest Africa DPS of humpback whales.

Because no mortalities or effects on the distribution of Cape Verde Islands/Northwest Africa DPS of humpback whales are expected as a result of the proposed action, we do not anticipate the proposed research and enhancement activities will impede the recovery objectives for Cape Verde Islands/Northwest Africa DPS of humpback whales. In conclusion, we believe the effects associated with the proposed action are not expected to cause a reduction in the likelihood of survival and recovery of Cape Verde Islands/Northwest Africa DPS of humpback whales in the wild.

13.3 Humpback Whale – Central America Distinct Population Segment

No reduction in the distribution of Central America DPS of humpback whales from the Pacific Ocean are expected because of the research and enhancement activities proposed for authorization under the NMFS Permits and Conservation Division's cetacean research permitting program.

The global, pre-exploitation estimate for humpback whales is 1,000,000 (Roman and Palumbi 2003). The current abundance of the Central America DPS of humpback whale is 411. A population growth rate is currently unavailable for the Central America DPS of humpback whales.

No reduction in numbers is anticipated as part of the proposed action. Therefore, no reduction in reproduction is expected as a result of the proposed action. Because we do not anticipate a reduction in numbers or reproduction of Central America DPS of humpback whales as a result of the proposed research and enhancement activities, a reduction in the species' likelihood of survival is not expected.

The 1991 Final Recovery Plan for the humpback whale lists recovery objectives for the species. The following recovery objectives are relevant to the impacts of the proposed action:

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

We do not expect any mortalities of the Central America DPS of humpback whales from the proposed action. Although the effects analysis was done by separating the activities into distinct stressors, many of which along are not likely to adversely affect individual Central America DPS of humpback whales, the stressors often occur together (e.g., an animal cannot be tagged without being approached by a research vessel). Considering the totality of the research and enhancement activities, individual animals may experience stress, minor injury from active acoustic playbacks, biopsy sampling, or tagging, or alter its behavior in some way. Under the proposed action, Central America DPS of humpback whales (not necessarily individuals) will be subject to research and enhancement activities each year. Effects to individual humpback whales are expected to be short term (generally hours or days). Any injury from biopsy sampling is expected to heal within weeks. Tags are not expected to cause a hindrance to swimming because of the small size and mass of the tag compared to those of a Central America DPS of humpback whale. Behavioral and physiological responses that may be exhibited by Central America DPS of humpback whales upon tagging are expected to return to baseline within minutes of tag attachment. None of the research and enhancement activities are expected to result in any fitness consequence for individual Central America DPS of humpback whales.

Because no mortalities or effects on the distribution of Central America DPS of humpback whales are expected as a result of the proposed action, we do not anticipate the proposed research and enhancement activities will impede the recovery objectives for Central America DPS of humpback whales. In conclusion, we believe the effects associated with the proposed action are not expected to cause a reduction in the likelihood of survival and recovery of Central America DPS of humpback whales in the wild.

13.4 Humpback Whale – Mexico Distinct Population Segment

No reduction in the distribution of Mexico DPS of humpback whales from the Pacific Ocean are expected because of the research and enhancement activities proposed for authorization under the NMFS Permits and Conservation Division's cetacean research permitting program.

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

No reduction in numbers is anticipated as part of the proposed action. Therefore, no reduction in reproduction is expected as a result of the proposed action. Because we do not anticipate a reduction in numbers or reproduction of Mexico DPS of humpback whales as a result of the proposed research and enhancement activities, a reduction in the species' likelihood of survival is not expected.

The 1991 Final Recovery Plan for the humpback whale lists recovery objectives for the species. The following recovery objectives are relevant to the impacts of the proposed action:

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

We do not expect any mortalities of the Mexico DPS of humpback whales from the proposed action. Although the effects analysis was done by separating the activities into distinct stressors, many of which along are not likely to adversely affect individual Mexico DPS of humpback whales, the stressors often occur together (e.g., an animal cannot be tagged without being approached by a research vessel). Considering the totality of the research and enhancement activities, individual animals may experience stress, minor injury from active acoustic playbacks, biopsy sampling, or tagging, or alter its behavior in some way. Under the proposed action, Mexico DPS of humpback whales (not necessarily individuals) will be subject to research and enhancement activities each year. Effects to individual Mexico DPS of humpback whales are expected to be short term (generally hours or days). Any injury from biopsy sampling is expected to heal within weeks. Tags are not expected to cause a hindrance to swimming because of the small size and mass of the tag compared to those of a Mexico DPS of humpback whale. Behavioral and physiological responses that may be exhibited by Mexico DPS of humpback whales upon tagging are expected to return to baseline within minutes of tag attachment. None of the research and enhancement activities are expected to result in any fitness consequence for individual Mexico DPS of humpback whales. As such, we do not anticipate the proposed research activities will impede the recovery objectives for the Mexico DPS of humpback whales.

Because no mortalities or effects on the distribution of Mexico DPS of humpback whales are expected as a result of the proposed action, we do not anticipate the proposed research and enhancement activities will impede the recovery objectives for Mexico DPS of humpback whales. In conclusion, we believe the effects associated with the proposed action are not expected to cause a reduction in the likelihood of survival and recovery of Mexico DPS of humpback whales in the wild.

13.5 Humpback Whale – Western North Pacific Distinct Population Segment

No reduction in the distribution of Western North Pacific DPS of humpback whales from the Pacific Ocean are expected because of the research and enhancement activities proposed for authorization under the NMFS Permits and Conservation Division's cetacean research permitting program.

The global, pre-exploitation estimate for humpback whales is 1,000,000 (Roman and Palumbi 2003). The current abundance of the Western North Pacific DPS is 1,059. A population growth rate is currently unavailable for the Western North Pacific DPS of humpback whales.

No reduction in numbers is anticipated as part of the proposed action. Therefore, no reduction in reproduction is expected as a result of the proposed action. Because we do not anticipate a reduction in numbers or reproduction of Western North Pacific DPS of humpback whales as a result of the proposed research and enhancement activities, a reduction in the species' likelihood of survival is not expected.

The 1991 Final Recovery Plan for the humpback whale lists recovery objectives for the species. The following recovery objectives are relevant to the impacts of the proposed action:

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

We do not expect any mortalities of the Western North Pacific DPS of humpback whales from the proposed action. Although the effects analysis was done by separating the activities into distinct stressors, many of which along are not likely to adversely affect individual Western North Pacific DPS of humpback whales, the stressors often occur together (e.g., an animal cannot be tagged without being approached by a research vessel). Considering the totality of the research and enhancement activities, individual animals may experience stress, minor injury from active acoustic playbacks, biopsy sampling, or tagging, or alter its behavior in some way. Under the proposed action, Western North Pacific DPS of humpback whales (not necessarily individuals) will be subject to research and enhancement activities each year. Effects to individual Western North Pacific DPS of humpback whales are expected to be short term (generally hours or days). Any injury from biopsy sampling is expected to heal within weeks. Tags are not expected to cause a hindrance to swimming because of the small size and mass of the tag compared to those of a Western North Pacific DPS of humpback whale. Behavioral and physiological responses that may be exhibited by Western North Pacific DPS of humpback whales upon tagging are expected to return to baseline within minutes of tag attachment. None of the research and enhancement activities are expected to result in any fitness consequence for individual Western North Pacific DPS of humpback whales.

Because no mortalities or effects on the distribution of Western North Pacific DPS of humpback whales are expected as a result of the proposed action, we do not anticipate the proposed research and enhancement activities will impede the recovery objectives for Western North Pacific DPS of humpback whales. In conclusion, we believe the effects associated with the proposed action are not expected to cause a reduction in the likelihood of survival and recovery of Western North Pacific DPS of humpback whales in the wild.

13.6 Killer Whale – Southern Resident Distinct Population Segment

No reduction in the distribution of Southern Resident DPS of killer whales from the Pacific Ocean are expected because of the research and enhancement activities proposed for authorization under the NMFS Permits and Conservation Division's cetacean research permitting program.

The most recent abundance estimate for the Southern Resident DPS is 81 whales in 2015 (Carretta et al. 2017) (80 whales in 2016[4]). This represents a decline from just a few years ago, when in 2012, there were 85 whales. Population abundance has fluctuated over time with a maximum of approximately 100 whales in 1995 (Carretta et al. 2017), 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 2016f). 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. 2017).

No reduction in numbers is anticipated as part of the proposed action. Therefore, no reduction in reproduction is expected as a result of the proposed action. Because we do not anticipate a reduction in numbers or reproduction of Southern Resident DPS of killer whales as a result of the proposed research and enhancement activities, a reduction in the species' likelihood of survival is not expected.

The 2008 Final Recovery Plan for the Southern Resident DPS of killer whales lists recovery objectives for the species. The following recovery objectives are relevant to the impacts of the proposed action:

- 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.

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

- Pollution/Contamination: Clean up existing contaminated sites, minimizing continuing inputs of contaminants harmful to killer whales, and monitor emerging contaminants.
- Vessel Effects: Continue with evaluation and improvement of guidelines for vessel activity near Southern Resident DPS of killer whales and evaluate the need for regulations or protected areas.
- Oil Spills: Prevent oils spills and improve response preparation to minimize effects on Southern Resident DPS of killer whales and their habitat in the event of a spill.
- Acoustic Effects: Continue agency coordination and use of existing ESA and MMPA mechanisms to minimize potential impacts from anthropogenic sound.
- 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 DPS of killer whale sightings and strandings.
- 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.
- Transboundary and Interagency Coordination: Coordinate monitoring, research, enforcement, and complementary recovery planning with Canadian agencies, and Federal and State partners.
- 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.

We do not expect any mortalities of the Southern Resident DPS of killer whales from the proposed action. Although the effects analysis was done by separating the activities into distinct stressors, many of which along are not likely to adversely affect individual Southern Resident DPS of killer whales, the stressors often occur together (e.g., an animal cannot be tagged without being approached by a research vessel). Considering the totality of the research and enhancement activities, individual animals may experience stress, minor injury from active acoustic playbacks, biopsy sampling, or tagging, or alter its behavior in some way. Under the proposed action, Southern Resident DPS of killer whales (not necessarily individuals) will be subject to research and enhancement activities each year. Effects to individual Southern Resident DPS of killer whales are expected to be short term (generally hours or days). Any injury from biopsy sampling is expected to heal within weeks. Tags are not expected to cause a hindrance to swimming because of the small size and mass of the tag compared to those of a Southern Resident DPS of killer whale. Behavioral and physiological responses that may be exhibited by Southern Resident DPS of killer whales upon tagging are expected to return to baseline within minutes of tag attachment. None of the research and enhancement activities are expected to result in any fitness consequence for individual Southern Resident DPS of killer whales.

Because no mortalities or effects on the distribution of Southern Resident DPS of killer whales are expected as a result of the proposed action, we do not anticipate the proposed research and enhancement activities will impede the recovery objectives for Southern Resident DPS of killer whales. In conclusion, we believe the effects associated with the proposed action are not expected to cause a reduction in the likelihood of survival and recovery of Southern Resident DPS of killer whales in the wild.

13.7 North Atlantic Right Whale

No reduction in the distribution of North Atlantic right whales from the Atlantic Ocean are expected because of the research and enhancement activities proposed for authorization under the NMFS Permits and Conservation Division's cetacean research permitting program.

In the western North Atlantic Ocean, the species demonstrated overall growth rates of 2.6 percent over the period 1990 through 2010, despite two periods of increased mortality during that time span (Hayes et al. 2017). However, in most recent years, photo-identification data indicate the populations is now in decline (Hayes et al. 2017; Kraus et al. 2016).

As discussed previously (see Section 9.14), the North Atlantic right whale population is currently experiencing an unusual mortality event that appears to be related to both vessel strikes and entanglement in fishing gear (Daoust et al. 2017). Also, the North Atlantic right whale population has low female survival, male biased sex ratio, low calving success, and reduced prey availability that are contributing to the population's current decline.

No reduction in numbers is anticipated as part of the proposed action. Therefore, no reduction in reproduction is expected as a result of the proposed action. Because we do not anticipate a reduction in numbers or reproduction of North Atlantic right whales as a result of the proposed research and enhancement activities, a reduction in the species' likelihood of survival is not expected.

The 2005 updated Recovery Plan for the North Atlantic right whale lists recovery objectives for the species. The following recovery objectives are relevant to the impacts of the proposed action:

- 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 North Atlantic right whales are indicative of an increasing population.
- The population has increased for a period of 35 years at an average rate of increase equal to or greater than two percent per year.
- None of the known threats to North Atlantic right whales are known to limit the population's growth rate.
- Given current and projected threats and environmental conditions, the North Atlantic right whale population has not more than a one percent chance of quasi-extinction in one hundred years.

We do not expect any mortalities of the North Atlantic right whales from the proposed action. Although the effects analysis was done by separating the activities into distinct stressors, many of which along are not likely to adversely affect individual North Atlantic right whales, the stressors often occur together (e.g., an animal cannot be tagged without being approached by a research vessel). Considering the totality of the research and enhancement activities, individual animals may experience stress, minor injury from active acoustic playbacks, biopsy sampling, or tagging, or alter its behavior in some way. Under the proposed action North Atlantic, right whales (not necessarily individuals) will be subject to research and enhancement activities each year. Effects to individual North Atlantic right whales are expected to be short term (generally hours or days). Any injury from biopsy sampling is expected to heal within weeks. Tags are not expected to cause a hindrance to swimming because of the small size and mass of the tag compared to those of a North Atlantic right whale. Behavioral and physiological responses that may be exhibited by humpback whales upon tagging are expected to return to baseline within minutes of tag attachment. None of the research and enhancement activities are expected to result in any fitness consequence for individual North Atlantic right whales.

Because no mortalities or effects on the distribution of North Atlantic right whales are expected as a result of the proposed action, we do not anticipate the proposed research and enhancement activities will impede the recovery for North Atlantic right whales. In conclusion, we believe the effects associated with the proposed action are not expected to cause a reduction in the likelihood of survival and recovery of North Atlantic right whales in the wild.

13.8 North Pacific Right Whale

No reduction in the distribution of North Pacific right whales from the Pacific Ocean are expected because of the research and enhancement activities proposed for authorization under the NMFS Permits and Conservation Division's cetacean research permitting program.

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. 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. 2017). Genetic data have identified 23 individuals based on samples collected between 1997 and 2011 (Leduc et al. 2012). The Western North Pacific stock is likely more abundant and was estimated to consist of 922 whales (95 percent confidence intervals 404 to 2,108) based on data collected in 1989, 1990, and 1992 (IWC 2001; Thomas et al. 2016). 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. 2016). There is currently no information on the population trend of North Pacific right whales.

No reduction in numbers is anticipated as part of the proposed action. Therefore, no reduction in reproduction is expected as a result of the proposed action. Because we do not anticipate a reduction in numbers or reproduction of North Pacific right whales as a result of the proposed research and enhancement activities, a reduction in the species' likelihood of survival is not expected.

