DRAFT

SUPPLEMENTAL

ENVIRONMENTAL IMPACT STATEMENT/OVERSEAS ENVIRONMENTAL IMPACT STATEMENT

For

Surveillance Towed Array Sensor System Low Frequency Active Sonar Training and Testing in the Western North Pacific and Indian Oceans

APPENDICES

May 2025

APPENDIX A Public and Agency Involvement

In accordance with the National Environmental Policy Act (NEPA) and United States Department of the Navy (Navy) regulations and guidance, the public is invited to participate in the NEPA process. Additionally, the Navy is required to coordinate and consult with other federal agencies and tribal governments under various environmental statutes and Executive Orders. This appendix describes the efforts to involve the public in preparing this Supplemental Environmental Impact Statement/Overseas Environmental Impact Statement (SEIS/OEIS), including distribution of the Draft SEIS/OEIS.

A.1 Project Website

A public website was established to provide the public with project information and includes public notices, project fact sheets, maps, NEPA process, and previous SURTASS LFA environmental compliance documentation. The public was able to submit comments via the website. The project website is https://www.nepa.navy.mil/surtass-lfa/.

A.2 Scoping Period

The Navy published a Notice of Intent (NOI) to prepare a SEIS/OEIS in the Federal Register on August 21, 2024 (89 FR 67630). The Navy solicited public and agency comments during a scoping period from August 21, 2024 through September 19, 2024.

Public Scoping Comments

The scoping comments could be submitted via the project website or by mail. The Navy received a total of two scoping comments; both were letters received from federal agencies. These letters are shown in Figure A-1 and Figure A-2. The Navy considered these comments when developing this draft SEIS/OEIS.

REGION 9

SAN FRANCISCO, CA 94105

September 17, 2024

John Burke
Department of the Navy, Pacific Fleet Environmental Readiness
250 Makalapa Drive
Pearl Harbor, Hawaii 96860

Subject: EPA Comments on the Notice of Intent to Prepare a Supplemental Environmental Impact Statement/Overseas Environmental Impact Statement for Pacific Surveillance Towed Array Sensor System Low Frequency Active Sonar Training and Testing

Dear John Burke:

The U.S. Environmental Protection Agency has reviewed the above-referenced document pursuant to the National Environmental Policy Act, Council on Environmental Quality regulations (40 CFR Parts 1500-1508), and our NEPA review authority under Section 309 of the Clean Air Act. The CAA Section 309 role is unique to EPA. It requires EPA to review and comment on the environmental impact on any proposed federal action subject to NEPA's environmental impact statement requirements and to make its comments public.

The U.S. Navy proposes to continue utilizing Surveillance Towed Array Sensor System (SURTASS) Low Frequency Active (LFA) sonar training and testing activities in large portion of the western North Pacific Ocean and eastern Indian Ocean. The Proposed Action would include utilizing SURTASS LFA on the Navy's four surveillance ships and may potentially include the addition of new ships while decommissioning older ships. The timeframe for the project would be approximately seven years, which is the length of the Marine Mammal Protection Act incidental take permit for cetaceans.

The NOI invites public input on the scope of the environmental analysis, alternatives, and environmental concerns. Our detailed comments on these and other topics are attached. We also understand that the Navy and the National Oceanic and Atmospheric Administration (NOAA) are currently updating the Marine Mammal Acoustic Technical Guidance. We highly encourage the Navy to adopt latest science in the Draft SEIS even if the guidance has not been finalized prior to the publication of the Draft SEIS. Further, we recommend that the Navy and NOAA, in their role as a cooperating agency, work closely with the Marine Mammal Commission due to their independent, science-based oversight of domestic and international policies and actions of federal agencies addressing human impacts on marine mammals and their ecosystems.

Figure A-1. Environmental Protection Agency Scoping Comment

We appreciate the opportunity to review this scoping notice and are available to discuss our comments. When the Draft SEIS is prepared for this proposed action and released for public review, please notify me and provide an electronic version. If you have any questions, please contact me at (415) 972-3961 or samples.sarah@epa.gov.

Sincerely,

Samples, Sarah

Digitally signed by Samples, Sarah
Date: 2024.09.17 13:00:30 -06'00'

Sarah Samples
Environmental Review Section 1

ENCLOSURE
1. EPA's Detailed Comments

cc: Leah Davis
Biologist, National Oceanic Atmospheric Administration

Peter Thomas
Executive Director, Marine Mammal Commission

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Figure A-1. Environmental Protection Agency Scoping Comment (continued)

EPA'S DETAILED COMMENTS ON NOTICE OF INTENT TO PREPARE A SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT/OVERSEAS ENVIRONMENTAL IMPACT STATEMENT FOR PACIFIC SURVEILLANCE TOWED ARRAY SENSOR SYSTEM LOW FREQUENCY ACTIVE SONAR TRAINING AND TESTING – SEPTEMBER 17, 2024

Alternatives

Sound Levels Below Exposure Thresholds

The EPA recommends adding an alternative where the Navy would formulate SURTASS LFA training and testing to limit potential exposure of marine mammals to sound levels below exposure thresholds where the National Marine Fisheries Service determines take would likely be by harassment only.

Maintaining Sonar at Current Levels

For proposed increases to current levels in training and testing, we recommend including an alternative that holds LFA sonar use at current levels while increasing training activity, as was done under the Navy's Hawaii Range Complex EIS.

Environmentally Preferable Alternative

In accordance with the updated NEPA regulations as of July 1, 2024, ensure that the Draft SEIS identifies the environmentally preferable alternative that would "best promote the national environmental policy expressed in section 101 of NEPA by maximizing environmental benefits" and cause "the least damage to the biological and physical environment" (40 CFR 1502.14(f)).

Impact Assessment Approach

Previous Navy training EISs have averaged impacts over large areas of the ocean. Averaging impacts does not address impacts to local resources such as coral reefs and nearshore areas that might be utilized by fish and wildlife and it does not assist in identifying potential measures to mitigate such localized effects. The EPA advises against this approach and instead recommends ensuring that the Draft SEIS determines impacts to specific resources in the training and testing locales. Further, we recommend against concluding that localized impacts are less-than-significant without a scientific justification. In absence of a scientific justification, the EPA recommends adopting precautionary measures to ensure marine wildlife protection. We encourage the Navy to work with NOAA and the Marine Mammal Commission to develop the impact assessment approach as well as any precautionary measures, as needed.

Monitoring Results

As the Draft SEIS is supplemental to the main EIS in 2001, information about past monitoring is needed to inform the updated impact assessment. We recommend including a section in the Draft SEIS, or in each resource section, that summarizes monitoring results and discusses any adaptive management responses that have been taken. We also recommend committing to monitoring efforts to track compliance with take authorizations, help evaluate the effectiveness of implemented mitigation measures, and advance the understanding of the impacts of the proposed action on marine and terrestrial resources.

In addition, timely posting of these monitoring efforts on a public website is needed to ensure information is available to the public. For example, we appreciate that the project website includes annual and comprehensive mitigation monitoring reports; however, the page is out of date since the latest monitoring report is from 2019-2020. We recommend committing to updating this page within one month of any report being finalized.

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Figure A-1. Environmental Protection Agency Scoping Comment (continued)

Clean Water Act Section 312(n)

Section 312(n) of the Clean Water Act requires the EPA and the Department of Defense to establish Uniform National Discharge Standards to control discharges incidental to the normal operation of military vessels. New performance standards have recently been established and several more may be finalized during the project timeline that may apply to the proposed action. For more information, see: http://www.epa.gov/vessels-marinas-and-ports/uniform-national-discharge-standards-unds-homepage.

Environmental Justice

The EPA recognizes that the 2001 EIS addresses environmental justice impacts; however, Executive Order 12898 *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (February 11, 1994) was supplemented by Executive Order 14096, *Revitalizing Our Nation's Commitment to Environmental Justice for All* on April 26, 2023. E.O. 14096 directs federal agencies, as appropriate and consistent with applicable law, to identify, analyze, and address disproportionate and adverse human health and environmental effects (including risks) and hazards of Federal activities, including those related to climate change and cumulative impacts of environmental and other burdens on communities with environmental justice concerns. In light of E.O. 14096 and varying training locales, please confirm if prior conclusions from 2001 had full consideration of environmental impacts.

Please see the following subsections for additional information. Also, note that demographic data is likely unavailable for the areas of impact, and we recommend that the Navy use the *Promising Practices for Environmental Justice Methodologies in NEPA Reviews*[1] to identify minority and low-income information.

Disproportionate and Adverse Impacts

Disproportionate and adverse impacts may not be inherently clear as impacts for all populations may appear similar; however, the social determinants of health, or "the conditions in which people are born, grow, work, live, and age, and the wider set of forces and systems shaping the conditions of daily life",[2] play a large role in assessing disproportionate and adverse impacts. When deciding whether an impact may be disproportionate and adverse, the EPA recommends that the Draft EIS:

- Identify island communities in the area of impact that could be affected and describe any unique conditions of the potentially affected minority populations and low-income populations that may be affected by the proposed action, including:
  - Human health vulnerabilities (e.g., heightened disease susceptibility, health disparities).
  - Socioeconomic vulnerabilities (e.g., reliance on a particular resource that may be affected by the proposed action).
  - Cultural vulnerabilities (e.g., subsistence).
- Apply methods from the *Promising Practices for Environmental Justice Methodologies in NEPA Reviews*. This report provides guidance in assessing the potential direct and indirect impacts of a

[1] Federal Interagency Working Group on Environmental Justice & NEPA Committee (2016, March). Promising Practices for EJ Methodologies in NEPA Reviews. https://www.epa.gov/sites/production/files/2016-08/documents/nepa_promising_practices_document_2016.pdf

[2] U.S. Center for Disease Control and Prevention. (2022, December). Social Determinants of Health at CDC. https://www.cdc.gov/about/sdoh/index.html

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Figure A-1. Environmental Protection Agency Scoping Comment (continued)

project, as well as the potentially increased vulnerabilities certain populations may have due to the cumulative impacts of environmental harm.

- Develop alternatives and/or mitigation to prevent, minimize, or compensate for disproportionate and adverse impacts.

Meaningful Public Engagement

E.O. 14096 directs federal agencies to provide opportunities in the NEPA process for early and meaningful involvement for communities with environmental justice concerns that may be potentially affected by a proposed action. As such, the EPA recommends that during the NEPA process the Navy:

- Provide early and frequent outreach and engagement opportunities to collect and incorporate community feedback throughout the NEPA process. This may include, but is not limited to:
  - Providing translation services to accommodate linguistically isolated populations, as applicable.
  - Addressing technology barriers that may prohibit participation from affected communities.
  - Ensuring that meetings are scheduled at a time and location that is accessible for community participants, including scheduling meetings after work hours and on weekends as appropriate and providing opportunities for hybrid meetings.
  - Providing ample notice of meetings and commenting opportunities so that community members have sufficient time to prepare and participate.
  - Promoting engagement opportunities within appropriate outlets used by affected communities, such as newspapers, radio, and social media.
  - Ensuring that all project-related information is conveyed using plain language so that community members of varied reading proficiencies can readily understand the project-related information.
- Review and consider community feedback provided during the NEPA process.
- Document actions taken by the Navy to provide opportunities for meaningful public engagement.
- Disclose any community concerns, even those outside the jurisdiction of the Navy.
- Describe how community feedback and preferences are reflected in the Navy's NEPA decision-making process, including alternatives development, identification of the environmental preferable alternative, and the selected alternative and mitigation.

<u>Acoustic Impacts on Marine Mammals</u>

Utilizing the Updated Marine Mammal Acoustic Technical Guidance

The EPA understands that the Navy and NOAA are currently updating the Marine Mammal Acoustic Technical Guidance.[3] Although the guidance may not be completed prior to publishing the Draft SEIS, we recommend including any known updates to acoustic models, marine mammal and sea turtle densities, and marine species criteria and thresholds based on the updated guidance. Because these sections of the EIS are highly technical, writing in plain language in a manner that is understandable to the general public is recommended (40 CFR 1502.8), with the more technical reports included as appendices. In addition, disclose all uncertainty regarding predicted impacts and ensure that lack of information is not depicted as a lack of impact.

[3] National Oceanic Atmospheric Administration. (2024, July 17). Marine Mammal Acoustic Technical Guidance. https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-acoustic-technical-guidance

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Figure A-1. Environmental Protection Agency Scoping Comment (continued)

Mitigation

We understand that the previous SEIS's procedural mitigation measures included visual, passive acoustic, and active acoustic monitoring to minimize effects to marine mammals in the LFA mitigation/buffer zones. In the Draft SEIS's discussion of acoustic impact mitigation, we recommend including information regarding mitigation effectiveness based on previous years of utilizing the mitigation.[4] The EPA highlights that untested mitigation measures cannot be assumed to be effective.

In the Draft SEIS, distinguish the effectiveness of mitigation measures for marine mammals with a low probability of visual observation versus other easily observed marine mammals. To the maximum extent, we recommend the Navy formulate training and testing to limit potential exposure of marine mammals to sound levels below exposure thresholds where the NMFS determines take would likely be by harassment only. Further, discuss any technological advances under consideration to improve or supplement monitoring and mitigation efforts (e.g., unmanned aerial detection and automated data processing).

Agency Coordination

In determining impacts to cetaceans, the EPA recommends working closely with the Marine Mammal Commission as well as NOAA in their cooperating agency role. To effectively address special status species, including those listed under the Marine Mammal Protection Act, the EPA recommends that the Draft SEIS:

- Identify and quantify which species and/or critical habitat might be directly, indirectly, or cumulatively affected by each alternative.
- Complete and append the biological opinion and incidental take permit (40 CFR 1502.24[5]) and include all recommendations from these documents.
- Discuss mitigation measures to minimize impacts to special status species and indicate how they would be implemented and enforced.

<u>Subsistence</u>

Given the high nutritional and cultural value of subsistence food in the Pacific Ocean, the EPA recommends analyzing the potential impacts of the proposed project and its reasonably foreseeable actions to regional subsistence practices and economies. When analyzing the impact of the proposed action on subsistence practice, account for the unique cumulative impacts caused by remote geography (i.e., off the road system), regional food equity, and importance of subsistence way-of-life practices experienced by communities as a result of the proposed action(s).

To analyze the impacts of the proposed project on subsistence practices and resources, the EPA recommends that the SEIS document: the baseline subsistence food consumption; changes in the quantity, quality, and/or perceived quality of subsistence foods due to the proposed project; and potential impacts in subsistence practices in response to changes in quality of subsistence resources. Consider indirect effects that could occur to subsistence resources closer to the coastline as a result of

[4] The Supreme Court has required a mitigation discussion precisely for the purpose of evaluating whether anticipated environmental impacts can be avoided. Methow Valley, 490 U.S. at 351-52, 109 S.Ct. 1835 (citing 42 U.S.C. § 4332(C)(ii)).

[5] Please note that 40 CFR 1502.24 requires agencies, to fullest extent possible, to "prepare draft environmental impact statements concurrent and integrated with environmental impact analyses and related surveys and studies required by all other Federal environmental review laws and Executive orders applicable to the proposed action."

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Figure A-1. Environmental Protection Agency Scoping Comment (continued)

the proposed action(s) potentially contributing to degraded or altered ecosystem function, reduced water quality, and changing ocean conditions.

To address impacts by the proposed project on subsistence practices, the EPA recommends the Draft SEIS fully evaluate the proposed project impacts to subsistence practices and resources; meaningfully engage with the impacted communities throughout the NEPA analysis; and, in consultation with the impacted communities, identify mechanisms to avoid and/or mitigate impacts to subsistence communities and subsistence resources.

Indigenous Knowledge

Indigenous Knowledge is a body of observations, oral and written knowledge, innovations, practices, and beliefs developed by Tribes and Indigenous communities through direct contact and experience with the environment. Regarding the Proposed Action, it can include the collection of local and traditional knowledge concerning the affected environment and anticipated impacts from the project. It can also be used to support the understanding of how climate change has impacted local environmental resources and subsistence resources, such as impacts to coral reefs.

Since Indigenous Knowledge is often unique and specific to Tribes or Indigenous communities and may exist in a variety of forms, consultation and collaboration with Tribe or Indigenous communities is critical to ensuring that Indigenous Knowledge is collected and applied in the NEPA process. As such, the EPA recommends that the Draft SEIS include the identification, inclusion, and integration of Indigenous Knowledge into the NEPA analysis and discuss how Indigenous Knowledge was used in decision-making (e.g., alternatives, mitigation). CEQ's *Guidance for Federal Departments and Agencies on Indigenous Knowledge*[6] is a useful resource to address Indigenous Knowledge in the Draft SEIS.

Cumulative Impacts

In the cumulative impacts analysis, identify how resources, ecosystems, and human communities have already been affected by past or present activities in the project areas. Characterize these resources in terms of their response to change and capacity to withstand stresses and identify the additional stresses that will affect resources. Trend data is recommended to evaluate the significance of historical degradation, and to predict the environmental effects of the proposed action. The EPA recommends that the Draft SEIS ensure assessment of cumulative impacts to marine mammals, including cumulative noise impacts to this resource, water quality, ocean conditions and ecosystems, pelagic species, and coral reefs. We suggest consideration of the methodology developed by Federal Highways Administration and California Department of Transportation, with assistance by the EPA, for use in assessing cumulative impacts. [7] While this guidance was prepared for transportation projects in California, the principles and the 8-step process outlined therein can be applied successfully to other types of projects.

[6] Council on Environmental Quality. (2022, November 30). *Guidance for Federal Departments and Agencies on Indigenous Knowledge*. https://www.whitehouse.gov/wp-content/uploads/2022/12/OSTP-CEQ-IK-Guidance.pdf

[7] California Department of Transportation. (2005, June 30). *Guidance for Preparers of Cumulative Impact Analysis*. https://dot.ca.gov/-/media/dot-media/programs/environmental-analysis/documents/ser/approach-and-guidance-a11y.pdf

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Figure A-1. Environmental Protection Agency Scoping Comment (continued)

NRDC

Via Electronic Mail

October 7, 2024

Mr. Karnig Ohannessian
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Department of the Navy
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Mr. Ben Colbert
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Office of Protected Resources
National Marine Fisheries Service
1315 East-West Highway
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Re: *Intent to prepare a Supplemental EIS/OEIS for SURTASS LFA*

Dear Mr. Ohannessian, Mr. Colbert, and Ms. Harrison:

On behalf of the Natural Resources Defense Council ("NRDC") and our millions of members and activists, we are writing to submit these brief scoping comments on the U.S. Navy's Pacific Surveillance Towed Array Sensor System (SURTASS) Low Frequency Active Sonar Training and Testing activities. 89 Fed. Reg. 67,630 (Aug. 21, 2024).

As you know, our organization has long been concerned about the Navy's operation of SURTASS LFA (or "LFA") sonar. Our concern derives not only from the system itself and its capacity to introduce high-powered, low-frequency noise into the marine environment, but from its use in ocean regions where data on marine mammal populations are often extremely limited. For these reasons, we believe it is imperative that the agencies improve their understanding of

NATURAL RESOURCES DEFENSE COUNCIL

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Figure A-2. Natural Resources Defense Council Scoping Comment

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the system's environmental impacts, which until now has depended on older research. Likewise, they must ensure that their mitigation achieves the "least practicable adverse impact" on marine mammals while allowing the Navy to effectively operate the system. *See, e.g., NRDC v. Pritzker*, 828 F3d 1125, 1138, 1140, 1141 (9th Cir. 2016) (holding, *inter alia*, that protecting marine mammal habitat from Navy sonar is "of paramount importance" under the law).

With this in mind, we offer the following two recommendations.

(1) The Navy should move forward with a behavioral response study on the effects of SURTASS LFA, or LFA-type signals, on high-priority marine mammal species.

Since the late 1990s, the agencies have relied on the LFA Scientific Research Program ("SRP") in establishing behavioral risk parameters for the SURTASS LFA system. This study was ambitious for its time, as those of us invited to witness its second Southern California phase, in 1997, will remember.

But marine mammal science, including the technology used to study behavioral response to underwater noise, has advanced significantly over the two decades since the SRP concluded. Notably, the Time-Depth Recorders used in the SRP, in rendering only depth profile, are primitive by comparison to contemporary marine mammal tags, which include accelerometers, magnetometers, and hydrophones. These newer tags provide far greater capacity to track alterations in animal orientation, velocity, and noise production, and therefore to detect disruptions in marine mammal feeding, calling, and other behaviors; some also allow for direct measurement of physiological parameters such as blood cortisol and heart rate. And modern platforms for passive acoustics, such as gliders, have substantially expanded the detection range of changes in vocalizations associated with relevant behavioral states.

Behavioral response studies that have taken place in the intervening years indicate the limitations of the SRP. For example, a tagging study of sperm whales in the Gulf of Mexico—conducted only a decade later—did not detect any significant avoidance of the noise source (an airgun array), but did find significant reductions in buzz rate, a proxy for prey capture,[1] a finding that could not have been made without acoustic tags. It is unlikely that the SRP's tagging and focal follow techniques, which were designed to pick up basic changes in vocalization and movement patterns, could detect such other responses, which have significant implications for foraging and other biologically important activities. Indeed, Gomez et al. (2016), a meta-analysis of dose-response relationships in the marine mammal disturbance literature, caution about relying on

[1] Miller, P.J.O., Johnson, M.P., Madsen, P.T., Biassoni, N., Quero, M., and Tyack, P.L., Using at-sea experiments to study the effects of airguns on the foraging behavior of sperm whales in the Gulf of Mexico, *Deep-Sea Research I*, 56, 1168-1181 (2009).

Figure A-2. Natural Resources Defense Council Scoping Comment (continued)

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horizontal displacement and limited tagging data in determining when behavioral responses occur.[2]

In its comments on NMFS' Proposed Rule 2019, the Marine Mammal Commission expressed strong concern about the agencies' continued reliance on the SRP and recommended that they "prioritize conducting a BRS [Behavioral Response Study]" on the effects of SURTASS LFA on mysticetes, as well as on phocids and odontocetes like sperm whales that are sensitive to lower-frequency sound.[3] NMFS stated, in response, that the Navy "[had] agreed to evaluate the feasibility and appropriate methods to collect new data to supplement the data available on behavioral responses of marine mammals to SURTASS LFA." 84 Fed. Reg. 40132, 40141 (Aug. 13, 2019). Indeed, it reported that the Navy had begun to undertake that work (*id.*), and we understand that the Navy further supported the development of research plans. But all of that effort has not yet resulted in a study.

Likewise, with each year, the SRP's application to acoustically reactive odontocetes becomes less tenable. The literature has long since demonstrated that certain species, such as beaked whales—non-focal species for the SRP—are acutely responsive to a variety of anthropogenic sounds, including sounds of predominantly low-frequency content.[4]

NMFS attempted to address this problem, in its 2012 rulemaking, by requiring the Navy to advance research on the impacts of LFA sonar on beaked whales and harbor porpoises. The Navy would convene an independent Scientific Advisory Group to make research and monitoring recommendations and, second, would either promulgate a plan of action to implement the Advisory Group's recommendations or submit a written response to NMFS explaining why they are infeasible. The Advisory Group reported back within a year and an interagency oversight group subsequently ranked its recommendations. *See* 84 Fed. Reg. 7186, 7249-50 (Mar. 1, 2019).

Yet, according to NMFS' 2019 Proposed Rule, the only research to have been funded, aside from general research to extend the frequency range of field-based auditory measurements, was a desktop study of the potential spatial overlap between SURTASS LFA operations and harbor

[2] Gomez, C., Lawson, J.W., Wright, A.J., Buren, A.D., Tollit, D., and Lesage, V., A systematic review on the behavioral responses of wild marine mammals to noise: The disparity between science and policy, *Canadian Journal of Zoology* 94: 801-19 (2016).

[3] Comments from P.O. Thomas, Executive Director, Marine Mammal Commission, to J. Harrison, Chief of Permits and Conservation Division, NMFS Office of Protected Resources at 6 (Apr. 1, 2019).

[4] *See, e.g.*, Tougaard, J., Carstensen, J., Teilmann, J., Skov, H., and Rasmussen, P., Pile driving zone of responsiveness extends beyond 20 km for harbor porpoises (Phocoena, (L.)), *Journal of the Acoustical Society of America* 126: 11-14 (2009); Pirotta, E., Milor, R., Quick, N., Moretti, D., Di Marzio, N., Tyack, P., Boyd, I., and Hastie, G., Vessel noise affects beaked whale behavior: Results of a dedicated acoustic response study, *PLoS ONE* 7(8): e42535.doi:10.1371/journal.pone.0042535 (2012); Gomez, C., Lawson, J.W., Wright, A.J., Buren, A.D., Tollit, D., and Lesage, V., A systematic review on the behavioral responses of wild marine mammals to noise: The disparity between science and policy, *Canadian Journal of Zoology* 94: 801-19 (2016).

Figure A-2. Natural Resources Defense Council Scoping Comment (continued)

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porpoise habitat. *Id.* at 7250. No effort was made to assess the behavioral responses of beaked whale species or harbor porpoises to low-frequency tonal noise, which was the point of the original recommendation. Recognizing "the relative lack of data regarding beaked whale responses to LFA sonar," the Navy, in 2019, agreed to examine the feasibility of conducting a controlled exposure experiment on those species, along with those recommended by the Marine Mammal Commission. 84 Fed. Reg. at 40152.

A follow-up to the SRP is very long overdue. **We strongly urge** the Navy to move forward with a behavioral response study during the present environmental compliance cycle, with baleen whales and then beaked whales as highest priorities. Ideally, that study would employ the SURTASS LFA platform, but a well-designed experiment using playbacks or a reasonable proxy source could provide significantly more information than we presently have about the responses of marine mammals to LFA-type signals. The Navy's recent studies on responses of baleen whales and other species to mid-frequency sonar[5] demonstrate the availability of appropriate methods and tools, and, potentially, species-specific baselines, of value here.

(2) The agencies should integrate new information into their identification of OBIAs in the relatively data-poor Western Pacific and Indian Oceans.

The protection of Offshore Biologically Important Areas, or "OBIAs," is "a central component" of the agencies' mitigation measures for LFA sonar, as the courts have recognized. *NRDC v. Pritzker*, 828 F.3d at 1138. It has also become the principal focus of the environmental community's comments on SURTASS LFA. During the last authorization cycle, NRDC submitted extensive comments on the Navy's Draft Environmental Impact Statement and NMFS' Proposed Rule concerning how OBIAs are identified and assessed.[6] These comments not only provided a review and critique of the agencies' methodologies, but also characterized specific habitat in the Western Pacific and Indian Oceans, the Navy's operations area, that we had prioritized for mitigation based on input from in-house and external subject-matter experts.[7]

Here, we want to flag two important sources of information that should be incorporated into the agencies' OBIA analyses at the earliest possible stage. First, **we recommend** that the agencies finally integrate habitat models and available line-transect data into their mitigation for the regions at issue here. Within much of the U.S. Exclusive Economic Zone, and in certain other "data-rich" areas, the identification of high-density marine mammal habitat is aided by predictive

[5] *E.g.*, Southall, B.L., Allen, A.N., Calambokidis, J., Casey, C., DeRuiter, S.L., Fregosi, S., Friedlaender, A.S., Goldbogen, J.A., Harris, C.M., Hazen, E.L., Popov, V. and Stimpert, A.K., Behavioural responses of fin whales to military mid-frequency active sonar, *Royal Society Open Science* 10(12): art. 231775 (2023).

[6] We refer the agencies to these previous comments for more detail.

[7] For example, one of us (FK) has served as an expert for the Important Marine Mammal Area ("IMMA") identification process, including for some of the regions at issue here.

Figure A-2. Natural Resources Defense Council Scoping Comment (continued)

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models.[8] As you are aware, however, the validity of such models can be impeded by large data gaps worldwide, especially at tropical latitudes.

In this case, it is prudent for the agencies to consider alternative modeling approaches capable of accounting for non-standardized collection of survey data and opportunistic sightings—as well as new advances in surface density modeling, some of which the Navy is already applying separately in its offshore range analyses. In particular, the agencies should take full account of DenMod (Marine Mammal Density and Distribution Modeling in Data-Poor Areas) and its successor efforts: *i.e.*, the project established in the 2016 SURTASS LFA settlement agreement specifically to improve modeling in data-poor areas.[9] Available information includes line-transect data from the International Whaling Commission's Pacific Ocean Whale and Ecosystem Research (POWER) program, a long-term, multinational undertaking that has surveyed the western and central Pacific for more than ten years.[10]

Second, **we recommend** that the agencies communicate directly with researchers in the Indian Ocean and Asia to identify potential areas of biological importance, including areas with high cetacean abundance. Considering that many of the locations to be impacted are located offshore of developing countries, which may lack the resources, or linguistic skills, to publish in English-language journals, it is highly likely that there are large unpublished data sets belonging to researchers in these regions. Institutions such as the CetAsia Research Group, The Institute of Cetacean Research (Japan), the University of Karachi, and Moscow State University, among others, would provide valuable local expertise.