The 2013 Final Recovery Plan for the North Pacific right whale lists recovery objectives for the species. The following recovery objectives are relevant to the impacts of the proposed action:

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

We do not expect any mortalities of the North Pacific right whales from the proposed action. Although the effects analysis was done by separating the activities into distinct stressors, many of which along are not likely to adversely affect individual North Pacific right whales, the stressors often occur together (e.g., an animal cannot be tagged without being approached by a research vessel). Considering the totality of the research and enhancement activities, individual animals may experience stress, minor injury from active acoustic playbacks, biopsy sampling, or tagging, or alter its behavior in some way. Under the proposed action, North Pacific right whales (not necessarily individuals) will be subject to research and enhancement activities each year. Effects to individual North Pacific right whales are expected to be short term (generally hours or days). Any injury from biopsy sampling is expected to heal within weeks. Tags are not expected to cause a hindrance to swimming because of the small size and mass of the tag compared to those of a North Pacific right whale. Behavioral and physiological responses that may be exhibited by North Pacific right whales upon tagging are expected to return to baseline within minutes of tag attachment. None of the research and enhancement activities are expected to result in any fitness consequence for individual North Pacific right whales.

Because no mortalities or effects on the distribution of North Pacific right whales are expected as a result of the proposed action, we do not anticipate the proposed research and enhancement activities will impede the recovery objectives for North Pacific right whales. In conclusion, we believe the effects associated with the proposed action are not expected to cause a reduction in the likelihood of survival and recovery of North Pacific right whales in the wild.

13.9 Sei Whale

No reduction in the distribution of sei whales from the Atlantic, Indian, and Pacific Ocean are expected because of the research and enhancement activities proposed for authorization under the NMFS Permits and Conservation Division's cetacean research permitting program.

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. 2016). 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 relatively small stocks occur in U.S. waters: Nova Scotia (N=357, N_{min}=236), Hawaii (N=178, N_{min}=93), and Eastern North Pacific (N=519, N_{min}=374). 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.

No reduction in numbers is anticipated as part of the proposed action. Therefore, no reduction in reproduction is expected as a result of the proposed action. Because we do not anticipate a reduction in numbers or reproduction of sei whales as a result of the proposed research and enhancement activities, a reduction in the species' likelihood of survival is not expected.

The 2001 Final Recovery Plan for the sei whale lists recovery objectives for the species. The following recovery objectives are relevant to the impacts of the proposed actions:

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

We do not expect any mortalities of sei whales from the proposed action. Although the effects analysis was done by separating the activities into distinct stressors, many of which along are not likely to adversely affect individual sei whales, the stressors often occur together (e.g., an animal cannot be tagged without being approached by a research vessel). Considering the totality of the research and enhancement activities, individual animals may experience stress, minor injury from active acoustic playbacks, biopsy sampling, or tagging, or alter its behavior in some way. Under the proposed action, sei whales (not necessarily individuals) will be subject to research and enhancement activities each year. Effects to individual sei whales are expected to be short term (generally hours or days). Any injury from biopsy sampling is expected to heal within weeks. Tags are not expected to cause a hindrance to swimming because of the small size and mass of the tag compared to those of a sei whale. Behavioral and physiological responses that may be exhibited by sei whales upon tagging are expected to return to baseline within minutes of tag attachment. None of the research and enhancement activities are expected to result in any fitness consequence for individual sei whales.

Because no mortalities or effects on the distribution of sei whales are expected as a result of the proposed action, we do not anticipate the proposed research and enhancement activities will impede the recovery objectives for sei whales. In conclusion, we believe the effects associated with the proposed action are not expected to cause a reduction in the likelihood of survival and recovery of sei whales s in the wild.

13.10 Southern Right Whale

No reduction in the distribution of Southern right whales from the Atlantic, Indian, Pacific, and Southern Ocean are expected because of the research and enhancement activities proposed for authorization under the NMFS Permits and Conservation Division's cetacean research permitting program.

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 of 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 status of the Peru and Chile breeding populations is unknown (NMFS 2015a). 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 survival rates, between 0.87 and 0.95 percent (Carroll et al. 2016).

No reduction in numbers is anticipated as part of the proposed action. Therefore, no reduction in reproduction is expected as a result of the proposed action. Because we do not anticipate a reduction in numbers or reproduction of Southern right whales as a result of the proposed research and enhancement activities, a reduction in the species' likelihood of survival is not expected.

There is currently no recovery plan for the Southern right whale.

We do not expect any mortalities of the Southern right whales from the proposed action. Although the effects analysis was done by separating the activities into distinct stressors, many of which along are not likely to adversely affect individual Southern right whales, the stressors often occur together (e.g., an animal cannot be tagged without being approached by a research vessel). Considering the totality of the research and enhancement activities, individual animals may experience stress, minor injury from active acoustic playbacks, biopsy sampling, or tagging, or alter its behavior in some way. Under the proposed action, Southern right whales (not necessarily individuals) will be subject to research and enhancement activities each year. Effects to individual Southern right whales are expected to be short term (generally hours or days). Any injury from biopsy sampling is expected to heal within weeks. Tags are not expected to cause a hindrance to swimming because of the small size and mass of the tag compared to those of a Southern right whale. Behavioral and physiological responses that may be exhibited by Southern right whales upon tagging are expected to return to baseline within minutes of tag attachment. None of the research and enhancement activities are expected to result in any fitness consequence for individual Southern right whales.

Because no mortalities or effects on the distribution of Southern right whales are expected as a result of the proposed action, we do not anticipate the proposed research and enhancement activities will impede the recovery objectives for Southern right whales. In conclusion, we believe the effects associated with the proposed action are not expected to cause a reduction in the likelihood of survival and recovery of Southern right whales in the wild.

13.11 Sperm Whale

No reduction in the distribution of sperm whales from the Arctic, Atlantic, Indian, Pacific, and Southern Oceans are expected because of the research and enhancement activities proposed for authorization under the NMFS Permits and Conservation Division's cetacean research permitting program.

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. There are no reliable estimates for sperm whale abundance across the entire Atlantic Ocean. However, estimates are available for two to three United States stocks in the Atlantic Ocean, the Northern Gulf of Mexico stock, estimated to consists of 763 individuals (N_{min}=560) and the North Atlantic stock, underestimated to consist of 2,288 individuals (N_{min}=1,815). 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 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 to three United States stocks that occur in the Pacific, the California/Oregon/Washington stock, estimated to consist of 2,106 individuals (N_{min}=1,332), and the Hawaii stock, estimated to consist of 3,354 individuals (N_{min}=2,539). There are insufficient data to estimate the population abundance of the North Pacific stock. We are aware of no reliable abundance estimates specifically for sperm whales in the South Pacific Ocean, and there is insufficient data to evaluate trends in abundance and growth rates of sperm whale populations at this time. There is insufficient data to evaluate trends in abundance and growth rates of sperm whales at this time.

No reduction in numbers is anticipated as part of the proposed action. Therefore, no reduction in reproduction is expected as a result of the proposed action. Because we do not anticipate a reduction in numbers or reproduction of sperm whales as a result of the proposed research and enhancement activities, a reduction in the species' likelihood of survival is not expected.

The 2010 Final Recovery Plan for the sperm whale lists recovery objectives for the species. The following recovery objectives are relevant to the impacts of the proposed actions:

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

We do not expect any mortalities of the sperm whales from the proposed action. Although the effects analysis was done by separating the activities into distinct stressors, many of which along are not likely to adversely affect individual sperm whales, the stressors often occur together (e.g., an animal cannot be tagged without being approached by a research vessel). Considering the totality of the research and enhancement activities, individual animals may experience stress, minor injury from active acoustics, biopsy sampling, or tagging, or alter its behavior in some way. Under the proposed action, sperm whales (not necessarily individuals) will be subject to research and enhancement activities each year. Effects to individual sperm whales are expected to be short term (generally hours or days). Any injury from biopsy sampling is expected to heal within weeks. Tags are not expected to cause a hindrance to swimming because of the small size and mass of the tag compared to those of a sperm whale. Behavioral and physiological responses that may be exhibited by sperm whales upon tagging are expected to return to baseline within minutes of tag attachment. None of the research and enhancement activities are expected to result in any fitness consequence for individual North Atlantic right whales.

Because no mortalities or effects on the distribution of sperm whales are expected as a result of the proposed action, we do not anticipate the proposed research and enhancement activities will impede the recovery objectives for sperm whales. In conclusion, we believe the effects associated with the proposed action are not expected to cause a reduction in the likelihood of survival and recovery of sperm whales in the wild.

13.12 South Island Hector's Dolphin

No reduction in the distribution of South Island Hector's dolphins from the Pacific Ocean are expected because of the research and enhancement activities proposed for authorization under the NMFS Permits and Conservation Division's cetacean research permitting program.

The earliest reliable population abundance for South Island Hector's dolphins is from 1984/1985, with an estimated 3,274 South Island Hector's dolphins (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 through 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).

The South Island Hector's dolphin shows evidence of a population decline, which is thought to be primarily due to bycatch in commercial and recreational gillnets and trawls (Manning and Grantz. 2016). While changes in the management of New Zealand fisheries appear to have reduced some of the impacts from this threat, the sub-species is expected to continue to decline as a result of bycatch (Manning and Grantz 2016). Habitat modification and degradation due to development and industrial activities, and disease and tourism also pose a threat to the sub-species (Manning and Grantz 2016).

No reduction in numbers is anticipated as part of the proposed action. Therefore, no reduction in reproduction is expected as a result of the proposed action. Because we do not anticipate a reduction in numbers or reproduction of South Island Hector's dolphins as a result of the proposed research and enhancement activities, a reduction in the species' likelihood of survival is not expected.

There is currently no recovery plan for the South Island Hector's dolphin.

We do not expect any mortalities of the South Island Hector's dolphins from the proposed action. Although the effects analysis was done by separating the activities into distinct stressors, many of which along are not likely to adversely affect individual South Island Hector's dolphins, the stressors often occur together (e.g., an animal cannot be tagged without being approached by a research vessel). Considering the totality of the research and enhancement activities, individual animals may experience stress, minor injury from active acoustic playbacks, biopsy sampling, or tagging, or alter its behavior in some way. Under the proposed action, South Island Hector's dolphins (not necessarily individuals) will be subject to research and enhancement activities each year. Effects to individual South Island Hector's dolphins are expected to be short term (generally hours or days). Any injury from biopsy sampling is expected to heal within weeks. Suction-cup tags are not expected to cause a hindrance to swimming because of the small size and mass of the tag compared to those of a South Island Hector's dolphin. Behavioral and physiological responses that may be exhibited by South Island Hector's dolphins upon tagging are expected to return to baseline within minutes of tag attachment. None of the research and enhancement activities are expected to result in any fitness consequence for individual South Island Hector's dolphins.

Because no mortalities or effects on the distribution of the South Island Hector's dolphin population is expected as a result of the proposed action, we do not anticipate the proposed research and enhancement activities will impede the recovery objectives for South Island Hector's dolphins. In conclusion, we believe the effects associated with the proposed action are not expected to cause a reduction in the likelihood of survival and recovery of South Island Hector's dolphins in the wild.

14 Conclusion

After reviewing the current status of the ESA-listed species, the effects of the proposed action, any effects of interrelated and interdependent actions, and cumulative effects, it is NMFS' biological and conference opinion that the proposed action is not likely to jeopardize the continued existence of Cook Inlet DPS of beluga whales, blue whales, bowhead whales, Gulf of Mexico subspecies of Bryde's whales, Main Hawaiian Islands insular DPS of false killer whales, fin whales, Western North Pacific population of gray whales, Arabian Sea DPS of humpback whales, Cape Verde Islands/Northwest Africa DPS of humpback whales, Central America DPS of humpback whales, Mexico DPS of humpback whales, Western North Pacific DPS of humpback whales, Southern Resident DPS of killer whales, North Atlantic right whales, North Pacific right whales, sei whales, Southern right whales, sperm whales, and South Island Hector's dolphins.

15 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 (16 U.S.C. §1532(19)). "Harm" is further defined by regulation 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 (50 CFR §222.102). "Harass" is further defined as an act that "creates 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). 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.

All research activities associated with the issuance of scientific research permits involve directed take for the purposes of scientific research and is exempt under ESA section 10(a). Therefore, the NMFS does not expect the proposed action will incidentally take threatened or endangered species under ESA section 7(o)(2). However, we request that the NMFS Permits and Conservation Division report to us whether the average annual MMPA-authorized take specified in Table 18 actually occurs and the actual numbers of take in comparison to the permitted ESA and MMPA take numbers at the expiration of the permits, as well as any available information on the response animals exhibited to those takes. Such information will be used to inform the *Environmental Baseline* and *Effects of the Action* for future consultations for researchers and other similar research and enhancement activities permitted by the NMFS Permits and Conservation Division.

16 Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered 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 develop information (50 C.F.R. §402.02).

We make the following conservation recommendations, which will provide information for future consultations involving the issuance of permits that may affect ESA-listed cetaceans and proposed or designated critical habitat.

Programmatic Consultations

We recommend the NMFS Permits and Conservation Division continue to work collaboratively with the NMFS ESA Interagency Cooperation Division to explore opportunities for developing and consulting on scientific research permit programmatic consultations for other ESA-listed species and/or taxa (e.g., pinnipeds).

Coordination

We recommend the NMFS Permits and Conservation Division continue to work collaboratively with the NMFS Regional Offices to organize meetings and workshops to ensure that the results of all research programs or other studies on specific ESA-listed species are communicated and coordinated among the different investigators and other interested parties to coordinate research and enhancement activities among scientists within various regions with the same species or DPSs to reduce the potential for repeated disturbances concurrently or independently. Meeting participants should include regional species recovery coordinators, academic institutions, researchers, U.S. Fish and Wildlife experts, state agencies, and other stakeholders (see recommendations below for other suggestions to strengthen collaboration including tagging effectiveness data, data reporting and sharing, and database development and utilization).

We recommend the NMFS Permits and Conservation Division work collaboratively with permit holders and international researchers conducting research and enhancement activities to minimize duplicative efforts and/or additional potential stressors (e.g., deep-implantable tags) directed at ESA-listed cetaceans.

Effects of Invasive Tagging

We recommend the NMFS Permits and Conservation Division continue to require that all researchers who conduct invasive tagging of ESA-listed cetaceans provide detailed information in permit applications and annual reports on the responses they have observed. The level of detail and type of information provided in the application, supporting materials, and annual reports should help inform recommendations related to minimizing impacts of invasive tagging on ESA-listed cetaceans.

Results of Tagging

We recommend the NMFS Permits and Conservation Division gather data from researchers conducting invasive tagging of cetaceans to provide detailed information on how many tags were successfully deployed, how many tags were unsuccessfully deployed, how many tags failed to transmit entirely, and how many tags were delayed and for how long in transmitting after deployment. This should be provided as part of the annual reporting.

Aggregate Take Tracking

We recommend that the NMFS Permits and Conservation Division develop a system for tracking and evaluating the extent of take permitted and that which is observed for any given population of ESA-listed species. The NMFS Permits and Conservation Division's current permit tracking system allows tracking of individual permitted takes. However, for the purpose of understanding the extent of research at broad scales (e.g., number of research permits in a particular region), it remains difficult to quantify the extent of take each individual population of ESA-listed species may be subject to across permits for any given period of time. Such aggregate take tracking will better enable us to evaluate the impact of multiple, simultaneous research and enhancement efforts on ESA-listed species.

Reporting

We recommend the NMFS Permits and Conservation Division tailor the required reporting for research permits to include information that will aid managers in protecting and conserving ESA-listed species. In requiring researchers to provide annual reports, the NMFS Permits and Conservation Division is positioned to collect unprecedented, nationwide data on ESA-listed species. We recommend that the NMFS Permits and Conservation Division continue to request information on the effects of research and enhancement activities on ESA-listed cetaceans, and where possible, require applicants to provide quantitative data regarding the impacts of their research and enhancement activities on species. We also recommend that the NMFS Permits and Conservation Division require at least basic behavioral response reports from all relatively new research methods that will be permitted. For the purposes of this consultation, this will include AEP testing, remote ultrasound, exhaled breath sampling, and skin sampling because little information is available about how cetaceans respond to these research methods, and the use of unmanned aircraft systems.

We recommend the NMFS Permits and Conservation Division report takes on the effects of research and enhancement activities on ESA-listed cetaceans as part of annual reporting to us in an ESA context such as "harm" and "harassment" as defined in this consultation in addition to the MMPA context such as "Level A harassment," "Level B harassment," serious injury, and mortality.

Data Sharing

We recommend the NMFS Permits and Conservation Division work to establish protocols for data sharing among all permit holders. While many researchers in the community collaborate, having a national standard for data sharing among all researchers permitted by the NMFS could improve the quality of research produced. Data sharing will reduce impacts to trusted resources by minimizing duplicative research efforts. We recommend basic reporting information be required from each researcher including the species, location, number of individuals, and age, sex, and identity (if known) at the expiration of each permit. This information will further inform the tracking of impacts of multiple research and enhancement activities on ESA-listed cetaceans.

Tagging Database

We recommend that the NMFS Permits and Conservation Division consider requiring that researchers report radio and satellite tracking study data for the behavior and movement of tagged animals to tracking networks such as the multi-agency U.S. Animal Telemetry Network. These data tracking systems utilize data collected remotely via acoustic and satellite telemetry techniques to allow real-time tracking. Databases such as these will further assist NMFS Permits and Conservation Division and NMFS ESA Interagency Cooperation Division with information on tagging effectiveness (i.e., deployment and duration) as well as for NMFS to make future management decisions. Furthermore, data being readily accessible in this format will assist NMFS Permits and Conservation Division and NMFS ESA Interagency Cooperation Division with implementing the ESA and/or MMPA.

Sighting Database

We recommend the NMFS Permits and Conservation require permit holders to submit their monitoring data (i.e., visual sightings) by researchers to online databases such as the Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations so that it can be added to the aggregate marine mammal, seabird, sea turtle, and fish observation data from around the world. This will also encourage collaboration and further interactions among researchers under this programmatic consultation.

Designated Critical Habitat

We recommend that the NMFS Permits and Conservation Division should include terms and conditions in the scientific research permits to actively avoid, to the maximum extent practicable, proposed or designated critical habitat for Cook Inlet DPS of beluga whales, Main Hawaiian Islands insular DPS of false killer whales, Southern Resident DPS of killer whales, North Atlantic right whale, North Pacific right whale, Hawaiian monk seal, proposed Arctic subspecies of ringed seal, Western DPS of Steller sea lion, North Atlantic DPS of green turtle, hawksbill turtle, leatherback turtle, Northwest Atlantic Ocean DPS of loggerhead turtle, Gulf of Maine DPS of Atlantic salmon, salmonids in the Pacific Ocean, Carolina DPS of Atlantic sturgeon, Chesapeake DPS of Atlantic sturgeon, Gulf of Maine DPS of Atlantic sturgeon, New York Bight DPS of Atlantic sturgeon, South Atlantic DPS of Atlantic sturgeon, Southern DPS of green sturgeon, Gulf sturgeon, Puget Sound/Georgia Basin DPS of bocaccio and yelloweye rockfish, Southern DPS of eulachon, U.S. portion of range DPS of smalltooth sawfish, black abalone, elkhorn and staghorn coral, and Johnson's seagrass.

In order for NMFS's ESA Interagency Cooperation Division to be kept informed of actions minimizing or avoiding adverse effects on, or benefiting, ESA-listed species or their critical habitat, the NMFS Permits and Conservation Division should notify the NMFS ESA Interagency Cooperation Division of any conservation recommendations they implement in their final action.

17 Reinitiation Notice

This concludes formal consultation for the NMFS Permits and Conservation Division proposal to implement a program for the issuance of permits for research and enhancement activities on cetaceans. Since the cetacean research permitting program does not have a definitive sunset (or expiration) date, there is no pre-determined end date on this opinion. As discussed above (see Section 3.16), the dynamic and adaptive elements of the cetacean research permitting program (i.e., adaptive management approach) are critically important for reducing risk and avoiding jeopardy or adverse modification over time. The standard reinitiation triggers, which apply to all opinions, provide an additional safeguard against jeopardy or adverse modification over time.

As 50 C.F.R. §402.16 states, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if:

(1) The amount or extent of taking specified in the incidental take statement 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 ESA-listed species or designated critical habitat that was not considered in this consultation.
(4) A new species is listed or critical habitat designated under the ESA that may be affected by the action.

Each of these standard reinitiation triggers is discussed below in the context of this consultation.

As discussed in the *Description of the Proposed Action* (Section 3), the NMFS Permits and Conservation Division will work closely with the NMFS ESA Interagency Cooperation Division throughout implementation of its cetacean research 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 cetacean research permitting program is functioning overall, and determine whether new information indicates that the NMFS Permits and Conservation Division should request reinitiation of this programmatic consultation. The NMFS Permits and Conservation Division foresee regular reporting and periodic check-ins with the NMFS ESA Interagency Cooperation Division as an ongoing dialogue as part of the adaptive management of the cetacean research permitting program using the best available information.

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19 Appendices

19.1 Endangered Species Act/Marine Mammal Protection Act Application Instructions

The text below was taken directly from the proposed application instructions template provided to us in the consultation initiation package from the NMFS Permits and Conservation Division. Future application instructions may have minor changes that will not affect this programmatic consultation.

National Marine Fisheries Service

Marine Mammal Scientific Research and Enhancement Permit Application

OMB No. 0648-0084

Expires: 12/31/2019

Marine Mammal Scientific Research and Enhancement Permit Application

TABLE OF CONTENTS

Introduction

What is this application for?

- This application is for requesting a Marine Mammal Protection Act (MMPA) and Endangered Species Act (ESA) scientific research or enhancement permit to take[1], import, or export National Marine Fisheries Service (NMFS) protected marine mammals, including:
  - Cetaceans (dolphins, porpoises, and whales)
  - Pinnipeds (seals and sea lions)

What is this application not for?

- *Bona fide*[2] scientific research on non-ESA listed marine mammals for activities involving only Level B harassment[3] under the General Authorization
- Commercial or educational photography/filming of marine mammals
- Only importing, exporting, or receiving marine mammal parts
- Public display of marine mammals

Learn more about different types of permits.

When should I apply?

- ESA-MMPA permits: at least 1 year before your project will begin
- MMPA permits: at least 6 months before your project will begin

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[1] 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 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.

[2] Bona fide scientific research means research on marine mammals, conducted by qualified individuals, the results of which:

- are likely to be accepted for publication in a refereed scientific journal;
- are likely to contribute to the basic knowledge of the species biology or ecology; or
- are likely to identify, evaluate, or resolve conservation problems.

[3] Harassment means any act of pursuit, torment, or annoyance which--

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

What is the process for getting a permit?

1. Follow these instructions and contact the Permits and Conservation Division at 301-427-8401 with any questions.
2. Submit your application via APPS, our online permit system.
    a. An assigned permit analyst will contact you and review the application.
3. Address any questions on the application. To facilitate processing, reference the application File No. in all correspondence.
    a. Once complete, we will publish a notice in the *Federal Register*, which starts a mandatory 30-day public comment period.
    b. Concurrently, we will send your application to the Marine Mammal Commission and other subject matter experts in partner institutions and federal and state agencies for review.
    c. If needed, we will also request consultation under section 7 of the ESA to assess impacts to ESA-listed species. The ESA consultation can take up to 6 months.
4. Address any questions received during the comment period and consultation.
    a. We will then draft the permit and supporting documentation (including National Environmental Policy Act analyses and documentation of MMPA and ESA issuance criteria), which will be reviewed by various NMFS offices including a legal review by General Counsel.
    b. A Biological Opinion will be issued if ESA-listed species may be taken and adversely affected to determine if the activity will jeopardize the species or adversely modify critical habitat.
    c. The Office Director will make a final decision.

Important information

- If you do not follow these instructions, your application will be withdrawn and you will be asked to resubmit a new application that includes the information required.
- If we request additional information and do not receive it within 60 days, we may withdraw your application.
- Your permit may only authorize what is in your application; therefore, it must be a stand-alone document that describes all proposed activities even when you reference previous permits or published literature.
- When a question does not apply (i.e., N/A), explain why.
- Your application should be free of grammatical errors and readable to a lay person.
- Permit reports for current or previous permits must be up-to-date. Outstanding reports will delay processing of your new application.

- You are highly encouraged to contact us at 301-427-8401 with questions in advance of submitting your application.

How do I use APPS?

- Refer to Chapter 2 (“How to Use the System”).
- When starting from your portfolio, click on the link of your file number under the File Number column to take you to the application.
- **Save your application every 20 minutes or you will lose information!**
- You do not have to complete an application in one session. Your application will remain in draft mode until you submit.
- An * means it is a required field.
- If you cut and paste from Word, special characters and formatting may be lost.
- Attachments cannot be larger than 10MB – contact us if you have larger files.

Questions?

- Contact the Permits and Conservation Division at 301-427-8401.

APPLICATION INSTRUCTIONS

Project Information

File Number

- This number is automatically generated and cannot be changed. To facilitate processing, reference this File No. in correspondence with our office.

***Project Title** (up to 255 characters)

- Provide a concise title to include the activity, species (or taxa if multiple species), location, and purpose of the study. For example:
  - *Vessel surveys, sampling, and tagging cetaceans in the Gulf of Mexico to characterize population structure, forging ecology, and movement patterns.*

*Project Status

- The project status (New or Renewal) is automatically selected based on your answers in the pre-application guide (PAG). Do not change this field.

Previous Federal or State Permit

- If applicable, enter your most recent and closely related NMFS permit number. Otherwise leave blank. State permit numbers are not applicable.

***Permits Requested**

- One or more permit will be listed based on your answers in the PAG. If the options listed are incorrect, please call us at 301-427-8401 for assistance.

***Where Will the Activities Occur?**

- One or more general locations will be listed based on your answers in the PAG. If a location is incorrect, please call us at 301-427-8401 for assistance.

***Research Timeframe**

- Enter the desired start and end dates of the entire project in the following format: MM/DD/YYYY. The start date must not be prior to the date you submit the application and should be at least 6 months (MMPA) or 1 year (MMPA-ESA) after the date you submit. The end date must be within five years of the start date because permits are valid for a maximum of five years.

***Sampling Season/Project Duration** (up to 1,000 characters)

- Describe the annual field season(s) including the months and frequency of fieldwork (i.e., when and how many times per year/how frequently will you conduct your activities?). If this includes year-round research, indicate when activities are most likely to occur and how frequently.

***Abstract** (up to 2,000 characters)

- Federal regulations require the following information be published in the *Federal Register* Notice of Receipt that initiates a mandatory 30-day public comment period:
  - Purpose of the research or enhancement
  - Target and non-target species (common and scientific names)
  - Proposed take activities (e.g., vessel based surveys, remote biopsy sampling, tagging), import, or export
  - Numbers of animals to be taken or imported/exported or number of animals from which specimens will be imported/exported, by species or taxa, annually
  - Specific geographic locations of take and locations from which animals or samples will be imported or to where they will be exported, if applicable
  - Requested duration of the permit (the maximum is five years)

Project Description Page

***Project Purpose: Hypothesis/Objectives and Justification** (up to 64,000 characters)

- Discuss the **purpose** of your project including your hypotheses and/or objectives.

- Briefly **summarize published findings** related to your objectives. If you previously held or worked under a permit, use literature citations from that work to show how you previously met your objectives; or, use other published literature on the subject. Describe how this study is different from, builds upon, or duplicates past research

- If proposing **novel procedures**, include a discussion on results from pilot studies or studies on other species, if available.
- Explain how you determined your **sample size/take numbers**. For example, did you base your numbers on previous encounter rates or abundance estimates for your study area? If appropriate for your study, include a power analysis or other sample size estimation to show whether the sample size is sufficient to provide statistically significant or otherwise robust results appropriate for your study.
- The information above should **support how your proposed research is *bona fide***, including how the results of your research:
  - are likely to be accepted for publication in a refereed scientific journal;
  - are likely to contribute to the basic knowledge of the species biology or ecology; or
  - are likely to identify, evaluate, or resolve conservation problems.

For **ESA-listed and MMPA-depleted** species, also:

- Discuss why your project must involve ESA-listed or MMPA-depleted species.
- Discuss how your project will, as applicable:
  - contribute to the objectives identified in the species' recovery or conservation plan or otherwise respond to recommendations of a scientific body charged with management of the species;
  - contribute significantly to understanding the basic biology or ecology of the species; and/or
  - contribute significantly to identifying, evaluating, or resolving conservation problems.
- If your goals are to directly enhance the survival or propagation of an ESA-listed or MMPA-depleted species:
  - Explain how the project will:
    - contribute to maintaining or increasing distribution or abundance,
    - enhance the health or welfare of the species, and/or
    - ensure the recovery of the species in the wild.
  - If captive maintenance for enhancement is proposed, explain how you will:
    - maintain a viable gene pool,
    - increase productivity,
    - provide necessary biological information, or
    - establish animal reserves.
  - How does the benefit of removing animals from the wild into captivity outweigh alternatives that do not require removal from the wild? What

plans are in place for returning animals and any offspring to the wild? Justify maintaining animals in permanent captivity.

***Project Description** (up to 64,000 characters)

- **Your permit may only authorize what you describe in your application.**
- Provide a **brief overview** of a day in the field and the suite of activities you intend to perform on each animal during an encounter or capture event including where your work will happen, especially if different projects occur in different locations.
- **Methods**: Provide **clear descriptions of all methods** for each species, by MMPA stock or ESA Distinct Population Segment (DPS) where applicable, and the **number of animals by age class[4] and sex** you expect to take by each method/procedure **annually**.
- **The** methods must match what is in the take table**.**
  - There should be a narrative description for each Take Action[5], Observe/Collect Method[6], and Procedure[7] in the take table, and the take numbers and procedures in the narrative must match the table.
  - Reference take table lines that correspond to the methods, as needed.
  - If you have multiple projects, it is helpful to name them by project number or title and include project names in the Details column of the take table.
- Indicate the **number of times known individuals will be intentionally taken** in a year (e.g., recapture for instrument retrieval or multiple biopsy samples per year). If recapturing animals, indicate whether they will be immediately released without processing or fully or partially processed (i.e., what will be done to them on recapture).
- Indicate if some animals may be **unintentionally recaptured** in a year, and if so, how many and whether they will be immediately released without processing or fully or partially processed.
- If some animals will only get a **subset of procedures**, list them on separate rows in the take table and make sure it is clear in the narrative. Explain how you decide which animals receive which procedures.

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[4] Define how age classes (e.g., neonate, calf/pup, juvenile, subadult, adult) are differentiated, by taxa or species.

5 The Take Action is a generalized overview of how animals will be taken. You may only have one Take Action for each Take Row. Examples: Capture/handle release; Harass.

[6] The Observe/Collect Method is the method of observation (e.g., survey, vessel) or capture (e.g., net). Select only one observe/collect method per take table row.