In addition, the expert groups established by the IUCN Joint WCPA/SSC Marine Mammal Protected Areas Task Force, specifically to support the identification and protection of Important Marine Mammal Areas (IMMAs) in the Pacific Islands region, the North East Indian Ocean and South East Asian Seas region, the Western Indian Ocean and Adjacent Seas region, and the Australia-New Zealand and South East Indian Ocean region, provide a useful nexus of researchers from across the LFA study area. The regional reports published on the Task Force website specify the names and affiliations of contributing experts.[11]

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[8] *See, e.g*, Roberts, J.J., Best, B.D., Mannocci, L., Fujioka, E., Halpin, P.N., Palka, D.L., Garrison, L.P., Mullin, K.D., Cole, T.V.N., Khan, C.B., McLellan, W.A., Pabst, D.A., and Lockhart, G.G., "Habitat-based cetacean density models for the U.S. Atlantic and Gulf of Mexico," *Scientific Reports* 6, 22615 (2016).

[9] The St. Andrews University website provides basic information on the DenMod project. Centre for Research into Ecological and Environmental Modeling (CREEM), "DenMod: Working group for the advancement of marine species density surface modeling," available at https://denmod.wp.st-andrews.ac.uk/ (accessed Sept. 30, 2024).

[10] The International Whaling Commission (IWC) website provides basic information on the program's objectives as well as yearly cruise reports. IWC, "Pacific Ocean Whale and Ecosystem Research Programme," available at https://iwc.int/scientific-research/sower/power (accessed Sept. 30, 2024). NMFS participates in the program.

[11] IUCN Joint WCPA/SSC Marine Mammal Protected Areas Task Force, "Important Marine Mammal Areas," available at www.marinemammalhabitat.org (accessed Oct. 1, 2024). The areas identified in these regional reports, and collected in the "IMMA E-Atlas" that is also available on the website, should likewise be considered for OBIAs, as they were during the most recent environmental review cycle for SURTASS LFA. IMMA has progressed since

Figure A-2. Natural Resources Defense Council Scoping Comment (continued)

Mr. Karnig Ohannessian
Mr. Ben Colbert
Ms. Jolie Harrison
October 7, 2024
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As always, we would welcome further discussion with you and your staffs.

Very truly yours,

Michael Jasny
Director, Marine Mammals

Francine Kershaw, Ph.D.
Senior Scientist, Marine Mammals

Cc: Peter O. Thomas, Ph.D., Executive Director, Marine Mammal Commission

2018-19, with new reports published and additional areas evaluated and identified. That said, we believe there is considerable value in consulting additionally with regional subject-matter experts.

Figure A-2. Natural Resources Defense Council Scoping Comment (continued)

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APPENDIX B ACOUSTIC IMPACTS SUPPORTING INFORMATION

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List of Figures

Acronyms and Abbreviations

Acronym	Definition
μPa	microPascal
μPa^2s	microPascal squared seconds
AEP	Auditory-evoked potential
dB	decibel
Hz	hertz
kHz	kilohertz
km	kilometer(s)
m/s	meter(s) per second
m	meter(s)
mm	millimeter(s)
OEIS	Overseas Environmental Impact Statement
P	pressure
psi	pounds per square inch
rms	Root-mean-square
SEIS	Supplemental Environmental Impact Statement
SEL	sound exposure level
SPL	sound pressure level
SURTASS LFA	Surveillance Towed Array Sensor System Low-Frequency Active
TL	Transmission loss

This appendix contains several sections that provide brief explanations of acoustic terminology and concepts, as well as information on the existing acoustic environment. The information contained herein can be used to inform understanding of the analysis of acoustic impacts associated with Surveillance Towed Array Sensor System Low-Frequency Active (SURTASS LFA) sonar provided in the Draft Supplemental Environmental Impact Statement (SEIS)/Overseas Environmental Impact Statement (OEIS). This appendix is written by a team of expert bioacoustic scientists and is updated as needed as relevant scientific studies are published.

B.1 Acoustic Concepts / Primer

This section briefly explains the transmission of sound energy underwater; introduces some of the basic mathematical formulas used to describe propagation; and defines acoustical terms, abbreviations, and units of measurement. Methods used to analyze hearing are also described. Note, some of the terminology described herein may not apply to the analysis presented in this Draft SEIS/OEIS.

For a more extensive background on acoustics and marine bioacoustics the following resources are recommended:

- *Marine Mammals and Noise* (Richardson et al. 1995)
- *Principles of Underwater Sound* (Urick 1983)
- *Fundamentals of Acoustical Oceanography* (Medwin and Clay 1998)
- *Principles of Marine Bioacoustics* (Au and Hastings 2008)
- *Exploring Animal Behavior Through Sound: Volume 1 Methods* (Erbe and Thomas 2022)
- *Discovery of Sound in the Sea* (https://dosits.org/)

B.1.1 Terminology

The following terms are used in this document when discussing sound and the attributes of a sound source.

B.1.1.1 Sound

Sound is produced when an elastic medium (such as air or water) is set into motion, typically by a vibrating object within the medium. As the object vibrates, its motion is transmitted to adjacent “particles” of the medium. The motion of these particles is transmitted to adjacent particles, and so on. The result is a mechanical disturbance (the “sound wave”) that moves away from the source and propagates at a medium-dependent speed (the “sound speed”). As the sound wave travels through the medium, the individual particles of the medium oscillate about their original positions but do not actually move with the sound wave. This particle movement creates small changes in the medium’s density, pressure, and temperature.

Sound may be described by both physical and subjective attributes. Physical attributes, such as sound amplitude and frequency, may be directly measured. Subjective (or sensory) attributes like loudness depend on an animal’s perception of sound, and can vary between species and individuals.

B.1.1.2 Signal Versus Noise

When sound is purposely created to convey information, communicate, or obtain information about the environment, it is often referred to as a signal. Examples of signals include sonar pings, marine mammal vocalizations and echolocation clicks, tones used in hearing experiments, and small sonobuoy explosions used for submarine detection. Typically, signals have some type of known characteristics, for example, they could use a limited set of frequencies, have a specific set of harmonics, or be used such that the pulse context provides information to a receiver.

Noise is defined as any undesired sound (American National Standards Institute 2013) that typically lacks the clear characteristics previously described. Sounds produced by naval aircraft and vessel propulsion are considered noise because they represent possible inefficiencies within the system and increased detectability by adversaries. Whether a sound is perceived as noise depends on the receiver (i.e., the animal or system that detects the sound). For example, small explosions and sonar pings used to generate sounds to locate enemy submarines produce signals that are useful to sailors engaged in anti-submarine warfare, but are assumed to be noise when detected by marine species.

The combination of all sounds (including signals and noise) at a particular location, whether these sources are located near or far, is defined as ambient noise (American National Standards Institute 2013). Ambient noise includes natural sources such as sound from crashing waves, rain, and animals (e.g., snapping shrimp), and anthropogenic sources such as seismic surveys and vessel noise. Every location in the marine environment contains some ambient noise, but how much depends on a multitude of factors. Characterizing the ambient noise level of a location is imperative to understanding potential impacts to marine life from anthropogenic sound.

B.1.1.3 Frequency and Wavelength

Frequency is the physical attribute associated with the subjective attribute "pitch", the higher the frequency, the higher the pitch. Frequency is defined by the number of oscillations (i.e., cycles) in the sound pressure or particle motion per second. One hertz (Hz) is equal to one oscillation per second, and one kilohertz (kHz) is equal to 1,000 oscillations per second. "Bandwidth" refers to the range between the minimum and maximum frequency of a sound source or receiver.

Pure tones have energy at a constant, single frequency. Complex tones contain energy at multiple, discrete frequencies, rather than a single frequency. A harmonic of a sound at a particular frequency is a multiple of that frequency. For example, harmonic frequencies of a 2 kHz fundamental frequency tone (i.e., the lowest and most intense frequency of a complex tone) are 4 kHz, 6 kHz, 8 kHz. A source operating at a nominal frequency may emit several harmonic frequencies, but at lower amplitudes and higher frequencies. Some sources may also emit subharmonics which are lower in frequency than the fundamental frequency; however, these are typically many orders of magnitude less powerful than the fundamental frequency. Sounds with large bandwidths ("broadband" sounds) have energy spread across many frequencies.

In this document, sounds are generally described as either low- (less than 1 kHz), mid- (1 kHz to 10 kHz), high- (10 kHz to 100 kHz), or very high- (greater than 100 kHz) frequencies. Hearing ranges of marine animals (e.g., fishes, birds, sea turtles, and marine mammals) are variable and species dependent. For example, some fishes can detect sounds below 100 Hz and some species of marine mammals have hearing capabilities that extend above 100 kHz. Therefore, acoustic impact analyses must focus on the sound amplitude (i.e., pressure or particle motion, see Section B.1.1.4, Sound Amplitude), in addition to the sound frequency and animal sensory capabilities.

The wavelength of a sound is the distance between wave peaks. Wavelength decreases as frequency increases. The frequency multiplied by the wavelength equals the speed of sound in a medium, as shown in this equation:

$$\text{sound speed (m/s)} = \text{frequency}\left(\frac{1}{s}\right) \text{ x wavelength (m)}$$

The approximate speed of sound in sea water is 1,500 meters per second (m/s) and in air is 340 m/s, although speed varies depending on environmental conditions (e.g., pressure, temperature, and, in the case of sea water, salinity; see Section B.1.3.1, Speed of Sound).

B.1.1.4 Sound Amplitude

Sound amplitude is the physical attribute associated with the subjective attribute loudness. Amplitude is related to the amount that the medium particles oscillate about their original positions and can be thought of as the "strength" of a sound (as the amplitude increases, the loudness also increases). As the sound wave travels, the particles of the medium oscillate and transfer energy from one particle to another but do not actually travel with the wave. The result is a mechanical disturbance (i.e., the sound wave) that propagates energy away from the sound source. Sound amplitude is typically characterized by measuring the acoustic pressure or particle motion.

B.1.1.5 Impulsive Versus Non-Impulsive Sounds

Although no standard definitions exist, sounds may be broadly categorized as impulsive or non-impulsive. Impulsive sounds have short durations, rapid rise-times, broad frequency content, and high peak pressures. Impulsive sounds are often produced by processes involving a rapid release of energy or mechanical impacts (Hamernik and Hsueh 1991). Explosions and weapons firing are examples of impulsive sound sources analyzed in this document. In contrast, sonar, vessel operation, and underwater transducers lack the characteristics of impulsive sound sources and are thus examples of non-impulsive sound sources. Non-impulsive sounds can be essentially continuous, such as machinery noise, or intermittent, such as sonar pings. Impulsive signals, particularly at close range, are characterized as brief and broadband with rapid rise time and higher instantaneous peak pressure than other signal types. However, because of propagation effects, an impulsive signal can lose those characteristics, and at a variable distance it could be characterized as a non-impulsive signal (Hastie et al. 2019; Martin et al. 2020).

There are no impulsive sound sources associated with SURTASS LFA; therefore, they are not discussed further herein.

B.1.1.6 Acoustic Impedance

Acoustic impedance is a property of the propagation medium (air, water, sediment, or tissue) that can be simply described as the opposition to the flow of a pressure wave. Acoustic impedance is a function of the density and speed of sound in a medium. Sound transmits more readily through materials of similar acoustic impedance, such as water and animal tissue, since soft tissue is mainly comprised of water. When sound waves encounter a medium with different acoustic impedance (for example, an air-water interface), they reflect and refract (see Sections B.1.3.3.3, Refraction, and B.1.3.3.4, Reflection and Multipath Propagation), creating more complex propagation conditions. For example, sound traveling in air (low impedance) encountering the water surface (high impedance) will be largely reflected, preventing most sound energy in the air from being transmitted into the water. The impedance difference at the tissue-air interface in animals with gas-containing organs also makes these areas susceptible to damage when exposed to the shock wave near an explosion. Transmission from high-impedance to low-impedance can result in large motion at the boundary.

B.1.1.7 Duty Cycle

Duty cycle describes the portion of time that a source generates sound. It is defined as the ratio of time that a signal or system is on compared to the time it is off during an operational period. For example, if a sonar source produces a one-second ping once every 10 seconds, the duty cycle is 10 percent. Duty cycles vary within and between different acoustic sources; in general, a duty cycle of 20 percent or less is considered low, and a duty cycle of 80 percent or higher is considered high.

B.1.1.8 Resonance

Resonance occurs when an object is vibrated at a frequency near its "natural frequency" or resonant frequency. The resonant frequency can be considered the preferred frequency at which an object will oscillate at a greater magnitude than when exposed to other frequencies. In this document, resonance is considered in relation to the size of an air bubble or air cavity (e.g., lungs). Biological life exposed to high pressure waves from an outside source can lead to potential injury. Due to an inverse relationship, the smaller the bubble, the higher the resonant frequency. The natural frequency of biological life would vary based on the size of the bubbles trapped within them. For example, large whale lungs would have a lower resonant frequency than dolphin lungs. The natural frequencies of dolphin and beluga lungs near the surface are about 36 Hz and 30 Hz, respectively (Finneran 2003). As an animal dives deep within the water column, there is a corresponding increase in pressure. Hence, any air bubbles trapped within the animal would likely shrink as a result of the pressure change (Bostrom et al. 2008). Because of the change in bubble size, the resonant frequencies would tend to increase as an animal dives.

B.1.2 Sound Metrics

The sound metrics described here are used to quantify exposure to a sound or explosion.

B.1.2.1 Pressure

Sound pressure is the incremental variation in a medium's static pressure (i.e., the ambient pressure without the added sound) as a sound wave travels through it. Sound pressure is typically expressed in units of micropascals (µPa), although explosive overpressure may also be described in pounds per square inch (psi).

Various sound pressure metrics are illustrated in Figure B.1-1 for (a) a non-impulsive sound (a pure tone in this illustration) and (b) an impulsive sound. As shown in Figure B.1-1, the non-impulsive sound has a relatively gradual rise in pressure from static pressure, while the impulsive sound has a near-instantaneous rise to a high peak pressure. The peak pressure shown on both illustrations is the maximum absolute value of the instantaneous sound pressure during a specified time interval ("zero-to-peak" or "peak"). "Peak-to-peak" pressure is the difference between the maximum and minimum sound pressures.

The root-mean-square (rms) value is often used to describe the average sound pressure level (SPL). SPLs provided in this Draft SEIS/OEIS are root-mean-square values unless otherwise specified. As the name suggests, this method takes the square root of the average squared sound pressure values over a time interval. The duration of this time interval can have a strong effect on the measured rms sound pressure for a given sound, especially where pressure levels vary significantly, as during an impulsive sound exposure. If the analysis duration includes a large portion of the waveform after the sound pressure has returned to zero, the rms pressure would be relatively low. If the analysis duration includes only the highest pressures of the impulsive exposure, the rms value would be comparatively high. For this reason, it is important to specify the duration used to calculate the rms pressure for impulsive sounds.

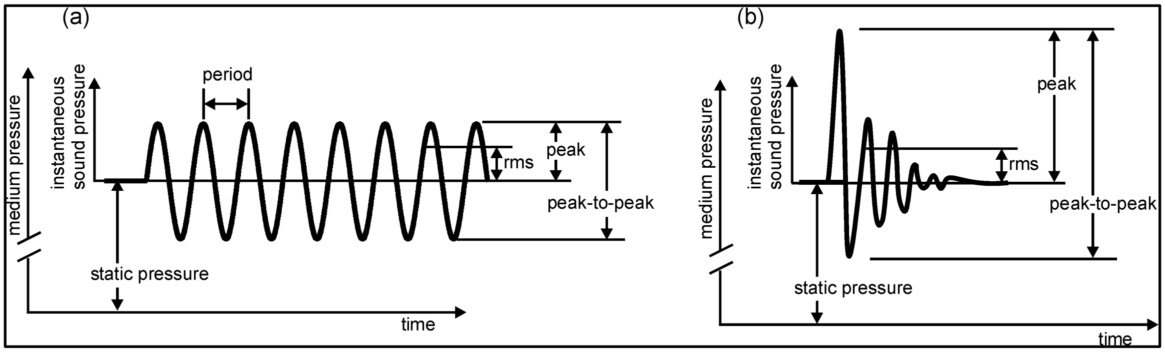


Figure B.1-1: Various Sound Pressure Metrics for a Hypothetical (a) Pure Tone (Non-Impulsive) and (b) Impulsive Sound

B.1.2.2 Sound Pressure Level

The most common sound level metric is SPL. Because many animals can detect very large pressure ranges and judge the relative loudness of sounds by the ratio of the sound pressures (a logarithmic behavior), SPL is described by taking the logarithm of the ratio of the sound pressure to a reference pressure. Use of a logarithmic scale compresses the wide range of measured pressure values into a more useful scale.

SPLs are normally expressed in decibels. A decibel is 1/10 of a bel, a unit of level when the logarithm is to the base ten and the quantities concerned are proportional to power (American National Standards Institute 2013). SPL in decibels is calculated as follows:

$$SPL = 20\log_{10}\left(\frac{P}{P_{ref}}\right)$$

where P is the sound pressure and P_{ref} is the reference pressure. Unless stated otherwise, the pressure (P) is the rms value of the pressure (American National Standards Institute 2013). In some situations, SPL is calculated for the peak pressure rather than the rms pressure. On the occasions when rms pressure is not used, the pressure metric will be stated (e.g., peak SPL means an SPL calculated using the peak pressure rather than the rms pressure).

When a value is presented in decibels, it is important to also specify the value and units of the reference quantity. Normally the numeric value is given, followed by the text “re,” meaning “with reference to,” and the numeric value and unit of the reference quantity. For example, a pressure of 1 Pa, expressed in decibels with a reference of 1 micropascal (µPa), is written 120 dB re 1 µPa. The standard reference pressures are 1 µPa for water and 20 µPa for air. The reference pressure for air, 20 µPa, is the approximate lowest threshold of human hearing. It is important to note that because of the differences in reference units, the same sound pressures would result in different SPL values for each medium (the same sound pressure measured in water and in air would result in a higher SPL in water than in air, since the in-air reference is larger). Therefore, SPLs in air and in water cannot be directly compared.

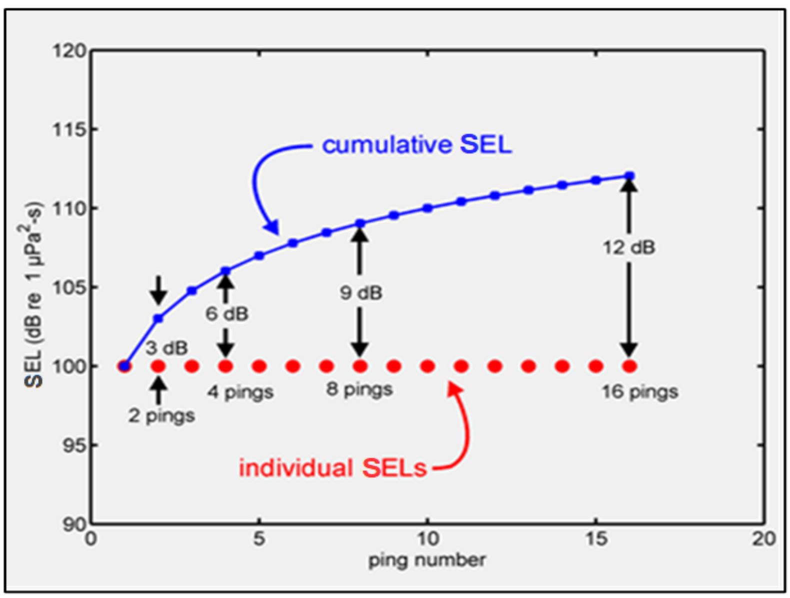
B.1.2.3 Sound Exposure Level

Sound exposure level (SEL) can be thought of as a composite metric that represents both the SPL of a sound and its duration. Individual time-varying noise events (e.g., a series of sonar pings or an impulsive sound) have two main characteristics: (1) a sound pressure that changes throughout the event and (2) a period during which a receiver is exposed to the sound. SEL can be provided for a single exposure (i.e., a single sonar ping) or for an entire acoustic event (i.e., multiple sonar pings). Cumulative SEL provides a measure of the net exposure of the entire acoustic event, but it does not directly represent the sound level at a given time. SEL is determined by calculating the decibel level of the cumulative sum-of-squared pressures over the duration of a sound, with units of dB re 1 micropascal squared seconds (re 1 $\mu Pa^2 s$) for sounds in water.

Guidelines for SEL are as follows:

- The numeric value of SEL is equal to the SPL of a one-second sound that has the same total energy as the exposure event. If the sound duration is one second, SPL and SEL have the same numeric value (but not the same reference quantities). For example, a one-second sound with an SPL of 100 dB re 1 µPa has a SEL of 100 dB re 1 $\mu Pa^2 s$.
- If the sound duration is constant but the SPL changes, SEL will change by the same number of decibels as the SPL.
- If the SPL is held constant and the duration (T) changes, SEL will change as a function of $10\log_{10}(T)$:
  - $10 \log_{10}(10) = 10$, so increasing duration by a factor of 10 raises SEL by 10 dB.
  - $10 \log_{10}(0.1) = -10$, so decreasing duration by a factor of 10 lowers SEL by 10 dB.
  - $10 \log_{10}(2) \approx 3$, so doubling the duration increases SEL by 3 dB.
  - $10 \log_{10}(1/2) \approx -3$, so halving the duration lowers SEL by 3 dB.

Figure B.1-2 illustrates the summation of energy for a succession of sonar pings. In this hypothetical case, each ping has the same duration and SPL. The SEL at a particular location from each individual ping is 100 dB re 1 $\mu Pa^2 s$ (red circles). The upper, blue curve shows the running total or cumulative SEL.

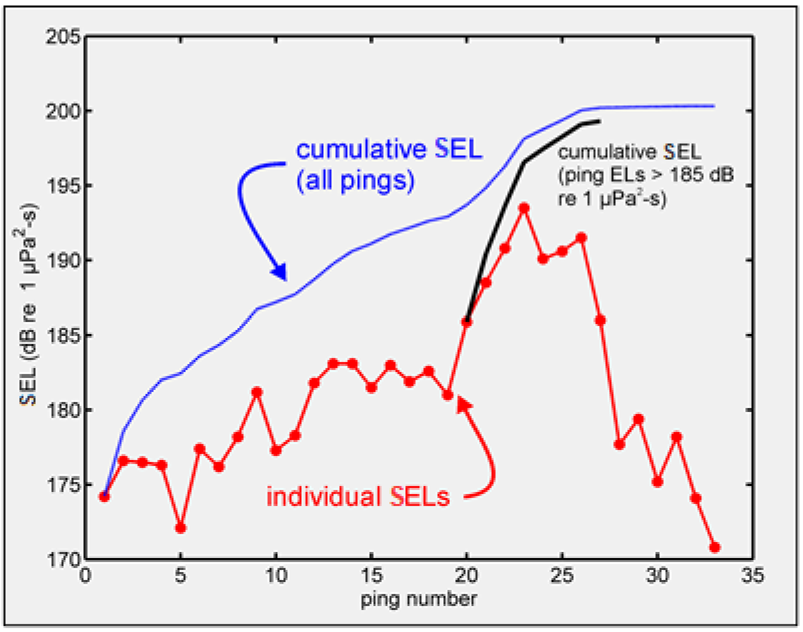


Note: dB = decibels; SEL = sound exposure level; dB re 1 μPa^2-s = decibels with a reference of 1 micropascal (µPa) squared per second

Figure B.1-2: Summation of Acoustic Energy from a Hypothetical, Intermittently Pinging, Stationary Sound Source

After the first ping, the cumulative SEL is 100 dB re 1 μPa^{2}s. Because each ping has the same duration and SPL, receiving two pings is the same as receiving a single ping with twice the duration. The cumulative SEL from two pings is therefore 103 dB re 1 μPa^{2}s. The cumulative SEL from four pings is 3 dB higher than the cumulative SEL from two pings, or 106 dB re 1 μPa^{2}s. Each doubling of the number of pings increases the cumulative SEL by 3 dB.

Figure B.1-3 shows a more realistic example where the individual pings do not have the same SEL. These data were recorded from a stationary hydrophone as a sound source approached, passed, and moved away from the hydrophone. As the source approached the hydrophone, the received SEL of each ping increased. After the source passed the hydrophone, the received SEL from each ping decreased as the source moved farther away (downward trend of red line), although the cumulative SEL increased with each additional ping received (slight upward trend of blue line). The main contributions are from those pings with the highest individual SELs. Individual pings with SELs 10 dB or more below the ping with the highest level contribute little (less than 0.5 dB) to the total cumulative SEL. This is shown in Figure B.1-3, where only a small error is introduced by summing the energy from the eight individual pings with SEL greater than 185 dB re 1 μPa^{2}s (black line), as opposed to including all pings (blue line).



Note: dB = decibels; ELs = exposure levels; SEL = sound exposure level; dB re 1 μPa^2-s = decibels with a reference of 1 micropascal (μPa) squared per second

Figure B.1-3: Cumulative SEL under Realistic Conditions with a Moving, Intermittently Pinging Sound Source

B.1.2.4 Particle Motion

The particles of a medium (e.g., water or air) oscillate around their original position as a sound wave passes through. Particle motion comprises particle displacement (m or dB re 1 pm), particle velocity (m/s or dB re 1 nm/s^2), and particle acceleration (m/s^2 or dB re 1 μm/s^2) (Nedelec et al. 2016). Note that particle velocity is not the same as sound speed, which is how fast a sound wave moves through a medium. Particle motion is also directional, whereas sound pressure measurements are not (Nedelec et al. 2016).

Near acoustic boundaries (e.g., the sea floor and sea surface) and in the shallow waters, the relationship between sound pressure and particle motion is complex and it is necessary to measure particle motion directly (Pierce 1989). At distances far from a sound source (i.e., in the far field) and without boundary interactions that could cause wave interference, particle velocity is directly proportional to sound pressure. However, closer to a sound source (i.e., in the near field), the particle velocity component of the field contains more energy than the sound pressure component of the field. The rate of decline of particle velocity in the near field depends on the nature of the sound source and its movement pattern (Harris and van Bergeijk 1962). The distance from a source at which the near field transitions to the far field is related to the wavelength of the signal, with a greater distance for lower frequencies.

B.1.2.5 Intensity

The intensity of a sound wave (I) is defined as the amount of energy per second (power in units Watts) propagating through 1 square meter of a medium (e.g., seawater). A propagating sound wave carries both kinetic energy of a medium's particles in motion (particle velocity [u]) and potential energy due to the acoustic impedance of the medium (sound pressure [p]) and is calculated as follows:

$$I = pu$$

Intensity and velocity are both vector quantities with a magnitude and direction. The motion of particles in a sound wave are generally oriented in the direction of propagation at a velocity equal to the velocity of sound (c). In a plane wave, the sound pressure is related to the particle velocity by:

$$p = \rho c u, \text{ or } u = \frac{p}{\rho c}$$

Where the fluid density (ρ) and velocity of sound (c) are known as the specific acoustic impedance of the medium. Therefore, for a plane wave, the instantaneous intensity is related to the instantaneous sound pressure by:

$$I = \frac{p^2}{\rho c}$$

B.1.3 Predicting How Sound Travels in Water

While the concept of a sound wave traveling from its source to a receiver is straightforward, sound propagation is complex because of the simultaneous presence of numerous sound waves of different frequencies and source levels (i.e., the sound radiated by a projector). Waves undergo changes in direction (i.e., reflection, refraction, and diffraction) that can cause interferences (waves adding together or cancelling one another out). Ocean bottom types, water density, and surface conditions also affect sound propagation. While simple examples are provided here for illustration, the Navy Acoustic Effects Model used to quantify acoustic exposures to marine mammals and sea turtles considers the influence of multiple factors to predict acoustic propagation [see technical report *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase IV Training and Testing* (U.S. Department of the Navy 2024b).