7 Procedures are the individual activities you conduct on animals that have been captured/taken by a certain Take Action and Observe/Collect Method. Examples: sample, blood; external tagging.

- If working with **lactating females and dependent calves or pups**, indicate their minimum age (e.g., pups greater than five days of age without an umbilicus attached, calves greater than six months of age, females with calves less than six months of age). Indicate if working with pregnant females, and if so, estimated trimester. These life stages should be on separate rows in the take table.
- **Figures and photographs** are useful to illustrate your methods (e.g., tags and instrument attachments, nets and net deployment), especially for ESA consultations. You can attach them on the Supplemental Information page.
- Cite **references** for the methods where applicable, but do not substitute a literature citation for a complete description of the methods.
- Include a brief statement of the **purpose** of each procedure/how it relates to meeting your objectives.
- **Mitigation** measures that are standard protocols may be included in this section or in the Humane Take and Measures to Minimize Impacts section below.
- See table below for examples of information to include when describing your procedures/methods.

Take action/ procedures	**Details to include in methods**
Active acoustics	-Sound source (e.g., sidescan sonar, underwater speaker, acoustic deterrent device) -Source depth in water column -Frequency (bandwidth) -Maximum source level -Maximum received level -Distance to target and non-target animals -Signal duration and duty cycle -Duration of exposure -Ambient sound level, when known -Propagation loss model results, when available -Post playback monitoring
Administer drugs or other substances (e.g., stable isotopes)	-Name of each drug/chemical and its purpose -Name of any drug reversal -Emergency response drugs and protocols -Dosage of each drug/chemical -Delivery method and route (e.g., dart gun, inhalation, intramuscular, intravenous, subcutaneous, topical); if dart gun, distance of animal to water -Location of administration on body -Duration of drug -Personnel that would administer drug (e.g., veterinarian or veterinary technician; state license requirements) -Post drug administration monitoring

Take action/ procedures	Details to include in methods
Aerial and vessel surveys (manned)	-Type of survey craft and vessel -Type of survey (e.g., line transect, photogrammetry) -Number of surveys per year -Minimum and maximum altitude/approach distance -Air/vessel speed -Protocols for breaking track to ID species -Duration spent with group or individual/day
Aerial surveys using unmanned aircraft systems (UAS)	Same general questions above for aerial surveys and also the following: -Type of UAS – fixed wing or vertical takeoff and landing (VTOL) -Payload components – what is the UAS carrying and for what purpose? -Size and mass of UAS -Will the UAS ever be beyond the line of sight? -Does the device have an auto-return feature should the device fail? -Ground control station description (what it is, where it will be located - on shore or on vessel, number of stations, and how close the station will be to animals) -Spotter roles (e.g., one spotter monitoring the UAS, another for monitoring the ground control station) -Battery life -Do you have the appropriate FAA permits/authorizations (including pilot licenses)?
Auditory brainstem response or evoked potential	-Type of measurement equipment (suction cup or needle electrodes) -Emitted sounds -Handling/restraint methods (including anesthesia/sedation, see above) -Handling duration -Data collection and analysis method -Whether animal will be transported to a facility (complete the Transport Section in Take Table)
Capture and restraint	-Type of capture (e.g., hand, hoop net, trap) and gear description (e.g., net dimensions and mesh size) -Deployment methods (e.g., on foot or boat approach and net deployment) -Configuration, duration, and monitoring of net sets (how often net set is checked) -Number of animals captured at a time -Number of animals processed at a time -Anesthesia/sedation (see Administer Drugs above) -Dimensions and type of holding container -Number and roles of personnel (must be adequate to perform all activities without harming excess captured animals; else they must be released immediately) -Additional equipment or personnel necessary for capturing and handling excess numbers -Duration of restraint/holding from capture to release -If capturing females with calves/pups, describe how calves/pups would be held, whether procedures would be conducted on them, duration separated, and how they would be reunited -Release

Take action/ procedures	**Details to include in methods**
Export/import samples	-Type of sample (e.g., blood, muscle) -Country sending samples to, country of origin, or high seas -Designated port of entry/import or export -How sample/animal is taken in country of origin or high seas and legal take authority -Type of storage/shipping, including preservatives, etc. -Sample preservation and analysis -Re-import/export if samples remain after analysis
External instruments (a table is helpful for multiple tag types)	-Type of instrument -Location on body -Dimensions -Mass in air or water -Percentage of body mass -Size/age class of animals to receive each tag type -Maximum footprint/maximum number of tags/animal -Method of attachment (e.g., remote suction cup or dart barb fired from cross bow; restraint and epoxy or harness) -For remote deployment: • minimum approach distance and angle • number of attempts per animal/day (include total number of attempts needed for all work if requesting multiple procedures [e.g., tag and biopsy] on same animal during same encounter) -Dart sterilization -Dart or tag penetration depth -Will it be coated with antifouling paint? -Duration of attachment procedure -Duration of instrument retention on animal -Release mechanism or recapture to remove -Type of data collection (e.g., archival requiring retrieval) -How will you determine which animals receive which tags or more than one tag? -Post-tag monitoring
Internal instruments	-Type of instrument -Dimensions -Mass in air or water -Percentage of body mass -Size/age class of animals to receive an internal instrument -Location within body -Cleaning/sterile preparation -Insertion method (e.g., surgical implant, injection, stomach tube) -Local anesthetic or anesthesia/sedation (see Administer drugs) if applicable -Personnel that would implant tag (e.g., veterinarian or vet tech – see Personnel section below) -Prophylactic antibiotic use (see Administer drugs above) -Duration of insertion procedure -Duration of instrument retention -How stomach pills are voided -Type of data collection

Take action/ procedures	Details to include in methods
Intrusive sampling (e.g., blood, blubber, muscle, skin); remote or under restraint	-Type of tissues -Size or volume of sample (diameter and depth or total volume) -Location on body -Number of samples per animal per capture event and per year -Sampling intervals (e.g., for serial blood or biopsy samples) -Equipment (e.g., dart and stopper depth, needle, punch, scalpel) -Equipment disinfection -If restrained: cleansing site; left open or wound closure -If remote: • collection method (e.g., dart fired from rifle) • minimum approach distance • number of attempts per animal/day (include total number of attempts needed for all work if requesting multiple procedures [e.g., tag and biopsy] on same animal during same encounter) -Sample preservation and analysis
Marking (e.g., bleach, flipper tag, freeze brand, hot brand, paint, PIT tag)	-Type of mark -Location on body -Method of application -Disinfection procedures -Duration of mark (e.g., until molt) -Dimensions of tag or mark -Total number and combination of tags or marks on each animal
Non-intrusive sampling (e.g., behavioral observations via focal follows and ground surveys, breath sampling, collecting scat/spew, passive acoustic monitoring, photo-ID, photogrammetry, remote video monitoring, underwater photography)	-Approach method -Sampling method -Minimum and maximum approach distance -Within sight of animals or not (e.g., from a blind)? -Frequency of observations/sampling -Number of approaches/attempts per animal/day -Duration of observations/sampling/day -Data or sample collection and analysis -If conducting underwater photography/videography, specify the method (e.g., snorkeling, underwater pole cam, or divers that could use typical gear or rebreathers) and number of individuals in the water at a given time

- **Non-target species and conspecifics**: Indicate the estimated number and type of non-target species that may be encountered in your study area annually, and whether and how they may be incidentally harassed, captured, or otherwise affected. This includes but is not limited to conspecifics as well as other marine mammals and ESA-listed species such as sea birds and sea turtles.
    - Explain how you will avoid them or minimize impacts to them (e.g., not in area during time of study; would not approach closer than 100 meters; would halt operations until non-target species moved out of study area).

- For ESA species designated by DPS, specify the DPSs that are likely to be encountered.
- If takes to non-target animals may occur, include these on separate rows in the Take Table to include incidental take (e.g., harassment or capture) of non-target conspecifics or other species.

Project Supplemental Information

Attach a Supplemental Information File

- You may attach supplemental files here.

Status of the Affected Species (up to 2,000 characters)

- As applicable, indicate the status of the species or stock as follows:
  - ESA - threatened or endangered;
  - MMPA - depleted or strategic; and
  - Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) - Appendix I, I, or III

  Species information is available at the following web sites:

  NMFS species

  U.S. Fish and Wildlife species
  CITES

Lethal Take (up to 2,000 characters)

- If authorization for serious injury[8] or mortality[9] (euthanasia/intentional[10] or accidental/unintentional) is proposed:
  - What activities could result in mortality?
  - Explain why it's not feasible to use other methods that won't result in mortality.
  - If authorization for mortalities of ESA-listed or MMPA-depleted species is proposed, explain how the research will directly benefit the species or fulfill a critically important research need.
  - What is the maximum number of animals of each species/DPS and age class that could be seriously injured, unintentionally die, or be euthanized annually? Over the life of the permit?

[8] A serious injury is an injury that will more likely than not result in mortality.

[9] Caused by the presence or actions of researchers including but not limited to deaths or serious injuries sustained during capture and handling, while attempting to avoid researchers or escape capture, or resulting from infections related to intrusive procedures such as sampling or tagging. This does **not** include a fetus if a pregnant female dies.

[10] This includes unintentional euthanasia for humane reasons (e.g., due to serious injury during research).

- Justify the number of mortalities.
- How is euthanasia decided, conducted, and who conducts it?
- What are the protocols for necropsy and carcass disposal?
- What are the protocols for disposition of dependent pups or calves if lactating females may die as a result of your actions?

Anticipated Effects on Animals (up to 64,000 characters)

- Using the **best available science** (i.e., literature citations or other cited data sources) and your experience (e.g., personal communication), discuss how each take action and procedure listed in the take table (e.g., tissue sampling, marking, and instrumentation) will affect target and non-target animals (short-term and long-term).
- Include such things as typical **behavioral and physiological responses**, worst-case responses, % of animals that normally respond, how long it takes for animals to recover, and the time it takes wounds to heal.
- Also include an assessment of such things as:
    - condition of animals on recapture/resight
    - recovery from sedation and handling
    - post-release behavior (immediate and long-term)
    - repopulating rookeries/haul outs after flushing
    - healing from intrusive sampling
    - healing from intrusive tag deployments
    - tag retention
    - effects to lactating females and their dependent young
- For **novel procedures**, discuss the most likely anticipated responses based on literature from studies on other species, if available.
- Briefly summarize any **mortalities** that have occurred during the previous ten years of your permitted research using the same or similar techniques; include circumstances and cause of death.
- Discuss the anticipated **effects on the species or stock**, especially if mortalities or reproductive effects are possible. On what is your determination based?

Humane[11] Take and Measures to Minimize Negative Effects (up to 64,000 characters)

- **Humane determination**: Explain how you determined your methods involve the least possible degree of pain and suffering possible and why there are no feasible alternative methods to obtain the desired data or results.

[11] Humane means using the method that involves the least possible degree of pain and suffering possible.

- Where an IACUC (Institutional Animal Care and Use Committee) review is required[12], to support a humane determination under the MMPA and compliance with the Animal Welfare Act, attach
  - the IACUC protocols submitted
  - any IACUC comments or recommendations
  - the signed IACUC approval (or status of approval)
- **Mitigation and monitoring**: You may include mitigation and monitoring protocols here, or in the Project Description section or Anticipated Effects section above. If included in another section, simply reference the section where the following information is found:
- For each Take Action, Observe/Collect Method, and Procedure, describe your standard **mitigation to avoid or minimize the potential for adverse impacts** identified above.
- Describe your short- and long-term **post-procedure monitoring** protocols.
- If monitoring or mitigation is not feasible for specific procedures, species, situations, etc., explain why.
- **Research Coordination**: Describe how you collaborate or coordinate with other researchers in your action area. Who are they? Explain how this will occur and how it will minimize impacts. For example, will it involve sharing resources, samples or data; timing surveys to minimize disturbance, etc

Attach a References File

- Attach a **bibliography** of references cited in this application. Referenced materials must be made available upon request, as needed for evaluation of the application, or preparation of any necessary ESA or NEPA analyses.

****Resources Needed to Accomplish Objectives*** (up to 2,000 characters and attach files if necessary)

- Explain how your expertise, facilities, and resources are adequate to accomplish your proposed objectives and activities.

- Attach copies of any relevant formal research proposals, contracts, grant awards, or letters of agreement that would demonstrate financial or logistical resources.

- Indicate the status of any other international, federal, state, or local authorizations you have applied for, secured, or will apply for.

[12] Any marine mammal research that involves an invasive procedure, and which can harm or materially alter the behavior of the animals under study **requires an IACUC review and approval.** If an applicant does not have an IACUC, an alternate IACUC (e.g., of a Co-investigator or a local university/research institution) may be used.

***Disposition of Tissue Samples** (up to 2,000 characters)

- Indicate the disposition of any remaining samples after your project is complete.
  - State whether samples will be consumed in analysis, destroyed, or exported back to facility/researcher
  - If applicable, list the name and location of the person or institution that will store/curate samples. Indicate if you will retain legal custody of the archived samples or if you wish to permanently transfer the samples once your project is complete.

***Public Availability of Product/Publications** (up to 800 characters)

- Describe the end products of your proposed project and how they will be made available to the public.

Captive Information

If you will be working with animals in captivity (permanent or temporary), including removing animals from the wild into captivity and research or enhancement on captive or rehabilitating animals**,** address the following ***as applicable*** (explain if not applicable):

a) If removing animals from the wild, explain why removal is necessary and why you cannot obtain suitable animals from captive or rehabilitated stock.

b) If the source stock is to be beached/stranded marine mammals undergoing rehabilitation, indicate the name and location of the rehabilitation facility.

c) If the source stock is from animals already in captivity (other than animals in rehabilitation) indicate the name and location of the facility and, where possible, identify the specific animals (by NOAA ID number if applicable) to be involved in the proposed activity.

d) Attach a copy of any license or registration issued by the Animal and Plant Health Inspection Service (APHIS) of the U.S. Department of Agriculture, any outstanding variances granted, and the most recent APHIS inspection report.

e) Attach the protocol forms submitted to the appropriate Institutional Animal Care and Use Committee (IACUC) established under the Animal Welfare Act (AWA), the IACUC approval, and any comments and recommendations of the IACUC.

f) Attach a written statement from the responsible veterinarian or expert certifying that the facilities, methods of care and maintenance, and methods of transport will be adequate to ensure the well-being of the animals and will comply with all care and transport standards established under the AWA.

g) Describe the care and maintenance of the animals, including a complete description of the facilities where they will be maintained. This includes but is not limited to:
   - dimensions of the pools or other holding facilities

- number, sex, and age of animals by species to be held in each
- water supply, amount, and quality
- diet, amount and type
- sanitation practices.

h) Indicate whether a captive breeding program will be established and, if so, provide justification in accordance with the species conservation or recovery plan as applicable for enhancement activities. *For ESA-listed species*, indicate if you are willing to participate in a captive breeding program if requested by NMFS.

i) Indicate the disposition of captive animals at the termination of research or enhancement activities.

j) If release of captive animals to the wild is proposed, state the length of time the animals will be held, no matter how temporary, and describe the protocols for the release, including post-release monitoring protocols. Include in the release protocol mitigation for the following:
- disease transmission between released animals and the wild population
- potential genetic exchanges between introduced and endemic stocks
- ability of the released animals to forage and protect themselves from predators
- elimination of behavioral patterns acquired during captivity that could prove detrimental to the released animals or the social structure of local populations.

Project Locations

- You will first describe where you plan to work. Then, for each location, you will use the Take Table to list the species you expect to encounter and the take procedures you will conduct.

- Add New Location: provide information about one (or more) study areas
  - General area (ocean basin)
  - State(s), as applicable.

- Enter Location Details, as applicable:
  - Waterbody: enter names of rivers, estuaries, bays, etc.
  - Latitude and longitude of your study area
  - River miles (Begin Mile and End Mile)
  - Limits of your study area (e.g., to the U.S. EEZ, to the edge of the continental shelf, to 50m depth)
  - Names of land masses where research will occur (e.g., islands, rookeries).

- Attach File: Attach a high quality map(s) with the correct scale that clearly shows the location of your proposed activity and any environmental aspects of interest. If possible, include a shapefile, Google Earth kmz/kml, or ASCII text file with lat/long data and the associated basic metadata with your electronic application submission.

Take Table

The take table represents the **estimated** number of animals you may take **annually** during your research.

The options that appear in the dropdown menus in the take table are based on the species group you indicated in the Pre-application Guide and the location that you have selected. If you are having difficulties, please first check that the previous fields were entered correctly.

Columns you will fill out in the take table:

1) **Select**: Leave this box blank unless you need to copy, move, or delete the line following the instructions above.
2) **Species**: Use the drop down list to select. Species are listed alphabetically by common name and/or category (e.g., dolphin, bottlenose). If the species you are looking for is not on the drop-down menu, double check your location (species are populated based on location). If you are still having problems, contact us at 301-427-8401.
3) **Listing Unit/Stock**: Select the applicable ESA listing unit/stock. Choose Range-wide if, for example, your location has multiple stocks of the same species and you cannot distinguish between them while in the field.
4) **Production/Origin**: Select from the drop-down list. Categories include Wild, Captive, Rehabilitation Facility (for marine mammals only), or All.
5) **Life Stage**: Select from the drop-down list. You may enter take information for more than one life stage (e.g., adult versus juvenile) on separate rows or select a combination of life stages for one take category. Include specified ages (including minimum mass/age of pups and calves) if they differ for each procedure in the Details column.
6) **Sex**: Select from the drop-down list. If your activity targets only one sex, indicate which. If it targets both and they can be targeted separately, enter separate rows for male and female; otherwise select Male and Female.
7) **Expected Take**: This represents a reasonable estimate of the maximum number of individuals you will take, import, or export, annually.

For cetaceans, you will count every animal you approach[13] within a certain distance, regardless of whether a behavioral reaction has occurred.

[13] An "approach" is defined as a continuous sequence of maneuvers involving a vessel, including drifting, directed toward a cetacean or group of cetaceans closer than 100 yards for baleen and sperm whales and 50 yards for all other cetaceans.

- Only count 1 take per cetacean per day including all approaches in water and attempts to remotely sample (e.g., biopsy, breath sample, photograph, tag, or ultrasound).
- Count 1 take per cetacean per day for animals observed during sound playback trials.
- During manned aerial surveys flown at an altitude lower than 1,000 ft, count 1 take per cetacean observed per day, regardless of the number of passes over the same animal.
- During Unmanned Aircraft System (UAS) surveys, count 1 take per cetacean approached per day, regardless of the number of passes.

For pinnipeds, you will only count and report 1 take per pinniped per day for those that show movement[14] or flushing[15] (excluding alert[16]) to an approach or other permitted activity, regardless of the number of approaches and behavioral responses of the same individual in a day.

8) **Takes Per Animal**: Estimate the number of times the same individual will be taken annually, if known.

9) **Take Action**: The "take action" is a generalized overview of how animals will be taken. If more than one action is proposed, you must enter the takes on separate rows.

10) **Observe/Collect Method**: Select the method of observation (e.g., survey, vessel) or collection/capture. Select only one observe/collect method per row. If various methods will be used, you must provide take information in separate rows for each observe method.

11) **Procedures**: Provide specific information on the research activities that will be conducted. A separate pop-up window will appear with a species-specific list of activities. Hold down the Control key to select all activities to be performed concurrently. Choose Other if your proposed activity is not listed. In the Details box (see below), briefly describe what the Other means.

12) **Transport**: If you chose transport as a Procedure, enter information about the transport.

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[14] Movements in response to the source of disturbance, ranging from short withdrawals at least twice the animal's body length to longer retreats over the beach, or if already moving a change of direction of greater than 90 degrees.

[15] All retreats (flushes) to the water.

[16] Seal head orientation or brief movement in response to disturbance, which may include turning head towards the disturbance, craning head and neck while holding the body rigid in a u-shaped position, changing from a lying to a sitting position, or brief movement of less than twice the animal's body length.

a) **Mode(s) of transportation**: Describe the mode of transportation. Include a description of the vehicle or other platform used to transport animals.

b) **The name of the transportation company, if applicable, and the qualifications of the common carrier to transport live animals**: If a contractor or other entity will do the transportation, enter information in the box. Otherwise, click on N/A.

c) **Maximum length of time from capture to arrival at destination**: How long will the animals be in transport?

d) **Description of the container (e.g., cage, tank) used to hold the animal during transit**: Include the material of the container and its dimensions.

e) **Any special care procedures (e.g., moisture, medicines) to be administered during transport**: How will the animals be cared for during transport?

f) **A statement as to whether the animals will be accompanied by a veterinarian or some similarly qualified person**: If so, give the name, affiliation, contact information for each person.

g) **Destination**: Use the drop down list to select the destination. If your destination is not on the list, click on the "New Facility" button to add it. If the animals will be taken to a laboratory or aquarium, provide details of the location. If the animals will be released in another waterbody, provide details of the location.

h) **How will the animals be contained at the destination facility?**: Describe the containment system for the animals, quarantine procedures, and effluent treatment.

i) **The final disposition of the animals**: Describe, for example, whether the animal will be released or retained in permanent captivity.

13) **Begin Date**: Populated with the Begin Date you entered on the Project Information page. You may change the date to coincide with a specific project time shorter than the overall duration of the project. You cannot enter a date that is earlier than your original Begin Date.

14) **End Date**: Populated with the End Date you entered on the Project Information page. You may change the date to coincide with a specific project time shorter than the overall duration of the project. You cannot enter a date that is later than the End Date you previously entered.

15) **Details**: Enter up to 255 characters in this text box to provide details on each take table row. This is especially useful for clarifying age class, takes, specific activities, or projects.

National Environmental Policy Act (NEPA) Considerations

In addition to providing information on effects to the target and non-target species in other sections of the application, provide information as requested below on potential environmental effects to determine if your activity may be categorically excluded from the requirement to prepare an environmental assessment or environmental impact statement under NEPA. If you believe any of the criteria are "not applicable" you must explain why.

1) If your activities will involve equipment (e.g., scientific instruments) or techniques that are new, untested, or otherwise have unknown or uncertain impacts on the biological or physical environment, please describe the equipment and techniques and provide any information about the use of these in the natural environment. In addition, please discuss the degree to which they are likely to be adopted by others for similar activities or applied more broadly.
2) Describe the physical characteristics of your project location, including:
   a. Whether you will be working in or near unique geographic areas including but not limited to Critical Habitat for endangered or threatened species, Essential Fish Habitat, National Marine Sanctuaries, Marine Protected Areas, State or National Parks, Wilderness Areas, Wildlife Refuges, Wild and Scenic Rivers, etc.
   b. Next, discuss how your activities could impact the physical environment in those locations, such as by direct alteration of substrate during use of anchoring vessels or buoys, erecting blinds or other structures, or ingress and egress of researchers, and measures you will take to minimize these impacts.
   c. Is there potential to cause direct or indirect physical, chemical or biological alterations of the waters or substrate, including loss of, or injury to, benthic organisms (e.g., sea grass, corals), prey species and their habitat, and other ecosystem components? Could your actions reduce the quality and/or quantity of Essential Fish Habitat? If so, please provide additional details below:
      - What is the degree of alteration (low, medium, high)?
      - Approximately how much area (square footage) of habitat/substrate (e.g., seafloor, estuary or river bed) will be disturbed?
3) Briefly describe important scientific, cultural, or historic resources (e.g., archeological resources, animals used for subsistence, sites listed in or eligible for listing in the National Register of Historic Places) in your project area and discuss measures you will take to ensure your work does not cause loss or destruction of such resources. If your activity will target animals in Alaska or Washington, discuss measures you will take to ensure your project does not adversely affect

the availability (e.g., distribution, abundance) or suitability (e.g., food safety) of these animals for subsistence uses.

4) Discuss whether your project involves activities known or suspected of introducing or spreading invasive species, intentionally or not, (e.g., transporting animals or tissues, discharging ballast water, use of boats/equipment at multiple sites). Describe measures you would take to prevent the possible introduction or spread of non-indigenous or invasive species, including plants, animals, microbes, or other biological agents.

Project Contacts

As the person entering the application, you will automatically be assigned the following roles: **Applicant/Permit Holder, Principal Investigator,** and **Primary Contact**. See Chapter 2 for directions on how to change who is assigned to these roles, and the table below.

Project Contact	Must be named in the permit application	Able to make changes to application, request changes to the permit, and submit reports; will receive automatic emails from APPS.	Description of qualifications required
Applicant/ Permit Holder	✓	✓	✓
Applicant or Responsible Party*	✓	✓	
Principal Investigator	✓	✓	✓
Primary Contact	✓	✓	
Co-Investigator	✓		✓
Authorized Recipients	✓		
Research Assistants			

* The Applicant or Responsible Party may also be the PI or a CI if participating in the research; therefore, the description of qualifications is required if they are listed as the PI or a CI.

To prevent duplicate entries, **you MUST ALWAYS SEARCH the database for the person before entering a new contact.** To facilitate the search, start with only putting the last name in APPS search box.

A project must have a **Responsible Party** if the Applicant/Permit Holder is an organization, institution, or agency. The Responsible Party or Applicant/Permit Holder is an official who has the legal authority to bind the organization, institution, or agency and is ultimately responsible for the activities of any individual operating under the authority of the permit.

The **Principal Investigator** (PI) is the individual primarily responsible for the take, import, export, and any related activities conducted under the permit. There can only be one PI on a permit. The PI:

- must have qualifications, knowledge and experience relevant to the activities authorized by the permit
- must be on site during activities conducted under the permit unless a Co-Investigator is present to act in place of the PI
- may also be the Applicant/Permit Holder and Primary Contact.

Co-investigators (CIs) are individuals who are qualified and authorized to conduct or directly supervise activities conducted under a permit without the on-site supervision of the PI.

- You may add CIs to the application if the PI will not always be present during the permitted activities.
- CIs can also be added or removed once a permit has been issued.

Authorized Recipients (ARs) are persons or institutions authorized to receive samples for the purposes of analysis or curation related to the objectives of your permit. The PI and CIs may also be ARs. ARs should not be CIs if they are only performing the analysis and are not overseeing the study or publishing the results (i.e., they are only providing an analytical service).

Include a table listing the names of the PI and CIs, and the specific procedures they will oversee or conduct. **Attach the following table on the Supplemental Information page**.

Example Table Attachment: Personnel Roles

Name/Affiliation	Role	Activities
Researcher name, Affiliation, City, State	Principal Investigator, Co-investigator, or Authorized Recipient	Specific activities they will conduct under the permit and whether they are supervising
John Smith, Ph.D., University A, City, State	Principal Investigator and Authorized Recipient	Supervise and perform all activities under the permit
Jane Smith, Institution B, City, State	Co-investigator	All activities excluding anesthesia during captures and UAS
Jane Doe, Ph.D., Institution C, City, State	Co-investigator	Conduct photo-ID
John Doe, Ph.D., University D, City, State	Co-investigator and Authorized Recipient	Collect remote skin/blubber biopsy samples and create cell lines
Laboratory E, City, State	Authorized Recipient	Receive subset of skin/blubber samples for DNA sequencing

Qualifications and Experience

Federal Regulations require that persons authorized as the PI or CIs have qualifications commensurate with their duties. In addition, the names of the PI and CIs are sent to the NOAA Office of Law Enforcement to determine if any violations of the MMPA or ESA and other environmental laws have occurred.

The permit applicant is therefore required to submit the following information about the qualifications and experience of the PI and all CIs to demonstrate they have qualifications commensurate with their duties as stipulated in the Personnel Table. **A CV or resume must be up to date and contain all relevant information below**. If sufficient experience is not provided, additional information will be required and the personnel will not be authorized to conduct the proposed activities unless sufficient experience is demonstrated.

1) **Contact information -** All documentation submitted will be publicly available. **DO NOT include personal information** (e.g., social security number, date of birth, nationality, or home phone/ address-unless it is also the business phone/address).
   - Name (first middle last)
   - Business phone, e-mail, and mailing address
2) **Relevant education and training**
   - Degree, major, name of institution, year received
   - Applicable certificates or licenses, year received
   - Other relevant training or certification, year received
3) **Relevant experience**
   - Job title, affiliation/location, and dates of relevant experience
   - Detailed description of when and how the individual obtained training and experience in the methods they will be conducting and/or supervising as outlined in the Personnel Table. This should include objective metrics such as:
     - The specific level of training received and who trained them
     - The number of hours/months/years they have been performing the activities
     - Which and how many procedures they have performed successfully and on what species/age class (this is especially important for intrusive procedures such as blood and biopsy sampling, intrusive tagging, etc.)
     - Whether and to what extent they have performed the activities without supervision or supervised the proposed activities
     - What permits they have been PI or CI under and for what species and activities
4) **List of grants awarded demonstrating available resources relevant to the proposed activities or history of securing resources for similar work**

5) **Annotated publication history relevant to the activities being conducted under the permit**

Submit Application

See Chapter 2 for how to submit your application and check on its status.

ADDITIONAL INFORMATION

Under section 104(c) of the MMPA and section 10(a)(1)(A) of the ESA, persons may be authorized to take marine mammals and threatened and endangered species, respectively, for purposes of scientific research or enhancing the survival of the species. Interested persons are required to submit an application in accordance with the Acts and the implementing regulations at 50 CFR part 216, subpart D, and 50 CFR part 222. These instructions for applying for a research or enhancement permit are drawn from, but do not substitute for, ESA regulations and MMPA regulations. Read the full text of the MMPA, including Section 104. Read ESA section 10(a)(1)(A). Under NEPA, Federal agencies must assess the effects of federal actions on the environment. Under section 7 of the ESA, Federal agencies must ensure that the permitted activities will not jeopardize the continued existence of the species or result in adverse modification of critical habitat.

Paperwork Reduction Act Statement

The information requested in this application is required and is used to determine whether the activities described in the application are consistent with the purposes and policies of the Acts and their implementing regulations. **Public reporting burden for this collection of information is estimated to average 50 hours per response**, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to the Chief, Permits and Conservation Division, Office of Protected Resources, F/PR1, NOAA/National Marine Fisheries Service, 1315 East-West Highway, Silver Spring, MD 20910. All permit documentation, including the application, permit and amendments, reports, inventory information, and any other associated documents are considered public information and as such, are subject to the Freedom of Information Act. Notwithstanding any other provision of the law, no person is required to respond to, nor shall any person be subject to a penalty for failure to comply with, a collection of information subject to the requirements of the Paperwork Reduction Act, unless that collection of information displays a currently valid OMB Control Number.