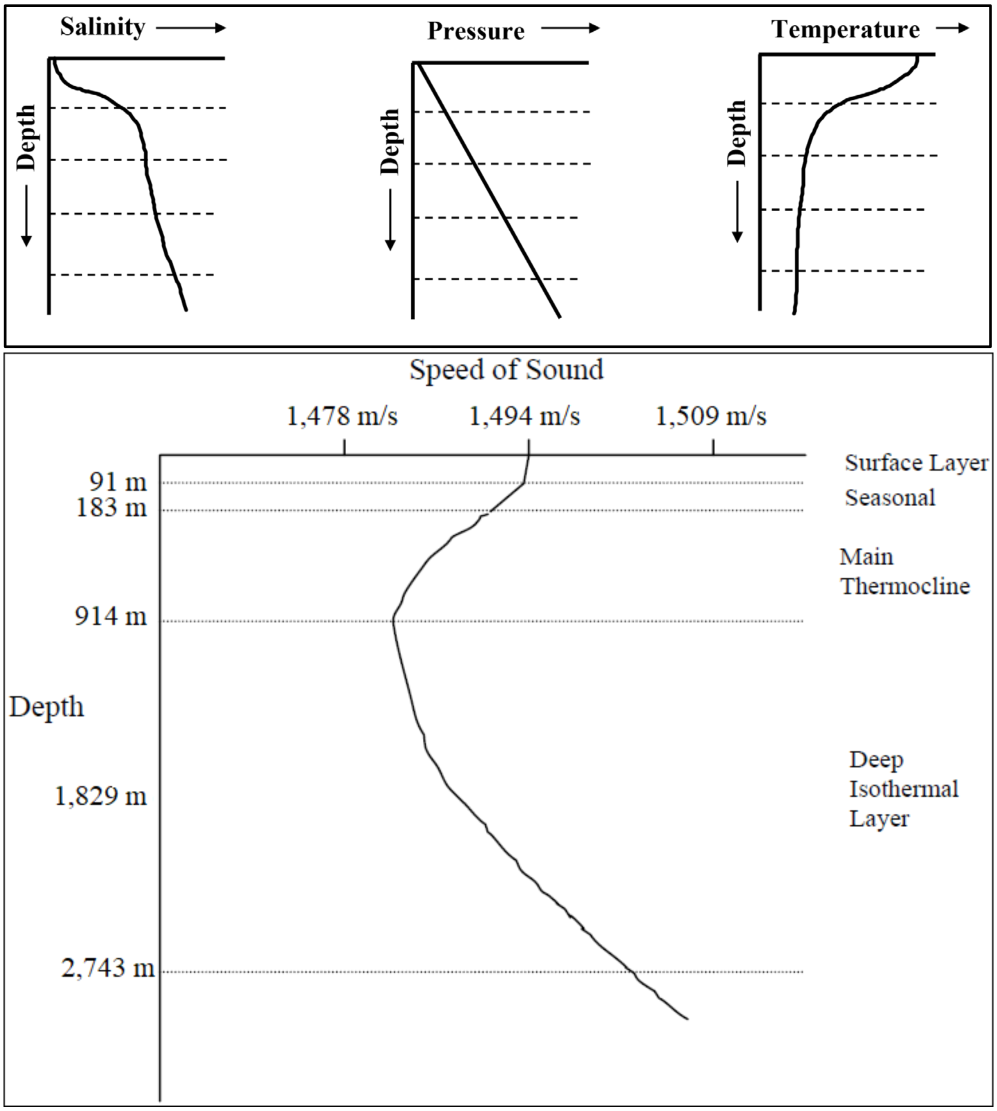
B.1.3.1 Speed of Sound

The speed of sound is not affected by the SPL or frequency of the sound, but depends wholly on characteristics of the medium through which it is passing. The speed of sound (c) is calculated using the bulk modulus (B), which describes resistance to compression, and density (ρ) of seawater, which are influenced by the pressure and temperature of the medium.

$$c = \sqrt{\frac{B}{\rho}}$$

Sound travels faster through a medium that is harder to compress. For example, water is more difficult to compress than air, and sound travels approximately 340 m/s in air and 1,500 m/s in seawater. The density of air is primarily influenced by temperature, relative humidity, and pressure, because these attributes affect the density and compressibility of air. Generally, the speed of sound in air increases as air temperature increases. The density of seawater is primarily influenced by temperature, pressure, and salinity. In general, the density is higher for colder temperatures, higher hydrostatic pressure, and higher salinity. The speed of sound in seawater also increases with increasing temperature and, to a lesser degree, with increasing hydrostatic pressure and salinity.

The combination of effects from temperature, pressure, and salinity creates a sound velocity profile. Figure B.1-4 shows the independent relationship each of these three attributes have with depth. For most areas of the ocean, temperature decreases from the surface to the bottom, although there are many local variations. Shallow layers see the most variation with time and depth (e.g., surface mixing, solar heating, currents, seasonal variations), and at deeper layers the temperature becomes relatively constant at 4°C. Hydrostatic pressure makes the speed of sound increase with depth because of variations in the bulk modulus. Below 1,500 meters (m), the increasing hydrostatic pressure is the dominant factor on sound speed. The change in the mix of pure water and dissolved salts affects the speed of sound. Salinity has minimal variation with depth, but there can be stronger variations near areas with freshwater inputs such as river estuaries and melting ice. Inhomogeneities in seawater can also affect the speed of sound and include bubble layers close to the surface, mineral particles in suspension, and living organisms.



Note: m = meters; m/s = meters per second

Figure B.1-4: Sound Velocity Profile (Sound Speed) Is Related to Temperature, Salinity, and Hydrostatic Pressure of Seawater

Figure B.1-4 also shows an example of a standard sound velocity profile and its four distinctive layers:

The surface layer tends to be irregular and is influenced by diurnal (i.e., daily) heating and cooling; mixing from currents, local wind action, and storms; and changes in salinity due to evaporation, precipitation, freezing, ice melt, and river runoff. The surface layer may contain a mixed layer of isothermal (i.e., nearly constant temperature) water that traps sound. Under prolonged calm and sunny conditions, the mixed layer does not exist, and water temperature decreases with depth. The seasonal thermocline (i.e., temperature gradient) is influenced by seasonal heating and cooling and mixing from wind action and storms. The seasonal thermocline is characterized by temperature decreasing with depth. During the summer and fall when waters are warm, the seasonal thermocline is well defined. However, during winter and spring or in cold waters, the seasonal thermocline can be indistinguishable from the surface layer. The main, or permanent thermocline, is independent of the surface layer, is only slightly affected by seasonal changes within a localized area and is where the major temperature difference between the cold depths of the sea occurs. The main thermocline extends to about 300 m and marks the limit where temperature has the most influence on sound velocity due to less mixing at greater depths. The deep isothermal layer is defined by a nearly constant temperature and sound velocity is mainly influenced by pressure. At the inflection point where sound velocity decreases with depth in the main thermocline, and where sound velocity begins to increase in the deep isothermal layer, is where a sound velocity minimum occurs and sound at depth is focused by refraction.

B.1.3.2 Source Directivity

Most sonar and other active acoustic sources do not radiate sound in all directions, unlike noise from vessels and explosions for example. Rather, they emit sounds over a limited range of angles to focus sound energy on a specific area or object of interest. The specific angles are sometimes given as horizontal or vertical beam width. Some sources can be described qualitatively as “forward-looking,” when sound energy is radiated in a limited direction in front of the source, or “downward-looking,” when sound energy is directed toward the bottom.

B.1.3.3 Transmission Loss

As a sound wave passes through a medium, the sound level decreases with distance from the sound source. This phenomenon is known as transmission loss (TL). The transmission loss is used to relate the source SPL (SL), defined as the SPL produced by a sound source at 1 m, and the received SPL (RL) at a particular location, as follows:

$$RL = SL - TL$$

The main contributors to transmission loss are as follows (Urick 1983) and are discussed in detail below:

- Geometric spreading of the sound wave as it propagates away from the source
- Sound absorption (conversion of sound energy into heat)
- Scattering, diffraction, multipath interference, and boundary effects

B.1.3.3.1 Spreading Loss

Spreading loss is a geometric effect representing the regular weakening of a sound wave as it spreads out from a source. Spreading describes the reduction in sound pressure caused by the increase in surface area as the distance from a sound source increases. Spherical and cylindrical spreading are the simplest forms of spreading loss.

In the simple case of sound propagating from a point source without obstruction or reflection, the sound waves take on the shape of an expanding sphere. An example of spherical spreading loss is shown in Figure B.1-5. As spherical propagation continues, the sound energy is distributed over an ever-larger area following the inverse square law: the pressure of a sound wave decreases inversely with the square of the distance between the source and the receptor. For example, doubling the distance between the receptor and a sound source results in a reduction in the pressure of the sound to one-fourth of its initial value, tripling the distance results in one-ninth of the original pressure, and so on. Because the surface area of a sphere is $4\pi r^2$, where r is the sphere radius, the change in SPL with distance r from the source is proportional to the radius squared. This relationship is known as the spherical spreading law.

The TL for spherical spreading between two locations is:

$$TL = 20log_{10}(r)$$

- 2 x distance, 6 dB loss
- 3 x distance, 10 dB loss
- 10 x distance, 20 dB loss

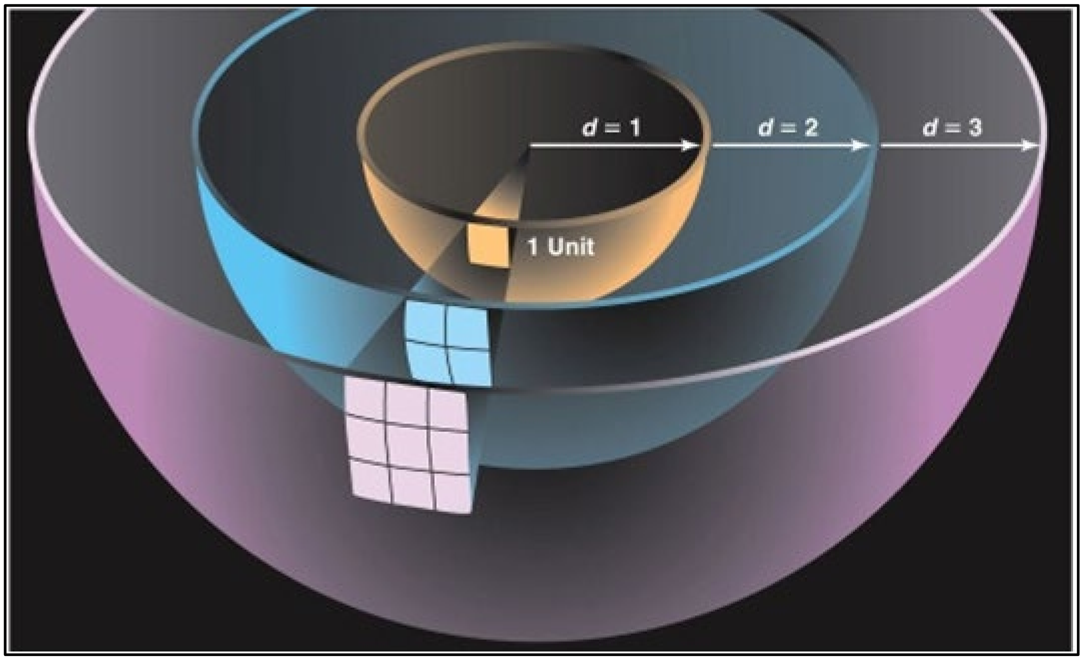


Figure B.1-5: Graphical Representation of the Inverse Square Relationship in Spherical Spreading with Increasing Distance from the Source (d)

In cylindrical spreading, spherical waves expanding from the source are constrained by the water surface and the seafloor and take on a cylindrical shape. In this case the sound wave expands in the shape of a cylinder rather than a sphere, and the transmission loss is:

$$TL = 10log_{10}(r)$$

- 2 x distance, 3 dB loss
- 3 x distance, 5 dB loss
- 10 x distance, 10 dB loss

The cylindrical and spherical spreading equations above represent two simple hypothetical cases. In reality, geometric spreading loss is more spherical near a source and more cylindrical with distance, and is better predicted using more complex models that account for environmental variables, such as the Navy Acoustic Effects Model [see technical report *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase IV Training and Testing* (U.S. Department of the Navy 2024b).

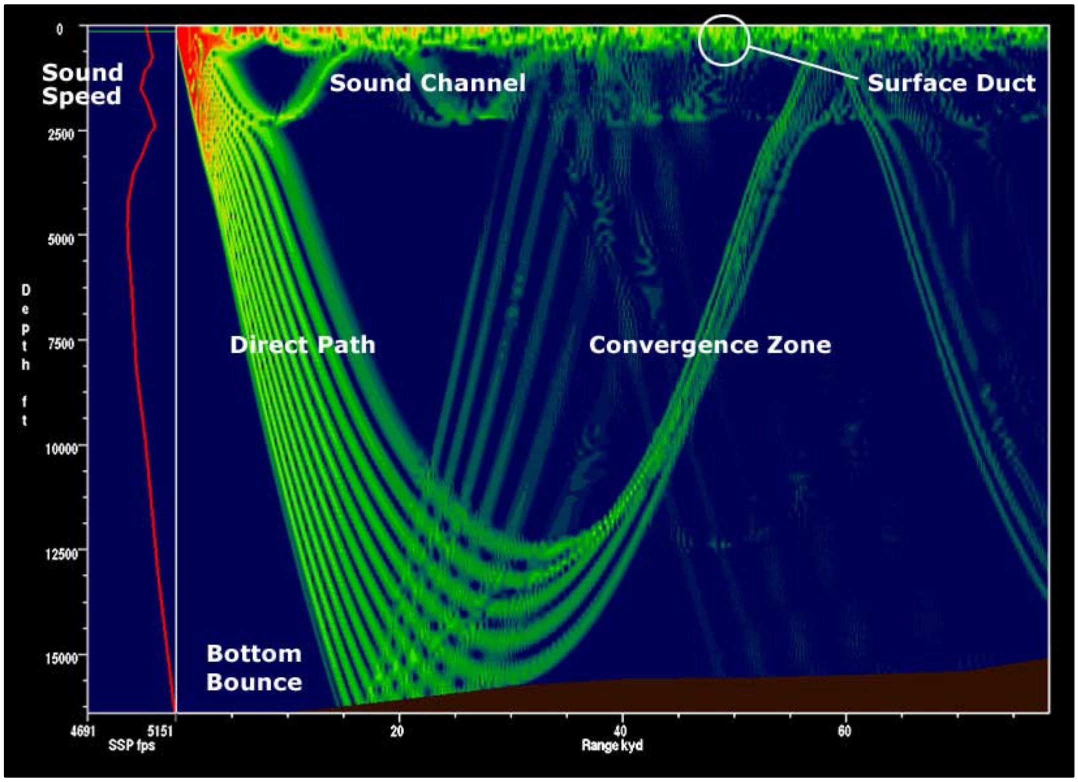
B.1.3.3.2 Absorption

Absorption loss is the conversion of acoustic energy to heat and kinetic energy and occurs when sound propagates through a medium (Urick 1983). Absorption is directly related to sound frequency, with higher frequencies (>10 kHz) having higher rates of absorption. The main cause of absorption in sea water occurs below 100 kHz and is due to ionic relaxation of dissolved salts (primarily magnesium sulfate). Therefore, absorption is the cause of an appreciable amount of attenuation for high- and very high-frequency sound sources, reducing the distance over which these sources may be perceived compared to mid- and low-frequency sound sources with the same source level.