OMB No. 0648-0084; Expires: 12/31/2019

19.2 Endangered Species Act/Marine Mammal Protection Act Permit Issuance Criteria Checklist

The text below was taken directly from the proposed permit issuance criteria checklist template provided to us in the consultation initiation package from the NMFS Permits and Conservation Division. Future permit issuance criteria may have minor changes that will not affect this programmatic consultation.

Application Review Checklist for ESA Sections 10(a)(1)(A) and 7 and MMPA Section 104

The following criteria in Table 1 are evaluated during the permit process for each application processed under the programmatic to determine whether the applicant has demonstrated how it meets the ESA/MMPA permit issuance criteria in 50 CFR Parts 216 and 222 (see Chapter 1).

Table 1. Documentation of Issuance Criteria/Requirements for Each Permit Application Under the Cetacean Programmatic.

Criterion	**Met? (Y/N)**	**Explain**
Application Requirements		
Followed instructions and used current OMB-approved version		
Application signed by appropriate person (Applicant or Responsible Party verifying information is true and correct)		
Application Requirements and Information for Section 7 Consultation		
Objectives are tied to recovery priorities (see issuance criteria below)		
Methods and geographic area are described in sufficient detail to evaluate potential effects by species/age/sex/ location including critical habitat		
Sample size is justified/ reasonably likely to occur		
Best available science is used to discuss possible adverse impacts and how they would be minimized or mitigated		
Proposed mitigation and monitoring is appropriate to minimize and evaluate effects of research		

Have applied for, secured, or will apply for funding; and/or, have demonstrated record of securing funding		

Criterion	**Met? (Y/N)**	**Explain**
Issuance Criteria the Office Director Considers		
The permit has been “applied for in good faith:” i.e., the applicant has demonstrated their intent to act consistently with the requirements of the ESA, MMPA, regulations, and permit conditions; their capability is consistent with what they purport to accomplish; they have acted in good faith in the past (e.g., submitting permit reports and not violating previous permits)		
Would further a *bona fide*[1] and necessary or desirable scientific purpose; or enhance survival		
Results would contribute to recovery plan objectives or otherwise respond to recommendations of a scientific body charged with management of the species; or contribute significantly to understanding the basic biology or ecology of the species; or contribute significantly to identifying, evaluating, or resolving conservation problems.		
Proposed activities cannot be conducted using an alternative species or stock (not listed)		
The activity is humane and does not present any unnecessary risks to the health and welfare of marine mammals; for invasive procedures, the Applicant has an established IACUC and approval has been granted or will be granted		
Personnel have adequate qualifications to carry out the proposed action		
Expert opinions have been considered and addressed		
The proposed activity will not operate to disadvantage of and will not have a significant impact on listed species (i.e., fits within the scope of the programmatic and all methods have been analyzed and appropriate mitigation and monitoring will be implemented)		

[1] Likely to be accepted for publication in a refereed scientific journal; or likely to contribute to the basic knowledge of the species biology or ecology; or likely to identify, evaluate, or resolve conservation problems.

19.3 Endangered Species Act/Marine Mammal Protection Act Permit Template for Cetacean Research

The text below was taken directly from the proposed permit template provided to us in the consultation initiation package from the NMFS Permits and Conservation Division. The final permit may have minor changes that will not affect this programmatic consultation.

Permit No. XXXXX-0X

Expiration Date: month dd, yyyy
Reports Due: month dd, annually

PERMIT TO TAKE PROTECTED SPECIES[5] FOR SCIENTIFIC AND/or ENHANCEMENT PURPOSES

I. Authorization

This permit is issued to Name of Permit Holder, Affiliation, address with city, state, and zipcode, (hereinafter "Permit Holder;" Responsible Party: Name, Ph.D.), pursuant to the provisions of the Marine Mammal Protection Act of 1972 as amended (MMPA; 16 U.S.C. 1361 *et seq.*); the regulations governing the taking and importing of marine mammals (50 CFR Part 216); the Endangered Species Act of 1973 (ESA; 16 U.S.C. 1531 *et seq*.); the regulations governing the taking, importing, and exporting of endangered and threatened species (50 CFR Parts 222-226); and the Fur Seal Act of 1966 (16 U.S.C. 1151 *et seq*.).

II. Abstract

The objectives of the permitted activity, as described in the application, is/are to [briefly summarize objectives from application. Note: it is not necessary to list or summarize the research methods or activities here (that's what the Take Tables are for), just the objectives of the study.].

[5] "Protected species" include species listed as threatened or endangered under the ESA, and marine mammals.

III. Terms and Conditions

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. Duration of Permit

1. Personnel listed in Condition C.1 of this permit (hereinafter "Researchers") may conduct activities authorized by this permit through month dd, yyyy. 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 permitted activities and the Permit Holder or Principal Investigator must contact the Chief, NMFS Permits and Conservation Division (hereinafter "Permits Division") for written permission to resume:

    a. If serious injury or mortality[6] of protected species occurs.

    b. If authorized take[7] is exceeded in any of the following ways:

        i. More animals are taken than allowed in Tables X of Appendix 1.
        ii. Animals are taken in a manner not authorized by this permit.

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[6] This permit does not allow for unintentional serious injury and mortality caused by the presence or actions of researchers up to the limit in Table X of Appendix 1. 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. [Use as applicable]

[7] 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 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.

iii. Protected species other than those authorized by this permit are taken.

c. Following incident reporting requirements at Condition E.2.

d. At the end of each permit year/field season (i.e., December 31). Annual re-authorization will be based on evaluation of the report (see Condition E.2) and may be denied or delayed if the report has not been received or approved. Authorization for each year's research does not guarantee or imply that NMFS will authorize subsequent years' activities.

3. The Permit Holder may continue to possess biological samples[8] acquired[9] under this permit after permit expiration without additional written authorization provided a copy of this permit is kept with the samples and they are maintained as specified in this permit.

B. Number and Kinds of Protected Species, Locations and Manner of Taking

1. The tables in Appendix 1 outlines the authorized species and stock or distinct population segment (DPS) authorized; 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. 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 1 as needed to document the permitted activities, provided the collection of such images or recordings does not result in takes.

3. The Permit Holder may use visual images and audio recordings collected under this permit, including those authorized in Table X of Appendix 1, 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.

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[8] Biological samples include, but are not limited to: carcasses (whole or parts); and any tissues, fluids, or other specimens from live or dead protected species; except feces, urine, and spew collected from the water or ground.
[9] Authorized methods of sample acquisition are specified in Appendix 1.

XXXXX. This statement must accompany the images and recordings in all subsequent uses or sales.

4. The Chief, Permits Division may grant written approval for personnel performing activities not essential to achieving the research objectives (e.g., a documentary film crew) to be present, provided:

   a. The Permit Holder submits a request to the Permits Division 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 for the purpose of such non-essential activities will not be allowed to participate in the permitted activities.

   d. The Permit Holder and Researchers do not require compensation from the individuals in return for allowing them to accompany Researchers.

5. Researchers must comply with the following conditions related to the manner of taking:

<u>Counting and Reporting Takes</u>

   a. Count and report a take of a cetacean or pinniped following the guidance below regardless of whether you observe a behavioral response to the permitted activity.

   b. During unmanned aircraft system (UAS) and manned aerial surveys flown at an altitude lower than 1,000 feet, count and report 1 take per cetacean or pinniped observed per day, regardless of the number of passes.

c. For all cetacean approaches[10] in water and attempts to remotely biopsy, tag, and ultrasound, count and report 1 take per cetacean per day.

   i. If all Level A harassment biopsy or tagging attempts on a single day are unsuccessful and do not make contact with the animal, count the take against your Level B harassment take row.

   ii. If any Level A harassment attempts on a single day are unsuccessful but do make contact with the animal, count the take for the day against your sampling or tagging take row.

d. For pinnipeds in the water: count and report 1 take per day for any pinniped that Researchers approach within 50 yards

   i. Do not count pinnipeds that approach Researchers.

   ii. Do not count takes of pinnipeds when transiting between research locations.

e. For pinnipeds encountered on land, count 1 take per pinniped per day based on behavioral responses:

   i. Count movements greater than 2 body lengths; and

   ii. Count changes of direction greater than 90 degrees.

   iii. If you are working on land and pinnipeds are in the water, do not count them unless you see an adverse behavioral response from your activities.

f. Count and report 1 take per cetacean or pinniped per day for animals observed during sound playback trials.

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[10] An "approach" is defined as a continuous sequence of maneuvers involving a vessel, equipment, or researcher's body, including drifting, directed toward a cetacean or group of cetaceans closer than 100 yards for baleen and sperm whales and 50 yards for all other cetaceans and pinnipeds.

General Mitigation

g. Approach animals cautiously and retreat if behaviors indicate that the approach may interfere with reproduction, feeding, or other vital functions.

h. [Only for ESA species with an NLAA determination for Level B research activities and No ESA take]

Immediately terminate efforts if animals exhibit avoidance and/or evasive behaviors.

i. Where females with calves are authorized to be taken:

   i. Immediately terminate efforts if animals exhibit signs that the activity may be interfering with pair-bonding or other vital functions;

   ii. Do not position the research vessel between the mother and calf;

   iii. Approach mothers and calves gradually to minimize or avoid any startle response;

   iv. Discontinue an approach if a calf is actively nursing; and

   v. Whenever possible, sample the calf first to minimize the mother's reaction when sampling mother/calf pairs.

Aerial Surveys

j. Aerial flights must not be conducted over pinnipeds on land.

Manned Aerial Surveys

k. Researchers must conduct manned aerial surveys at an altitude of XXX feet with the exception of [identify species] surveys, which can be flown at XXX feet. The aircraft may descend to no lower than XXX feet for [insert purpose, e.g., photo-identification] for x species.

l. To comply with ESA regulations (50 CFR 224.103) prohibiting approaches within 500 yards of North Atlantic right whales without a permit, this permit authorizes right whale aerial surveys flown at 1,000 feet (333 yards) or above. Take numbers are not required for these surveys at or above 1,000 feet. Takes are required for surveys below 1,000 feet and circling at 500 feet.

Unmanned Aircraft Systems (UAS)

m. Researchers may use up to one/two fixed wing/vertical take-off and landing unmanned aircraft system(s) (UAS) at one time.

n. Researchers must operate UAS at an altitude of XXX feet with the exception of [identify species] surveys, which can be flown at XXX feet. The UAS may descend to no lower than XXX feet for [insert purpose, e.g., photo-identification] for x species.

o. [For permits that authorize 2 UAS at one time]
When operating two UAS at the same time, one unit may be flown lower to [purpose (e.g., breath samples)]. The second UAS must be flown at an altitude of x feet or higher, for [purpose (e.g., monitoring; or to provide a more encompassing perspective of the target animal and other cetaceans in the area)].

Active Acoustics

Playbacks

p. [Insert specific sound sources, received level authorized, and time limits, based on request. See Examples below.]

[Example 1: For non-impulsive single source studies]

Non-impulsive sound source limit = [type of sound (e.g., killer whale calls)] at XX dB received level. Playbacks are limited to X minutes cumulatively over the course of a day (24 hrs).

[Example 2: For impulsive single source studies- check with applicant and PR2 to determine type of sound source.]

Impulsive sound source limit = [type of sound e.g., xx] at XX dB received level. Playbacks are limited to X minutes cumulatively over the course of a day (24 hrs).

[Example 3: For more complex acoustic studies with multiple sound sources (e.g., broad science center studies)]

For playback series using both impulsive and non-impulsive sound sources, Researchers must determine the accumulated energy of the entire exposure of the playback series in cumulative sound exposure level (SEL_{cum}) and then evaluate the exposure level based on the lower impulsive threshold (and resulting in larger isopleth). Additionally, when auditory weighting functions are incorporated based on the spectra associated with an impulsive or non-impulse source, researchers must incorporate the auditory weighting functions for whichever spectrum lead to the smaller adjustment (and resulting in the larger isopleth).

q. The received level of the entire playback series accumulated over the course of a day must be less than the permanent threshold shift (PTS; Level A) onset of all marine mammal species expected in the area during the playback (i.e., all hearing groups; target and non-target species) following the current acoustic thresholds in the 2016 NMFS Technical Guidance.

i. [Example 1: If a single sound source is defined in the application. Analysts may add zones by individual source.]

The zones for Level A and Level B take are defined as follows:

- Level A zone = x m

- Level B zone = x m

[Example 2: For scenarios where zones cannot be calculated in advance, or in the case of multiple sound sources]

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.

ii. To prevent injury, Researchers must continuously monitor the Level A harassment exclusion zone for the sound source, and the trial must be shut down if any animals approach within the Level A harassment exclusion zone.

r. A playback sequence must be discontinued if an animal exhibits repetitive strong adverse reactions to the playback activity or the vessel.

Target Animals and Age-classes

s. [placeholder for additional limits based on the nature of the request (e.g., trials per day based on known individuals, no exposure for calves, etc.)]

Non-targets

t. Playbacks must not be initiated and must be immediately shut down if non-target protected species are observed within the Level A or B zones, identified above in Condition B.5.n., except where authorized for playbacks in Appendix 1.

Echosounders for Prey Mapping [include in permit when intentionally used in the presence of cetaceans]

u. The received level of echosounder exposure for prey mapping studies must not exceed Level A harassment guidelines following the current acoustic thresholds.

Underwater Filming/Photography

v. No more than 2 snorkelers/divers may be in the water at one time during research. Contact the NMFS Permits Division for approval of additional snorkelers/diver(s).

w. Research Assistants may be snorkelers/divers and conduct underwater activities only if they are trained photographers, videographers, or safety divers.

x. Terminate an underwater approach/activity if a cetacean exhibits adverse or evasive changes in behavior.

Research in Washington State and/or Research on Humpback Whales in Hawaii

y. Vessels engaged in research activities in Washington State inland waters and Hawaii must fly a clearly visible triangular pennant at all times. The pennant must be yellow with minimum dimensions of 18"H x 26"L and with the permit number displayed in 6" high black numerals.

Killer Whales in Washington State inland waters

z. To the maximum extent possible, no more than one marine research vessel may be within 200 yards of the same individual or group of Southern Resident killer whales at the same time.

aa. UAS activities must be separated by at least 5 miles and may not target the same Southern Resident killer whale individuals or groups of animals concurrently.

bb. To comply with ESA regulations (50 CFR 224.103) prohibiting vessel approaches within 200 yards of killer whales in the inland waters of Washington without a permit, this permit authorizes approaches within 200 yards of killer whales for scientific research. Take numbers are not required under this permit for these approaches between 200 to 50 yards. Takes are required for approaches within 50 yards of killer whales, and must be counted and reported as indicated at Condition B.5.b. See Condition E.x for additional reporting requirements.

General Conditions for Remote Procedures (Biopsy sampling, Breath Collection, Tagging, Ultrasound)

cc. Researchers may attempt (deploy or discharge/fire) each procedure on an animal up to 3 times a day.

dd. Discontinue an attempt to [biopsy sample, breath sample, tag, or ultrasound] if an animal exhibits repetitive, strong, adverse reactions to the activity or vessel.

Data Collection and Sharing

ee. To the maximum extent possible, Researchers must collect photos or high-resolution video simultaneously when [biopsy sampling, and tagging] to identify the individual and the sampling/tagging location on each individual.

ff. [Consult with PR2 on a case-by-case basis for species specific requirements]

[For example:]Researchers must report information on tagged [insert species] to the Permits Division and the Marine Mammal Health and

Stranding Response Program (MMHSRP) following Permit Condition E.2.