B.1.3.3.3 Refraction

When a sound wave propagating in a medium encounters a second medium with a different density (e.g., the air-water boundary), part of the incident sound will be reflected back into the first medium and part will be transmitted into the second medium (Kinsler et al. 1982). The propagation direction will change as the sound wave enters the second medium; this phenomenon is called refraction. Refraction may also occur within a single medium if the properties (e.g., temperature) of the medium change enough to cause a variation in the sound speed.

As discussed in Section B.1.3.1, Speed of Sound, the sound speed in the ocean primarily depends on hydrostatic pressure (i.e., depth) and temperature. Although the actual variations in sound speed are small, the existence of sound speed gradients in the ocean has an appreciable effect on the propagation of sound in the ocean. If one pictures sound as rays emanating from an underwater source, the propagation of these rays changes as a function of the sound speed profile in the water column. Specifically, the directions of the rays bend toward regions of slower sound speed. This phenomenon creates ducts in which sound becomes “trapped,” allowing it to propagate with high efficiency for large distances within certain depth boundaries. During winter months, the reduced sound speed at the surface due to cooling can create a surface duct that efficiently propagates sound such as commercial shipping noise (Figure B.1-6).



Note: 1 kiloyard (kyd) = 0.9 km

Figure B.1-6: Sound Propagation Showing Multipath Propagation and Conditions for Surface Duct

Sources located within this surface duct can have their sounds trapped, but sources located below this layer would have their sounds refracted downward. The deep sound channel, or sound frequency and ranging (SOFAR) channel is between 600–1,200 m deep at mid-latitudes and is where the slowest sound speed (i.e., sound speed minimum) occurs. The sound speed minimum creates a waveguide where sound waves are continually bent, or refracted, towards the region of lower sound speed which allows sound to travel long distances with minimal attenuation.

Similarly, the path of sound will bend toward regions of lower sound speed in air. Air temperature typically decreases with altitude. Since the speed of sound decreases in cooler temperatures, sounds produced in air tend to bend skyward. When an atmospheric temperature inversion is present, air is cooler near the earth's surface than at altitude. In inversion conditions, sound waves near the earth's surface will tend to refract downward.

B.1.3.3.4 Reflection and Multipath Propagation

In multipath propagation, sound may not only travel a direct path (with no reflection) from a source to a receiver, but also be reflected from the surface or bottom multiple times before reaching the receiver (Urick 1983). Reflection is shown in Figure B.1-6 at the seafloor (bottom bounce) and at the water surface. At some distances, the reflected wave will be in phase with the direct wave (their waveforms add together and create a convergence zone), and at other distances the two waves will be out of phase (their waveforms cancel). The existence of multiple sound paths, or rays, arriving at a single point can result in multipath interference, a condition that permits the addition and cancellation between sound waves, resulting in the fluctuation of sound levels over short distances.

Reflection plays an important role in the pressures observed at different locations in the water column. Near the bottom, the direct path pressure wave may sum with the bottom-reflected pressure wave, increasing the exposure. Near the surface, however, the surface-reflected pressure wave may destructively interfere with the direct path pressure wave, by “cutting off” the wave and reducing exposure (called the Lloyd mirror effect). This can cause the sound level to decrease dramatically within the top few meters of the water column.

B.1.3.3.5 Diffraction, Scattering, and Reverberation

Diffraction, scattering, and reverberation are examples of what happens when sound waves interact with obstacles in the propagation path.

Diffraction may be thought as the change of direction of a sound wave as it passes around an obstacle. Diffraction depends on the size of the obstacle and the sound frequency. The wavelength of the sound must be larger than the obstacle for notable diffraction to occur. If the obstacle is larger than the wavelength of sound, an acoustic shadow zone will exist behind the obstacle where the sound is unlikely to be detected. Common examples of diffraction include sound heard from a source around the corner of a building and sound propagating through a small gap in an otherwise closed door or window.

An obstacle or inhomogeneity (e.g., smoke, suspended particles, gas bubbles due to waves, and marine life) in the path of a sound wave causes scattering as these inhomogeneities reradiate incident sound in a variety of directions (Urick 1983). Reverberation refers to the prolongation of a sound, after the source has stopped emitting, caused by multiple reflections at water boundaries (surface and bottom) and scattering.

B.1.3.3.6 Surface and Bottom Effects

Because the sea surface reflects and scatters sound, it has a major effect on the propagation of underwater sound in applications where either the source or receiver is at a shallow depth (Urick 1983). If the sea surface is smooth, the energy from a reflected sound wave is nearly equal to the energy of an incident (i.e., incoming) sound wave; however, if the sea surface is rough, the amplitude of the reflected sound wave will be reduced. Sound waves in water reflected from a boundary with air (i.e., the sea surface) experience a phase reversal (i.e., a 180° change). When the surface-reflected waves interact with the direct path waves near the surface, a destructive interference pattern is created in which the two waves are out of phase by half a cycle and cancel each other out when added together. As a result, the amplitude of the two waves and the sound pressure become zero.

The sea bottom is also a reflecting and scattering surface, like the sea surface. Sound interaction with the sea bottom is more complex, primarily because the acoustic properties of the sea bottom are more variable, and the bottom is often layered into regions of differing density. As sound travels into the seafloor it reflects off these different density layers in complex ways. For sources in contact with the bottom, such as bottom-placed explosives, a ground wave is produced that travels through the bottom sediment and may refract back into the water column.

Sediment grain size, composition, and the measure of pore space (i.e., porosity) affect sound propagation and attenuation at the sea floor. In addition, sediments contain free or trapped gas and/or organic content which can affect the bulk properties of the sediment. For a hard bottom such as rock, the reflected wave will be approximately in phase with the incident wave. Thus, near the ocean bottom, the incident and reflected sound pressures may add together (constructive interference), resulting in increased sound pressure near the sea bottom. Soft bottoms such as mud or sediment absorb sound waves and reduce the level in the water column overall.

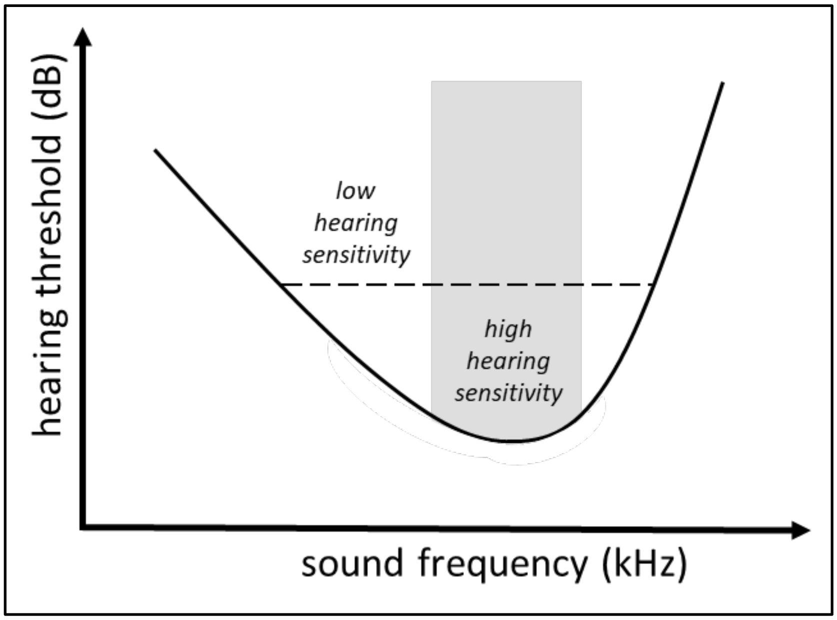
B.1.4 Auditory Perception

Animals with an eardrum or similar structure, including mammals, birds, and reptiles, detect the pressure component of sound. Some marine fishes also have specializations to detect pressure changes, although most invertebrates and many marine fishes do not have anatomical structures that enable them to detect the pressure component of sound and are only sensitive to the particle motion component of sound. This difference in acoustic energy sensing mechanisms limits the range at which fishes and invertebrates can detect most sound sources.

Because mammalian ears can detect large pressure ranges and humans judge the relative loudness of sounds by the ratio of the sound pressures (a logarithmic behavior), sound amplitude is described by the SPL, calculated by taking the logarithm of the ratio of the sound pressure to a reference pressure (see Section B.1.2.2, Sound Pressure Level). Use of a logarithmic scale compresses the wide range of pressure values into a more usable numerical scale. On the decibel scale, the smallest audible sound in air (near total silence) to a human is 0 dB re 20 µPa. If the sound intensity increases by a factor of 10, the SPL would increase to 10 dB re 20 µPa. If the sound intensity increases by a factor of 100, the SPL would increase to 20 dB re 20 µPa, and if the sound intensity increases by a factor of 1000, the SPL would be 30 dB re 20 µPa. A quiet conversation has an SPL of about 50 dB re 20 µPa, while a jet engine taking off 200 ft away is about 130 dB re 20 µPa (Cavanaugh and Tocci 1998).

While sound pressure and frequency are physical measures of the sound, loudness is a subjective attribute that varies not only with sound pressure but also other attributes of the sound, such as frequency. For example, a human listener would perceive a 60 dB re 20 µPa sound at 2 kHz to be louder than a 60 dB re 20 µPa sound at 50 Hz, even though the SPLs are identical. This effect is most noticeable at lower SPLs; however, at very high SPLs, the difference in perceived loudness at different frequencies becomes smaller. This difference in perception for sounds having the same SPLs but different frequencies is related to the hearing capabilities of the individual or species.

The most accurate tests for determining the hearing capabilities of animals are direct measurements of auditory sensitivity. The two standard types of hearing tests are: 1) behavioral, where an animal is trained to provide a response to sound, and 2) physiological, where – without any training – the brain's responses to sound are measured (auditory-evoked potentials, or AEPs) (Finneran 2015). During these tests, the sound is played at progressively lower levels until the animal can no longer hear it or until the brain's responses are no longer detected, and the hearing threshold in dB SPL is determined. The hearing threshold is the quietest audible sound, so a low hearing threshold indicates more sensitive hearing. When multiple frequencies are tested across the hearing range of an animal, a plot called an audiogram illustrates how hearing threshold changes as a function of sound frequency. An example of an audiogram is shown in Figure B.1-8.



Notes: (dB = decibels; kHz = kilohertz) The area within the solid curve represents audible sounds. The dotted line illustrates that the listener is not as sensitive to frequencies on the tail ends of the curve as the frequencies that align with the bottom of the "U." The shaded area is the frequency range with the lowest thresholds and highest hearing sensitivity, also called the region of best hearing. Marine mammal auditory sensitivity typically decreases more slowly at frequencies lower than the best frequency and decreases more quickly for frequencies higher than the best frequency.

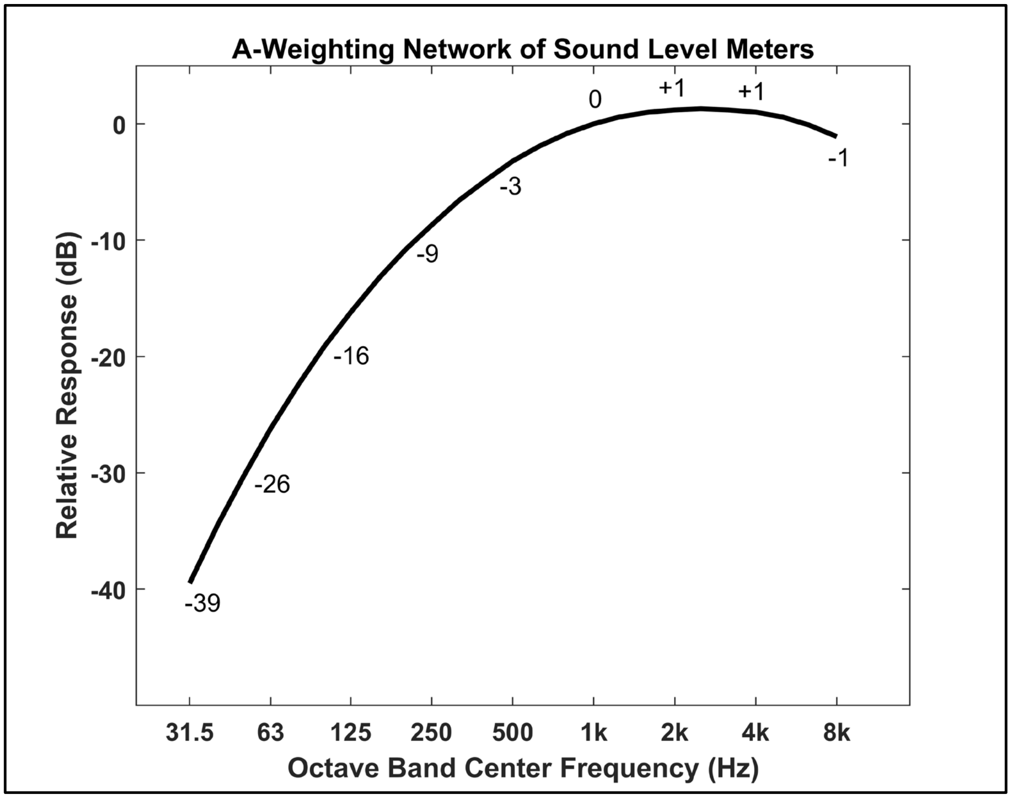
Figure B.1-7: Example of an Audiogram

To account for differences in hearing sensitivity at various frequencies, acoustic risk analyses commonly use auditory weighting functions—mathematical functions that adjust (or "weight") received sound levels with frequency based on how the listener's sensitivity or susceptibility to sound changes at different frequencies. For humans, the most common weighting function is called "A-weighting" (see Figure B.1-9). A-weighted sound levels are specified in units of "dBA" (A-weighted decibels). For example, if the unweighted received level of a 500 Hz tone at a human receiver was 90 dB re 20 µPa, the A-weighted sound level would be 90 dB – 3 dB = 87 dBA because the A-weighting function amplitude at 500 Hz is -3 dB (Figure B.1-9. Many measurements of sound in air appear as A-weighted decibels in the literature because the intent of the authors is to assess noise impacts on humans.