Protocol Modifications

gg. The Permit Holder or Principal Investigator (PI) must notify the

Permits Division before implementing any change to protocols to determine if additional authorization is required. This may include, but is not limited to:

i. Modifications to sterilization or IACUC requirements,

ii. Increases in a biopsy tip's size or depth of penetration, or

iii. Increases in a tag's mass, footprint, or number of anchors.

Biopsy Sampling

Biopsy Sterilization and Disinfection

hh. Biopsy tips must be sterile[11] before every use. Sterilization must follow your [Institutional Animal Care and Use Committee (IACUC) approved protocol/ the protocol provided in Appendix 3].

i. Researchers can reuse contaminated[12] tips that are only disinfected[13] (vs sterile) as a last resort during the same field trip. High level disinfection[14], may include 10% bleach for at least 20 minutes or similar high-level disinfection solution[15] (e.g., 6% hydrogen peroxide or 2% glutaraldehyde).

Target Animals and Age-classes

ii. [Placeholder to specify age classes/sex that may sampled or how based on the request.]
EXAMPLE: Researchers may biopsy sample adults, juveniles, and calves greater than approximately [1 year old] and females accompanied by these calves. However, Researchers must not biopsy sample a calf less than approximately 1 year old or a female accompanied by a calf less than 1 year old.

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[11] Sterilization = destroys or eliminates all forms of microbial life and is carried out by physical or chemical methods (CDC 2008). These methods must follow the IACUC-approved protocol for sterilization (e.g., gas or cold sterilization).
[12] Contaminated = e.g., missed attempt, contacts seawater, physical contact, etc.

[13] Disinfection = eliminates many or all pathogenic microorganisms, except bacterial spores, on inanimate objects usually by liquid chemicals (CDC 2008).
[14] High level disinfection can destroy all microbes, with the exception some bacterial spores.
[15] FDA 2015. FDA-Cleared Sterilants and High Level Disinfectants with General Claims for Processing Reusable Medical and Dental Devices - March 2015. Available online here: https://www.fda.gov/MedicalDevices/DeviceRegulationandGuidance/ReprocessingofReusableMedicalDevices/ucm437347.htm

jj. Before attempting to biopsy sample an individual, Researchers must take reasonable measures (e.g., compare photo-identifications) to avoid unintentional repeated takes of any individual.

Sampling Location and Frequency

kk. Do not attempt to biopsy sample a cetacean anywhere forward (cranial) of the pectoral fin.

ll. [Placeholder to specify intentional resampling of known individuals based on the request.]
EXAMPLE: [species name] may be biopsy sampled up to X times over the course of a year.

Tagging

Tagging Sterilization

mm. Invasive tag anchors (darts, pins, bolts, etc.), and deep-implant tags must be sterile[7] before every use. Sterilization must follow your Institutional Animal Care and Use Committee (IACUC) approved protocol.

i. Researchers must cease tagging efforts if all sterile tag [anchors or deep-implant tags] are contaminated[8].

nn. Handling or manipulation of the sterile tag anchors or deep-implant tags before deployment should be performed with sterile surgical gloves or other sterilized equipment.

Target Animals and Age-classes

oo. [Placeholder for species that may NOT be tagged based on the request and the programmatic limits.]

EXAMPLE 1: Dart/barb tags are not authorized for Southern Resident killer whales.

EXAMPLE 2: Deep-implant tags are not authorized for [list out sensitive small populations to be authorized in permit e.g., Cook Inlet beluga whales, Gulf of Mexico Bryde's whales, North Atlantic right whales, Main Hawaiian Islands false killer whales, and Southern Resident killer whales].

pp. [Placeholder to specify age classes/sex that may be tagged or how based on the request and the programmatic limits.]
EXAMPLE: Researchers may tag adults, juveniles and calves greater than approximately [1 year old] and females accompanied by these calves. However, Researchers must not tag a calf less than approximately 1 year old or a female accompanied by a calf less than 1 year old.

qq. Before attempting to tag an individual, Researchers must take reasonable measures (e.g., compare photo-identifications) to avoid unintentional repeated takes of any individual.

rr. Avoid invasive tagging of animals in obviously poor health or exhibiting species-specific body condition parameters indicating compromised health such as, but not limited to:

i. Noticeable reductions in body mass in the post-cranial region (i.e., exhibiting a nuchal fat pad depression);

ii. Prominent vertebral column;

iii. Visible ribs;

iv. Excessive skin lesions, parasites or cyamids;

v. Behaving abnormally;

vi. Obviously pregnant; or

vi. Otherwise compromised individuals.

Tagging Location and Frequency

ss. Avoid tagging a cetacean anywhere forward (cranial) of the pectoral fin or below (ventral) the lateral vertebral processes.

tt. [Placeholder for tag combinations, re-tagging/sampling as authorized]

Example 1: Researchers may deploy up to x tags at one time on the same animal with the exception that only one unit is a deep-implant tag, unless expressly authorized.

Example 2: Researchers must not intentionally re-tag an individual animal with a dart/barb tag/ deep-implant tag within the same permit year.

Post-tag Monitoring

uu. Researchers must make reasonable efforts to opportunistically monitor animals instrumented with invasive tags (dart/barb and deep-implant) through tracking and resightings (photographic/video or genetic) to assess:

i. The location on the body and condition of the tag (including breakage);

ii. Tag wound reaction and healing (e.g., severity of swelling, depressions, and coloration);

iii. Animal health and behavior;

iv. Fecundity (presence of calf); and

v. Survival.

vv. Results of post-tag monitoring must be provided in annual reports as indicated in Conditions at E.x.

[Additional Species-Specific Conditions for Adaptive Management for Small Populations]

For Gulf of Mexico Bryde's Whales

ww. The Permit Holder must receive written authorization from the Permits Division prior to conducting research activities that will result in take of Gulf of Mexico Bryde's whales (see Condition A.2.c).

xx. Researchers must attempt to collect photos or high-resolution video simultaneously when biopsy sampling or tagging to identify the individual and the sampling location on each individual. Also see Condition F.4 for data sharing requirements to send photos and video to the NMFS Southeast Fisheries Science Center's (SEFSC) photo-ID database.

yy. Before attempting to biopsy sample or tag an individual Gulf of Mexico Bryde's whale, Researchers must take reasonable measures (e.g., compare photographs, when possible) to avoid repeated sampling/tagging of any individual, unless specifically authorized.

zz. For biopsy sampling, each individual Gulf of Mexico Bryde's whale may be biopsy sampled once per year. Also see Condition F.4 for requirements to send a subsample of the biopsy to the SEFSC.

ab. For tagging, each individual Gulf of Mexico Bryde's whale may receive no more than two tags (one dart/barb tag and one suction-cup tag) per year.

i. Both tags may be attached at the same time or during separate events.

ii. Known individuals that have been dart tagged must not be intentionally dart/barb tagged a second time within the same calendar year.

ac. Researchers may biopsy sample and tag an individual on the same day.

Non-target Species

ad. This permit does not authorize takes of any protected species not identified in Appendix 1, including those species under the jurisdiction of the United States Fish and Wildlife Service (USFWS). Should other protected species be encountered during the research activities authorized under this permit, researchers must exercise caution and remain a safe distance from the animal(s) to avoid take, including harassment.

Cetaceans

ae. North Atlantic Right Whales

i. If a right whale is seen, Researchers must maintain a distance of at least 460 meters (500 yards) from the animal.

ii. Report all right whale sightings to the NMFS Sighting Advisory System:

A. In any location to the U.S. Coast Guard on channel 16.

B. From VA to ME to (978) 585-8473.

C. From NC to FL to (904) 237-4220.

af. Humpback Whales in Hawaii and Alaska: If a humpback whale is observed in the area, Researchers and vessels must maintain:

i. In Alaska: a distance of at least 91.4 meters (100 yards).

ii. In Hawaii: a distance of at least 91.4 meters (100 yards) and aircraft must maintain a distance of at least 300 meters (1,000 feet).

ag. Killer whales in Washington State inland waters: If a killer whale is seen, Researchers must maintain a distance of at least 183 meters (200 yards) and may not intercept a whale or position the vessel in its path.

Pinnipeds

ah. Researchers must not conduct any activities on pinniped rookeries until after the peak pupping season.

ai. Hawaiian Monk Seals: To minimize disturbance of Hawaiian monk seals:

i. Consult with the NMFS Hawaiian Monk Seal Research Program and either the U.S. Fish and Wildlife Service (USFWS) at Midway or the State of Hawaii Department of Land and Natural Resources (DLNR) at Kure for approval of any land-based activities.

ii. Do not enter the water when monk seals are present, and if approached by a seal, leave the area.

iii. Report any opportunistic monk seal sightings to the NMFS Pacific Islands Fisheries Science Center, Hawaiian Monk Seal Research Program, NOAA IRC, 1845 WASP Blvd, Building 176, Honolulu, HI 96818, as follows:

A. In the main Hawaiian Islands: Tracy Mercer; Tracy.Mercer@noaa.gov; phone (808) 725-5718; fax (808) 725-5567.

B. In the Northwestern Hawaiian Islands: Thea Johanos; Thea.Johanos-Kam@noaa.gov; phone (808) 725-5709; fax (808) 725-5567.

aj. Steller sea lions: To avoid taking Steller sea lions:

i. Do not approach within 92 meters (100 yards) of a Steller sea lion in the water or hauled out on land.

ii. Remain at an altitude of 3,000 feet while flying over any major Steller sea lion haulouts and rookeries listed in 50 CFR 223.202.

iii. Maintain an altitude of at least 1000 feet (304.8 meters) when flying over all other known Steller sea lion terrestrial habitat (rookeries and haulouts) and associated aquatic zones during periods when Steller sea lions are likely to be present.

iv. Maintain a vessel distance of at least 3 nautical miles (5.5 kilometers) of a Steller sea lion rookery site listed in 50 CFR 223.202.

v. Do not discharge a firearm at or within 100 yards (91.4 meters) of a Steller sea lion.

vi. Do not approach on land not privately owned within one-half statutory miles (0.8 kilometers) or within sight of a Steller sea lion rookery site listed in 50 CFR 223.202.

vii. Do not approach on land not privately owned within one and one-half statutory miles (2.4 kilometers) or within sight of the eastern shore of Marmot Island.

6. The Permit Holder must comply with the following conditions and the regulations at 50 CFR 216.37, for biological samples acquired or possessed under authority of this permit.

a. The Permit Holder is ultimately responsible for compliance with this permit and applicable regulations related to the samples unless the samples are permanently transferred according to NMFS regulations governing the taking and importing of marine mammals (50 CFR 216.37) and the regulations governing the taking, importing, and exporting of endangered and threatened species (50 CFR 222.308).

b. Samples must be maintained according to accepted curatorial standards and must be labeled with a unique identifier (e.g., alphanumeric code) that is connected to on-site records with information identifying the following:

i. Species and, where known, age and sex;
ii. Date of collection, acquisition, or import;
iii. Type of sample (e.g., blood, skin, bone);
iv. Origin (i.e., where collected or imported from); and
v. Legal authorization for original sample collection or import.

c. Biological samples belong to the Permit Holder and may be temporarily transferred to Authorized Recipients identified in Appendix 2 without additional written authorization, for analysis or curation related to the objectives of this permit. The Permit Holder remains responsible for the samples, including any reporting requirements.

d. The Permit Holder may request approval of additional Authorized Recipients for analysis and curation of samples related to the permit objectives by submitting a written request to the Permits Division specifying the following:

i. Name and affiliation of the recipient;

ii. Address of the recipient;

iii. Types of samples to be sent (species, tissue type); and

iv. Type of analysis or whether samples will be curated.

e. The Permit Holder may grant written approval to additional Authorized Recipients for analysis and curation of samples related to the permit objectives. The Permit Holder must maintain a record of the transfer including the following:

i. Name and affiliation of the recipient;

ii. Address of the recipient;

iii. Types of samples sent (species, tissue type); and

iv. Type of analysis or whether samples will be curated.

f. Sample recipients must have authorization pursuant to 50 CFR 216.37 prior to permanent transfer of samples and transfers for purposes not related to the objectives of this permit.

g. Samples cannot be bought or sold, including parts transferred pursuant to 50 CFR 216.37.

h. After meeting the permitted objectives, the Permit Holder may continue to possess and use samples acquired under this permit, without additional written authorization, provided the samples are maintained as specified in the permit and findings are discussed in the annual reports (See Condition E.3).

7. Researchers must comply with the following conditions related to methods of captive supervision, care, and transportation:

a. Marine mammals used in captive research [or for captive enhancement activities] in the U.S. must be maintained in U.S. Department of Agriculture, Animal and Plant Health Inspection Service (APHIS) registered research facilities and/or licensed public display facilities and

b. No marine mammal authorized under this permit may be released into the wild unless such a release has been authorized under an amendment to this permit or a separate scientific research/enhancement permit issued for that purpose.

c. Prior to transport of any animal authorized under this permit (transfer, receipt, import, or export):

i. The Permit Holder must have a travel plan documented at the permitted facility, and the animal must be accompanied by a health certificate signed by the attending veterinarian within 10 days of the transport;

ii. The Permit Holder must submit a completed Marine Mammal Transfer/Transport Notification Form (attached) 15 days prior to transport; and

iii. The U.S. Department of Agriculture, APHIS must approve the facility receiving the animal, pursuant to the AWA (9 CFR Part 3).

d. [Transports/import/re-export] The Permit Holder is authorized to export and return any imported animal to its originating facility provided that written notification is provided to the Office Director at least 15 days in

e. [Transports only] Animals must be transported into the U.S. in accordance with the Animal Welfare Act (AWA) regulations, "Specifications for the Humane Handling, Care, Treatment, and Transportation of Marine Mammals" (9 CFR Part 3, Subpart E). An emergency kit must accompany animals during transport. All transports must be done by qualified personnel experienced in pinniped/cetacean handling and medical procedures.

f. The Permit Holder must ensure that the authorized research/ enhancement has been reviewed and approved by the appropriate facilities' Institutional Animal Care and Use Committees (IACUC) in accordance with AWA regulations, and a copy of the signed approval and any comments on the protocols is received by the Permits Division.

g. Public display conditions:

[Display/Research permit] Any public display of animals authorized under this permit must be conducted incidental to and not interfere with the scientific research, conducted in a manner consistent with provisions applicable to public display, and approved by the Director, Office of Protected Resources. Such incidental public display may only occur as part of an educational program. A portion of this program must describe the research activities. The marine mammals maintained under the authority of this permit must not be trained for performance or included in any interactive program with the public.

<u>Non-intrusive research pursuant to an enhancement permit</u>

h. Pursuant to 50 CFR 216.41, non-intrusive scientific research activities as described in the application may be conducted (e.g., behavioral observations, husbandry sampling) at the discretion of the attending veterinarian. These activities must occur incidental to the permitted enhancement and must not interfere with survival or recovery objectives.

i. Any scientific research studies not described in the application will require authorization through amendment(s) to this permit. Detailed protocols for individual research projects must be submitted for review to the Sea World, Inc. Institutional Research Committee, an attending veterinarian and/or the applicable Institutional Animal Care and Use Committee, and NMFS, Office of Protected Resources for approval.

j. All non-intrusive research activities described in the application must be conducted, to the maximum extent possible, concurrent with the routine care and husbandry of the animal.