The auditory weighting concept can be applied to other species. When used in analyzing the impacts of sound on an animal, auditory weighting functions adjust received sound levels to emphasize ranges of best hearing and de-emphasize ranges of less or no sensitivity. Auditory weighting functions were developed for marine mammals and sea turtles and are used to assess acoustic impacts. Additional information on auditory weighting functions and their derivation for this analysis are described in the *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase IV) technical report* (U.S. Department of the Navy 2024a).

Masking occurs when noise interferes with the detection, discrimination, or recognition of the relevant sound or signal (Erbe et al. 2016). Auditory masking is defined as the amount in dB by which the threshold of hearing for one sound is raised by the presence of a masking sound (Acoustical Society of

America 2015). Masking occurs only in the presence of the masking noise and does not persist after the cessation of the noise.



Notes: (dB = decibels; Hz = hertz) The numbers along the curve indicate how a received sound level would be adjusted at that frequency.

Figure B.1-8: A-Weighting for Human Hearing of Sounds in Air (adapted from OSHA)

B.1.5 Acoustic Propagation in Small Tanks

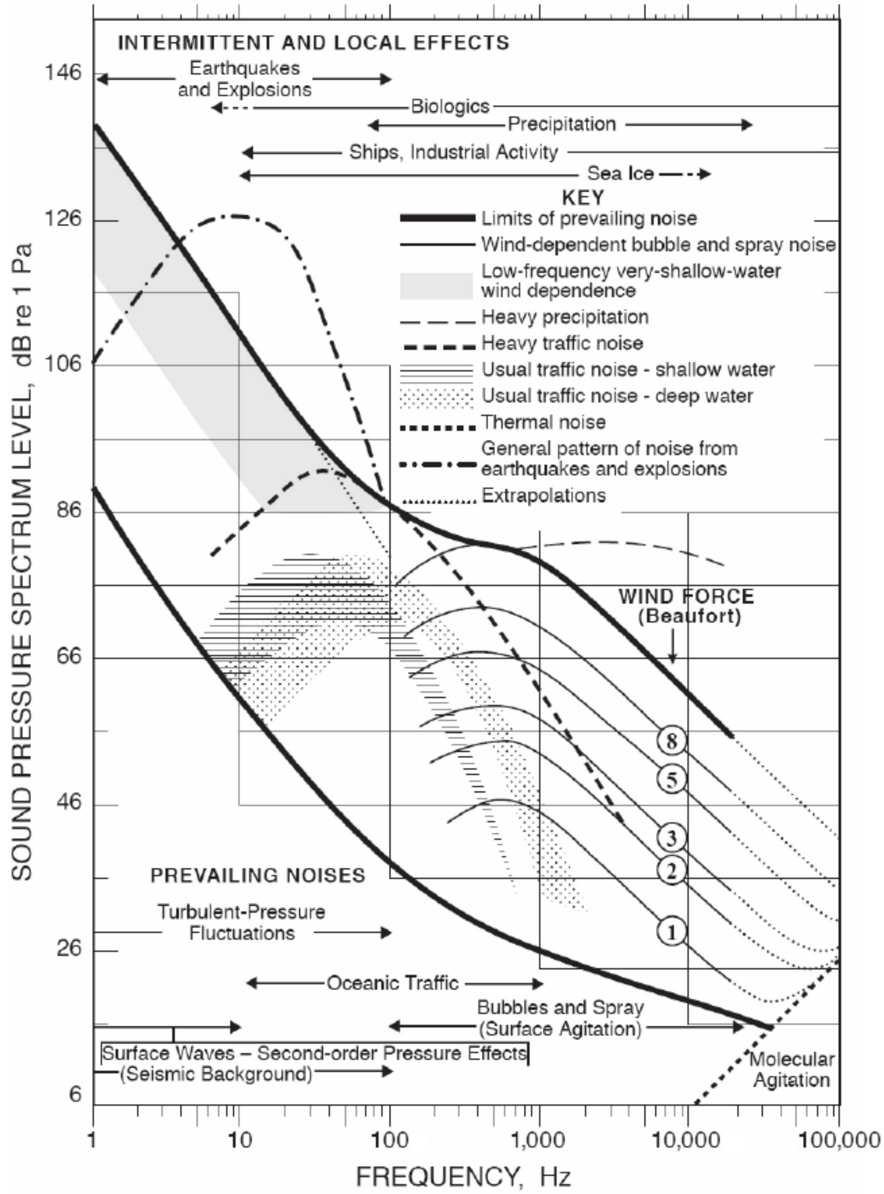
Although it is common to conduct bioacoustic research in small tanks with fishes, invertebrates, and other taxa, results from such experiments should be considered with caution due to the complicated acoustic fields that exist within small tank environments (Akamatsu et al. 2002). In a natural environment such as the open ocean, the particle velocity component of a signal contains more energy closer to the source (i.e., in the near field) compared to sound pressure. As sound propagates away from the source, this relationship shifts into a linear one as the two decay at the same rate in the far field. In a small tank, the acoustic field is complicated by boundaries, specifically the air-water interface at the walls and floor of the tank, and at the water surface (Akamatsu et al. 2002). These boundaries cause multiple overlapping reflections that alter the relationship between particle motion and sound pressure in the near field, attenuate the low-frequency components of the sound, and distort the directionality of the signal. As described in Section B.1.1.8, Resonance, it is known that small containers have resonant frequencies depending on their physical dimensions. When the acoustic signal used in an experiment overlaps that of the tank's resonant frequency, the sound is further distorted. Additionally, the physical dimensions of small tanks can be shorter than the wavelength of the signal used in bioacoustic experiments, further complicating the potential received signal. The placement of the sound source is also an important consideration as there is evidence that the source characteristics may vary at the receiver depending on whether the transducer is located in-water (within the tank) or in-air (adjacent to the tank) (Rogers et al. 2016). It is important for laboratory tests in small tanks to properly measure and characterize the sound field considering reverberations and refractions off the boundaries of the tank (Takahashi and Akamatsu 2018), as well as the test subject itself (especially when using animals that contain air filled organs). In the absence of such considerations, experiments conducted in small tanks may overestimate or mischaracterize the results.

B.2 ACOUSTIC HABITAT

Ambient noise is defined as encompassing all noise at a specific location and time in the absence of a specified sound (International Organization for Standardization 2017). Ambient noise is continuous and has considerable variation across time and space, varying by as much as 10–20 dB from day to day (Richardson et al. 1995). The first systematic investigation of ambient noise was performed by Knudsen et al. (1948 and examined the relationship between noise level, wind speed, and sea state. Wenz (1962 expanded on the work by Knudsen et al. (1948 and described the spectra of natural and anthropogenic sources that contribute to noise in the ocean (Figure B.2-1). In general, the ambient noise spectrum can be broadly categorized into three frequency bands (Wenz 1962). The low-frequency band (10-500 Hz) is dominated by shipping noise, the mid-frequency band (500 Hz-25 kHz) is governed by surface agitation from wind and weather, and the high-frequency band (greater than 25 kHz) is influenced by thermal noise from molecular agitation of water molecules (particularly greater than 50 kHz). Despite changes in the ocean environment, the Knudsen Curves and Wenz Curves are still applicable and useful for understanding and estimating noise levels.

B.2.1 NATURAL NOISE

In underwater soundscape ecology, naturally occurring noise is categorized as geophony, which includes natural sounds of the earth (e.g., wind, waves, and earthquakes), and biophony, which includes sounds from living organisms (e.g., whales, fish, and snapping shrimp). Anthropophony (human generated signals) are not considered part of natural environmental noise. In the absence of distant shipping noise, natural sources dominate the long-term, time-averaged ocean noise across all frequencies. When distant shipping noise is present, natural sources continue to dominate time-averaged ocean noise spectra below 5 Hz and from around 500 Hz to over 200 kHz (National Research Council 2003; Wenz 1962). Prevalent sources of naturally occurring noise discussed in this section are generated by processes including wind, waves, rain, earthquakes, volcanoes, thermal noise, and biological sources.



Source: Wenz (1962
Note: Hz = hertz; dB re 1 µPa = decibels with
a reference of 1 micropascal (µPa)

Figure B.2-1: Wenz Curves Describing the Spectra of Ambient Ocean Noise

B.2.1.1 Surface Interactions

Prevailing ambient noise associated with wind, waves, and rain has multiple contributing factors across a broad frequency range from below 1 Hz to at least 50 kHz (Figure B.2-1). Between 500 Hz and 25 kHz, ambient noise is governed by wind speed, sea state, and resulting surface agitation including air bubble cavitation and spray. At frequencies lower than 500 Hz, ambient noise is less correlated with wind speed and sea state, and as low as 50-100 Hz no relationship exists (Wenz 1962). Noise from shipping and other anthropogenic activities become the prevalent sources of ambient noise at frequencies lower than 500 Hz and it is difficult to discern the impact of wind related noise at lower frequencies (Wenz 1962). The wind-generated noise spectra for a given sea state (i.e., Beaufort 1, 2, 3, 5, and 8 in Figure B.2-1) have a slope of

-5 dB/octave (e.g., a loss of 5 dB of sound energy for each doubled frequency range) or -18 dB/decade (e.g., a loss of 18 dB of sound energy for each tenfold frequency range) and a -29 dB in the spectra from 500 Hz to 25 kHz (Knudsen et al. 1948). Cavitating air bubbles that form near the surface and grow due to a process called rectified diffusion from pressure changes caused by waves, contribute to overall noise levels when bubbles collapse. Whitecaps and spray at the surface can increase estimated noise levels for a given Beaufort sea state in Figure B.2-1 by 4-5 dB when conditions are unusually windy, such as during a large storm (Knudsen et al. 1948). In contrast, estimated noise levels for a given Beaufort sea state may be lower than those in Figure B.2-1 when there is reduced spray and calm conditions.

At frequencies below 10 Hz, surface gravity wave interactions create pressure fluctuations. First order pressure effects are due to the elevation and movement of water at the surface and causes subsurface pressure fluctuations below 0.3 Hz at less than 100 m depth (Wenz 1962). Second order pressure effects occur when two surface waves with the same wavelength travel in opposite directions (e.g., from being reflected offshore). This magnifies the crests and troughs and form a standing wave with consistent pressure across depth, and a frequency twice that of the two surface waves. The noise spectrum of a standing wave has a slope of -8 to -10 dB/octave in the frequency range from 1 to 10 Hz (Wenz 1962).

Intermittent ambient noise from rain is affected by the rate of rainfall, droplet size, wind speed, and area covered. Together, these factors contribute to noise levels primarily above 500 Hz, however, noise levels can extend to lower frequencies (e.g., if heavy rainfall occurs with low wind speeds) (Wenz 1962). Underwater noise from rainfall is generated by the impact of droplets on the water surface, and by trapping a bubble underwater during a splash (Nystuen 2001). Rain droplet size affects the underwater sound spectrum. Small droplets (0.8–1.2-millimieter [mm] diameter) have a strong signal in the spectrum from 13-25 kHz; medium droplets (1.2–2.0 mm diameter) have a signal from 1-30 kHz; large droplets (2.0–3.5-mm diameter) have a signal from 1-35 kHz with a peak in the spectrum at 2-5 kHz, and very large droplets (greater than 3.5-mm diameter) have a signal from 1-50 kHz with a peak in the spectrum from 1-2 kHz (Nystuen 2001). During light rainfall, the ambient noise level can increase by 10-20 dB around 15 kHz (Nystuen and Farmer 1987). In the 1-50 kHz range, heavy rainfall can increase the noise level up to 35 dB, and during extreme rainfall events (rate greater than 100 mm/hour) the noise level can increase up to 50 dB (Nystuen 2001).

B.2.1.2 Biological Sources

Biological sources with an appreciable contribution to underwater ambient noise levels are briefly summarized here. Additional details on sounds from biological sources are provided in the sections below.

Marine mammal vocalizations cover a wide frequency range from less than 10 Hz to around 200 kHz. Broadband clicks and burst pulse signals produced by odontocetes can be used for echolocation, navigation, prey capture, and communication and have peak energy between approximately 10 and 150 kHz. Odontocetes also produce whistles for communication with fundamental frequencies between approximately 1 and 50 kHz. Vocalizations from mysticetes are lower frequency, from tens of Hertz to typically less than 10 kHz, and have the potential to be detected over long distances. For example, low-frequency blue whale calls can be heard by other whales up to 1,600 km away. An exception are humpback whales which can produce calls over 10 kHz (Zoidis et al. 2008) with harmonics up to 24 kHz (Au et al. 2006). Calls from mysticetes are diverse and complex in composition and are used for breeding, feeding, navigation, and communication. Depending on the timing and location, marine mammal vocalizations can be the dominant source of underwater noise in a region. For example, vocalizations produced by migrating mysticetes can seasonally increase ambient noise levels an average of 2-9 dB and up to 25 dB in the 15-22 Hz band (Curtis et al. 1999).

Many species of fish produce pulsed signals with most energy below 1 kHz for communication, courtship, mating, aggressive interactions, and when in distress (National Research Council 2003). The occurrence of fish sounds can also exhibit diurnal, lunar, seasonal, and annual temporal variability. Sounds are produced by individuals, and collectively, many individuals produce choruses which can cause a sustained increase of 10-30 dB in ambient noise levels under 3 kHz (Cato 1978; D'Spain and Batchelor 2006).