Specific Captive Research/Enhancement Conditions [use only as applicable]

k. All procedures must be conducted in the least intrusive manner possible and, whenever possible, concurrent with the routine care and husbandry of the animals.

l. Researchers must closely monitor the subject animals to determine if research/enhancement activities are having an adverse effect on the individuals. Researchers must halt and re-evaluate the research/enhancement should animals exhibit signs of excessive stress, pain, or suffering resulting from the authorized activities. The attending veterinarian must be available for emergencies, illnesses, and for treating any health problems associated with the authorized procedures.

m. Researchers must use sterile disposable sampling tools to the maximum extent practicable.

n. Researchers must thoroughly disinfect and clean all non-disposable equipment between animals and, as needed, immediately prior to each use.

C. Qualifications, Responsibilities, and Designation of Personnel

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 – [name].

   b. Co-Investigators –See Appendix 2 for list of names and corresponding activities.

   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 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.

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 or PI may add CIs 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. If a CI will only be responsible for a subset of permitted activities, the request must also specify the activities for which they would provide oversight.

8. Where the Permit Holder is an institution/facility, 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.

9. Submit requests to add CIs or change the PI by one of the following:

   a. The online system at https://apps.nmfs.noaa.gov;

   b. An email attachment to the permit analyst for this permit; or

   c. A hard copy mailed or faxed to the Chief, Permits Division, Office of Protected Resources, NMFS, 1315 East-West Highway, Room 13705, Silver Spring, MD 20910; phone (301)427-8401; fax (301)713-0376.

D. Possession of Permit

1. This permit cannot be transferred or assigned to any other person.

2. The Permit Holder and 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. Reporting

1. The Permit Holder must submit incident and annual reports containing the information and in the format specified by the Permits Division.

a. Reports must be submitted to the Permits Division by one of the following:

i. The online system at https://apps.nmfs.noaa.gov;

ii. An email attachment to the permit analyst for this permit; or

iii. A hard copy mailed or faxed to the Chief, Permits Division.

b. You must contact your permit analyst for a reporting form if you do not submit reports through the online system.

2. Incident Reporting

a. If a serious injury or mortality occurs, or authorized takes have been exceeded as specified in Conditions A.2 and B.x, the Permit Holder must:

i. Contact the Permits Division by phone (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. 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 serious injury or research-related mortality or exceeding authorized take.

c. To assist in monitoring the [insert species- e.g., North Atlantic right whale] population and current unusual mortality event, any time Researchers [dart or deep-implant] tag an animal, they must report the tagging to the Permits Division and the MMHSRP (nmfs.mmhsrp.headquarters@noaa.gov) within 24 hours. The notification must include:

i. Date tagging occurred;

ii. Location tagging took place (latitude and longitude);

iii. Identification of the individual NARW (if known at the time, or provide within 1 week of individual identification);

iv. Location of the tag on the body; and

v. Photograph(s) of the tag placement.

3. Annual reports describing activities conducted during the previous permit year (from month/day to month/day) must:

   a. Be submitted by [insert date here and at top of first page] each year for which the permit is valid, and

   b. Include a tabular accounting of takes and a narrative description of activities and their effects.

   c. Summarize how animals reacted to specific procedures. 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 reactions to each procedure. For more details go here: https://www.fisheries.noaa.gov/national/endangered-species-conservation/reports-protected-species-permits.

   d. Provide data on Southern Resident killer whale behavioral responses to approaches between 200 and 50 yards, and within 50 yards.

   e. Researchers must report in annual reports results of post-invasive tagging monitoring (as outlined in B.5.x) to include photographs, video.

4. A joint annual/final report including a discussion of whether the objectives were achieved must be submitted by (insert date), or, if the research concludes prior to permit expiration, within 90 days of completion of the research.

5. 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.

6. For the purposes of monitoring and annual reauthorization of Gulf of Mexico Bryde's whale research, the Permit Holder must submit a separate annual report

to the Permits Division on research conducted on this sub-species for January – December, by December 31st 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 Condition B.5.m) and retention time of any tags;

f. Progress made toward meeting your objective(s), 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.

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 work 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)*: nmfs.pir.research.notification@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; phone (727)824-5312; fax (727)824-5309

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. Researchers must coordinate their 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.

G. Observers and Inspections

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. Modification, Suspension, and Revocation

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[16] 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

   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 216 and 50 CFR 222-226 is subject to civil and criminal penalties, permit sanctions, and forfeiture as authorized under the MMPA, ESA, and 15 CFR Part 904.

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[16] 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.

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;

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.

______________________________	___________________
Donna S. Wieting Director, Office of Protected Resources National Marine Fisheries Service	Date Issued
______________________________	___________________
[name of Permit Holder or Responsible Party] [permit holder's/RP's title and institution] Permit Holder /or/ Responsible Party	Date Effective

Appendix 1: Tables Specifying the Kind(s) of Protected Species, Location(s), and Manner of Taking

Line	Species	Stock/ Listing Unit	Life Stage	No. Takes[17]	Take Action	Procedures	Details

[17] Takes = the maximum number of animals, not necessarily individuals, that may be targeted for research annually for the suite of procedures in each row of the table.

Appendix 2: NMFS-Approved Personnel and Authorized Recipients for Permit No. XXXXX-0X.

The following individuals are approved to act as Co-Investigators pursuant to the terms and conditions under Section C (Qualifications, Responsibilities, and Designation of Personnel) of this permit.

Name of Co-Investigator	Activities
Dr. John Smith	Aerial surveys
Dr. Jane Doe	All research activities

Biological samples authorized for collection or acquisition in Table(s) X of Appendix 1 may be transferred to the following Authorized Recipients for the specified disposition, consistent with Condition B.6 of the permit:

Authorized Recipient	Sample Type	Disposition

Researchers name, affiliation, City, State	Whole blood and serum	Analysis and curation of remaining samples
Researcher’s name, affiliation, City, State	Blubber	Analysis (samples consumed in analysis)

Appendix 3: Requirements for Sterilization and Disinfection of Biopsy Tips

[Recommended protocol for sterilization and high-level disinfection of biopsy tips for applications that do not have an IACUC, or for applications where the approved IACUC protocol does not meet the definition of sterile.]

Sterilization

Biopsy tips must be sterile[1] before each use (see Condition B.x). For sterilization, the biopsy tips must be cleaned with soap and water, soaked in a 10% bleach solution for at least 20 minutes, rinsed, and sterilized with gas or in an autoclave. Sterilized biopsy tips must be kept in individual sterilized packages until use, and any manipulation of the tips after the sterilization must be conducted wearing gloves.

High-level Disinfection[18]

If the biopsy tip becomes contaminated and is no longer sterile, you must use a new sterile biopsy tip (see Condition B.x). In the rare event that a new sterile biopsy tip is not available, high-level disinfected tips may be used.

For high-level disinfection, the biopsy tips must be cleaned with soap and water, soaked in a 10% bleach solution for at least 20 minutes (or similar high-level disinfection solution[19], e.g., 6% hydrogen peroxide or 2% glutaraldehyde), rinsed, allowed to air dry or dried with a sterile cloth, and then placed in sterile packaging until use. Disinfected biopsy tips must be kept in individual packages until use, and any manipulation of the tips must be conducted wearing gloves. High-level disinfection solutions should be changed weekly or per manufacturer directions.

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[18] High level disinfection can destroy all microbes, with the exception some bacterial spores.

[19] FDA 2015. FDA-Cleared Sterilants and High Level Disinfectants with General Claims for Processing Reusable Medical and Dental Devices - March 2015. Available online here: https://www.fda.gov/MedicalDevices/DeviceRegulationandGuidance/ReprocessingofReusableMedicalDevices/ucm437347.htm

19.4 Endangered Species Act/Marine Mammal Protection Act Permit Annual Report Form

The text below was taken directly from the proposed permit annual report form template provided to us in the consultation initiation package from the NMFS Permits and Conservation Division. Future permit annual report forms may have minor changes that will not affect this programmatic consultation.

PROTECTED SPECIES PERMIT REPORT FORM

The following questions will appear in your reports in APPS at https://apps.nmfs.noaa.gov.

PART I: TAKE TABLE.

Enter the actual number of animals taken during this annual reporting period.

Take tables appear here with a column to be filled for "Actual number of animals taken."

If you conducted activities or took protected species which you were not authorized, you must enter those takes on separate lines of the table. Explain what happened in Part II, #4 below.

PART II: NARRATIVE.

Review Section E of your permit to ensure you address any specific questions related to your activities.

Provide complete answers to the best of your ability. If a question is not applicable, explain why. We acknowledge that monitoring during and after certain activities is often opportunistic.

1. What progress did you make toward **meeting your objectives** this year? Summarize what

you did and if and how you met your objectives. List citations for any reports, publications, and presentations from this reporting period. We may request electronic copies. *(10,000 characters maximum)*

2. Summarize **how animals reacted** to specific procedures. 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 reactions. *(64,000 characters maximum)*

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/novel procedures
- time it takes to resume normal in-water 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 handling and post-release behavior
- healing at site of intrusive sampling (e.g., biopsy)
- healing at site of intrusive tag deployment (e.g., surgical tag implants requiring sutures, remotely deployed dart/barb, fully implantable, medial ridge, and pygal tags)
- tag retention and tag breakage

4. Did **serious injuries or mortalities** occur **or** did you **take a protected species you were not permitted** to take? If so, and you already submitted an incident report, please briefly describe the event here and refer to the incident report. *(10,000 characters maximum)*

If such an incident occurred and you have not yet reported it, provide a full description of the incident (date and location of event; species and circumstances of how the take occurred; photographs; necropsy and histopathology reports, or other information to confirm cause of death or extent of injuries; etc.). Also, include steps that were or will be taken to reduce the possibility of it happening again. *(10,000 characters maximum)*

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. What efforts did you make to **coordinate** with the applicable NMFS Regional Office(s) and **collaborate** with other researchers? How did you collaborate (for example, avoiding field work at the same time or working together on the same animals, sharing vessels, sharing data)? *(10,000 characters maximum)*

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 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 research 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)

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)*

19.5 Example of Active Acoustic Analysis using National Marine Fisheries Service Revised Marine Mammal Acoustic Technical Guidance

Appendix 5: Example of active acoustic analysis using NMFS revised marine mammal acoustic technical guidance															
IMPULSIVE	SEL_{cum} = RMS + 10 log (duration, sec)														
	RECEIVED LEVEL	120 dB (RMS)		130 dB (RMS)		140 dB (RMS)		150 dB (RMS		160 dB (RMS)		170 dB (RMS)		180 dB (RMS)	
Hearing Group	**Threshold (SEL)**	**Max duration of exposure* (seconds)**	**Max duration * (minutes)**	**Max duration of exposure* (seconds)**	**Max duration * (minutes)**	**Max duration of exposure* (seconds)**	**Max duration* (minutes)**	**Max duration of exposure* (seconds)**	**Max duration* (minutes)**	**Max duration of exposure* (seconds)**	**Max duration* (minutes)**	**Max duration of exposure* (seconds)**	**Max duration* (minutes)**	**Max duration of exposure* (seconds)**	**Max duration* (minutes)**
LF Cetaceans	183	1995262.31	33254.37	199526.23	3325.44	19952.62	332.544	1995.26	33.254	199.53	3.3254	19.95	0.333	2.00	0.033254
MF Cetaceans	185	3162277.66	52704.63	316227.77	5270.46	31622.78	527.046	3162.28	52.705	316.23	5.2705	31.62	0.527	3.16	0.052705
HF Cetaceans	155	3162.28	52.70	316.23	5.27	31.62	0.527	3.16	0.053	0.32	0.0053	0.03	0.001	0.00	0.000053
Phocid Pinnipeds	185	3162277.66	52704.63	316227.77	5270.46	31622.78	527.046	3162.28	52.705	316.23	5.2705	31.62	0.527	3.16	0.052705
Otariid Pinnipeds	203	199526231.50	3325437.19	19952623.15	332543.72	1995262.31	33254.372	199526.23	3325.437	19952.62	332.5437	1995.26	33.254	199.53	3.325437
	Possible Criteria	Unlimited at 120 dB		Unlimited at 130 dB		Max 5.5 h at 140 dB		Max 30 min at 150 dB		Max 3 min at 160 dB					
		50 min for HF		5 min for HF		30 sec for HF		3 sec for HF		(except HF)					
To not exceed Level B (160 dB, intermittent sources, like impact pile driving, airguns, blasts): Received level has to be below 160 dB AND cannot exceed any PTS criteria above															
PEAK Thresholds	RECEIVED LEVEL														
Hearing Group	**Threshold (PK)**	These thesholds have no weighting and are not cumulative (i.e., only exceed once for no matter how long & it is take)													
LF Cetaceans	219	If it is an impulsive source, applicant must evaluate both SEL and PK threshold & use whichever produces largest isopleth													
MF Cetaceans	230														
HF Cetaceans	202														
Phocid Pinnipeds	218														
Otariid Pinnipeds	232														
NON-IMPULSIVE	SEL_{cum} = RMS + 10 log (duration, sec)														
	RECEIVED LEVEL	120 dB (RMS)		130 dB (RMS)		140 dB (RMS)		150 dB (RMS		160 dB (RMS)		170 dB (RMS)		180 dB (RMS)	
Hearing Group	**Threshold (SEL)**	**Max duration of exposure* (seconds)**	**Max duration * (minutes)**	**Max duration of exposure* (seconds)**	**Max duration * (minutes)**	**Max duration of exposure* (seconds)**	**Max duration* (minutes)**	**Max duration of exposure* (seconds)**	**Max duration* (minutes)**	**Max duration of exposure* (seconds)**	**Max duration* (minutes)**	**Max duration of exposure* (seconds)**	**Max duration* (minutes)**	**Max duration of exposure* (seconds)**	**Max duration* (minutes)**
LF Cetaceans	199	79432823.47	1323880.39	7943282.35	132388.039	794328.23	13238.804	79432.82	1323.8804	7943.28	132.388	794.33	13.239	79.43	1.324
MF Cetaceans	198	63095734.45	1051595.57	6309573.44	105159.557	630957.34	10515.956	63095.73	1051.5956	6309.57	105.160	630.96	10.516	63.10	1.052
HF Cetaceans	173	199526.23	3325.437	19952.62	332.544	1995.26	33.254372	199.53	3.3254372	19.95	0.333	2.00	0.033	0.20	0.003
Phocid Pinnipeds	201	125892541.18	2098209.02	12589254.12	209820.902	1258925.41	20982.09	125892.54	2098.209	12589.25	209.821	1258.93	20.982	125.89	2.098
Otariid Pinnipeds	219	7943282347.24	132388039	794328234.72	13238803.9	79432823.47	1323880.4	7943282.35	132388.04	794328.23	13238.804	79432.82	1323.880	7943.28	132.388
	Possible Criteria	Unlimited for all groups		Unlimited at 130 dB		Unlimited at 140 dB		Max 17.5 h at 150 dB		Max 1.75 h at 160 dB		Max 10 min at 170 dB		Max 1 min at 180 dB	
				5.5 h for HF		30 min for HF		3 min for HF		19 sec for HF		2 sec for HF		(except HF)	
To not exceed Level B (120 dB, continuous sources, like vibratory pile driving): Received level has to be below 120 dB.															
To not exceed Level B (160 dB, intermittent sources, like pingers, sonar): Received level has to be below 160 dB AND cannot exceed any PTS criteria above															