Sounds from marine invertebrates are prolific in bays, harbors, estuaries, and coastal areas, and can be a major source of biological noise. Snapping shrimp produce high intensity, broadband impulses to communicate, deter predators, and stun prey. Sounds they produce have peak energy from 2-5 kHz with spectral components up to 250 kHz (Au and Banks 1998) and can increase ambient noise levels up to 20 dB (Hildebrand 2009). They occur in large aggregations in shrimp beds and are prevalent year-round in shallow and warm waters between +/- 40 degrees latitude (Knudsen et al. 1948). Snap rates are positively correlated with water temperature, and noise levels can vary up to 15 dB in the 1.5-20 kHz frequency band between winter and summer (Bohnenstiehl et al. 2015). Although sounds from snapping shrimp are the most prevalent, other marine invertebrates generate sounds as well. For example, sea urchins generate a scraping sound during feeding from 800 to 2,800 Hz (Radford et al. 2008), and spiny lobsters generate broadband pulses called “antennal rasps”, potentially for intra-specific communication, with most energy below 1 kHz (Jezequel et al. 2022).

B.2.1.3 Geologic Activity

Geologic activity primarily contributes to ocean noise at frequencies less than 100 Hz. Earthquake generated acoustic waves in the ocean are called T-waves (tertiary waves) and produce intermittent sound at low frequencies. Earthquakes can occur under the ocean floor, or originate on land, and propagate between the land and ocean interface. Small earthquakes are more frequent and almost continuous in seismically active regions (e.g., the Mid-Atlantic Ridge and the East Pacific Rise). Recordings of earthquakes at the Mid-Atlantic Ridge have an estimated average source level between 199 and 234 dB re 1 µPa (Williams et al. 2006), and a 20 dB increase in the ambient noise level has been observed in the 5-32 Hz band (McGrath 1976). Active underwater volcanoes also generate low-frequency noise with most energy in the octave band centered near 10 Hz (Northrop 1974).

B.2.1.4 Thermal Noise

Thermal noise is generated by pressure fluctuations from the thermal agitation (the movement of molecules due to energy transference) of water molecules. It is the remaining noise when all other sources are removed and provides a threshold on the minimum observable noise levels in the ocean. Thermal noise dictates the shape and level of ambient noise spectra above 50-100 kHz and causes an increase in ambient noise levels at rate of 6 dB/octave (Urick 1983).

B.2.2 Anthropogenic Noise

Marine species have existed, evolved, and adapted in the presence of naturally occurring noise for millions of years whereas the presence of anthropogenic noise is relatively recent, has intensified in the past century, and caused widespread alterations to the acoustic habitat (Duarte et al. 2021). Noise from human activities is often dynamic and few sources (e.g., shipping) have consistent inputs to the acoustic habitat. Anthropogenic noise varies widely in terms of frequency range, duration, and loudness and can have short-term and localized effects on acoustic habitats, as well as long-term effects over large areas. These characteristics strongly influence any potential impacts on marine species and their acoustic habitats. Prevalent sources of anthropogenic noise discussed in this section include vessel noise, sonar, explosions, and industrial activities.

B.2.2.1 Vessel Noise

Vessel noise is a major contributor to noise in the ocean. Radiated noise from ships varies depending on the size, hull design, type of propulsion, and speed. Ship-radiated noise increases with speed and primarily includes propeller blade tip and sheet cavitation (i.e., low pressure vortices shed by blade tips, and a sheet of bubbles on the back of the blade respectively), and broadband noise from water flowing across the hull (Richardson et al. 1995; Urick 1983). Based on these factors, vessel noise can contribute to ocean noise from 10 Hz to 10 kHz (Wenz 1962). Different classes of vessels have unique acoustic signatures characterized by variances in dominant frequencies. Bulk carrier noise is predominantly near 100 Hz while container ship and tanker noise are predominantly below 40 Hz (McKenna et al. 2012). In comparison, small craft emit higher-frequency noise between 1 kHz and 5 kHz (Hildebrand 2009).

Globally, commercial shipping is not uniformly distributed. Major shipping lanes typically follow great circle routes or coastlines and go to and from dozens of major ports, and hundreds of small harbors and ports. Most recreational boating occurs in shallow coastal waters whereas military, fishing, and scientific research vessels can be widely distributed (National Research Council 2003).

Spectral characteristics of individual ships can be observed at short ranges and in isolated environments. At long ranges, multiple vessels contribute to the overall background noise from ocean traffic in the 10 Hz to 1 kHz band (Figure D.2-1). In shallow water, vessel noise repeatedly interacts with the seafloor and surface and is attenuated by reflection, scattering, and absorption. In deep water, vessel noise propagates downward with fewer interactions with the seafloor and surface and undergoes less attenuation (Erbe et al. 2019). Low-frequency components of vessel noise can propagate long distances in deep water and can travel across ocean basins with minimal energy loss especially within the sound fixing and ranging (SOFAR) channel (Erbe et al. 2019). In areas with sloping bathymetry, vessel noise generated in shallow water can radiate into deeper water due to downward propagation and can couple into the SOFAR channel and propagate long distances (Erbe et al. 2019; Hildebrand 2009). As a result, vessel noise generated in shallow nearshore waters can still be present in deep offshore waters many kilometers away from the source.

Commercial shipping's contribution to ambient noise in the ocean increased by as much as 12 dB between approximately the 1960s and 2005 and has been attributed to economic growth (Hildebrand 2009; McDonald et al. 2008). Frisk (2012 confirmed the trend and reported that between 1950 and 2007 ocean noise in the 25 to 50 Hz frequency range has increased 3.3 dB/decade. Assuming a constant baseline level of 52 dB (decibels re 1 $\mu Pa^2/Hz$) during this time results in a cumulative increase of approximately 19 dB. In areas with high levels of shipping traffic, daily average sound levels in the 63 and 125 Hz one-third octave bands were found to be near or higher than 100 dB re 1 μPa (Haver et al. 2021). Daily average sound levels were between approximately 10 to 20 dB higher relative to areas with lower levels of shipping activity (Haver et al. 2021). Temporary reductions in vessel traffic following the events of September 11, 2001, showed an overall decrease of 6 dB (from 50 Hz to 20 kHz), with a notable decrease under 150 Hz (Rolland et al. 2012). Similarly, reduced vessel traffic at the onset of the COVID-19 pandemic resulted in a decrease of 1.5 to 1.7 dB (below 100 Hz) (Breeze et al. 2021; Dahl et al. 2021; Thomson and Barclay 2020). Reductions during the COVID-19 pandemic can be attributed to reduced economic activity and shipping (Thomson and Barclay 2020); however, noise levels were also subject to local variations such as seasonal environmental conditions and the types of vessels active (Breeze et al. 2021; Dahl et al. 2021).

B.2.2.2 Sonar

Active sonar and other transducers emit non-impulsive sound waves into the water to detect objects, safely navigate, and communicate. The contribution of sonar to the acoustic habitat is highly varied and depends on source characteristics (e.g., frequency, source level, directionality, and duty cycle) and factors that affect sound propagation (e.g., temperature, salinity, pressure, and bathymetry). Temporal and spatial usage are also highly varied and can range from minutes to approximately a month, and from tens to hundreds of kilometers (National Research Council 2003). Frequency ranges for categorizing sonars are relative, and generalized divisions that are commonly used include: low-frequency (less than 1 kHz), mid-frequency (1-10 kHz), high-frequency (10-100 kHz), and very high-frequency (greater than 100 kHz) (National Research Council 2003). Given appreciable differences in usage and source characteristics, the contribution of sonar to the acoustic habitat is distinguished between military and commercial sonar systems.

Military sonar systems encompass all three frequency divisions and includes sources with wider beam widths and higher source levels compared with commercial sonar systems. Spatial and temporal usage is well defined both in terms of hours of operation, and the locations where activities occur. Activities are episodic and can last from hours, days to weeks, and over a month (National Research Council 2003). Examples of military specific applications include low-frequency surveillance sonar, mid-frequency tactical sonar, and high-frequency sonar from weapons.

Compared with military sonar systems, commercial sonar systems use higher frequency signals, have lower source levels, narrower beam patterns that are downward directed, shorter pulse lengths, and are typically operated for minutes to days (National Research Council 2003). Usage is widespread across locations and sectors including recreation, fishing, shipping, and research. Sources such as depth finders, multi-beam echosounders, and side-scan sonar are also utilized for military applications. Examples of common commercial sonar systems include depth finders and fish finding sonar (15 to 200 kHz) (Širović et al. 2020), both of which focus sound in a downward beam. Depth finders tend to be used in shallow and nearshore waters for navigation whereas fish finding sonar are operated in both shallow and deep waters. Acoustic deterrent and harassment devices and low powered pingers (5 to 160 kHz) (Hildebrand 2009) are used by fisheries to protect catch from predation. Sea floor mapping for seismic surveys and research utilize multi-beam echosounders (12 to 600 kHz) and side-scan sonar (65 to 500 kHz) (Crocker and Fratantonio 2016; Ruppel et al. 2022).

B.2.2.3 Explosions

Underwater explosions generate broadband high intensity impulsive sounds that propagate equally in all directions. The spectral and amplitude characteristics of explosions vary with the weight of the charge and the depth of the detonation. Most energy is at lower frequencies from tens to hundreds of Hertz. Explosions are typically localized and propagate tens of kilometers, with the exception of acoustic tomography experiments that measure temperatures and currents over large regions of the ocean and can propagate hundreds to thousands of kilometers (National Research Council 2003). Military applications of underwater explosives include bombs, mines, missiles, rockets, torpedoes, and projectiles. Spatial and temporal usage under the current action is well defined both in terms of counts of explosives, and the locations where activities occur. Commercial applications of underwater explosives include using explosives as an acoustic sound source for reflection seismology (i.e., rock/sediment penetration and determination) in geophysical exploration (i.e., oil and gas surveys) and for oceanographic research to study underwater acoustic tomography. The use of explosive sound sources for seismic surveys have largely been replaced by air guns due to environmental and handling safety concerns, as well as the lack of control when reproducing signals. Explosives are commonly used for decommissioning marine structures such as offshore oil and gas platforms by severing pilings and conductor pipes at the seafloor (Klima et al. 1988). In addition, small explosive charges known as seal bombs are commonly used by the fishing industry to protect fishing equipment and catch from predation by deterring marine mammals (Krumpel et al. 2021).

B.2.2.4 Industrial Activities

In many areas of the world, oil and gas seismic exploration in the ocean is undertaken using a group of air guns towed behind large research vessels. The air guns convert high-pressure air into very strong shock wave impulses that are designed to return information from the various buried layers of sediment under the seafloor. Most of the impulse energy (analogous to underwater explosions) produced by air guns is heard as low-frequency noise, which can travel long distances, especially in deep water. Most energy is below 200 Hz with additional energy extending to the kilohertz range (Greene and Richardson 1988; Ruppel et al. 2022). Similar to air guns, other sources that generate an impulse for sub-bottom profiling include: boomers, which use an actuator to displace a near-surface and downward oriented metal plate; sparkers, which discharge a high voltage electric field to vaporize salt water; and bubble guns, which compress air within a plate or pair of plates (Crocker and Fratantonio 2016; Ruppel et al. 2022). Seismic exploration surveys can encompass areas from tens of kilometers to over one hundred kilometers, and last from days to months (National Research Council 2003).

The operation of offshore oil and gas extraction platforms produces nearly continuous noise primarily from 20 to 1,000 Hz (Greene and Richardson 1988) and includes ancillary noise from support vessels and machinery. Oil and gas extraction is typically conducted on offshore platform rigs, drill ships, or artificial islands. Emplacement of permanent structures produces localized noise and lasts for weeks (National Research Council 2003). Drill ships are generally the loudest with most broadband energy between 10 Hz and 10 kHz (Richardson et al. 1995). This is because internal ship noise from machinery is effectively transmitted through the hull, and from the use of thrusters for dynamic positioning during drilling operations.

Pile driving is conducted for construction of nearshore structures such as piers, and for offshore structures including wind farm turbines and oil and gas platforms. Installing piles uses an impact hammer which results in an impulsive sound emanating from the length of the pile into the water column as well as from the bottom of the pile through the sediment. Because the impact wave travels through a steel pile at speeds faster than the speed of sound in water, a steep-fronted acoustic shock wave is formed in the water (Reinhall and Dahl 2011). Piles can also be installed by vibratory pile driving and removed by vibratory extraction, which generates continuous non-impulsive noise with peak pressures lower than impact pile driving. Sound levels can vary depending on the size and power level of the equipment, pile material and diameter, and seafloor sediment type. Installation and removal can encompass areas from less than one kilometer to hundreds of kilometers, and near-continuous activity can last from days to months (National Research Council 2003).

The construction of offshore wind farms can take weeks to months to complete and produces localized low-frequency noise less than 2 kHz (Amaral 2020). Most construction noise is produced from pile driving with ancillary noise from laying cable and support vessels. During operation, wind farms produce continuous low-frequency underwater noise primarily below 1 kHz, with tonals between 20 and 330 Hz (Pangerc et al. 2016).

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APPENDIX C Biological Resources Supplemental Information

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Abbreviations and Acronyms

Acronym	Definition
°C	degrees Celsius
°E	degrees East longitude
°F	degrees Fahrenheit
°N	degrees North latitude
°S	degrees South latitude
°W	degrees West longitude
ABR	auditory brainstem response
AEP	auditory evoked potential
AMW	Antarctic minke whale
ATOC	Acoustic Thermometry of Ocean Climate
CA-OR-WA	California-Oregon-Washington stock
CITES	Convention on International Trade in Endangered Species of Wild Flora and Fauna
CNMI	Commonwealth of the Northern Mariana Islands
CNP	Central North Pacific
CV	coefficient of variation
dB	decibels
dB re 1 µPa	decibels referenced to 1 micropascal
DPS	Distinct Population Segment(s)
EEZ	Exclusive Economic Zone
ESA	Endangered Species Act
ESU	evolutionary significant unit
ETP	Eastern Tropical Pacific
FM	frequency modulated
FR	Federal Register
ft	feet
ft/s	feet per second
HF	high frequency
Hz	Hertz
ICI	Inter-click interval(s)
IFKW	Insular false killer whale(s)
IUCN	International Union for Conservation of Nature
kHz	kilohertz
km	Kilometer(s)
kph	Kilometer(s) per hour
kt	Knot(s)
LF	low frequency
m	meter(s)
m/s	meter(s) per second
MHI	Main Hawaiian Islands
mi	mile(s)

Acronym	Definition
min	minute(s)
MMPA	Marine Mammal Protection Act
mph	mile(s) per hour
msec	millisecond(s)
navy	United States Department of the Navy
NM	Nautical mile(s)
NMFS	National Marine Fisheries Service
NPRW	North Pacific Right Whale
RL	Received Level
rms	root mean square
SEIS/SOEIS	Supplemental Environmental Impact Statement/Supplemental Overseas Environmental Impact Statement
sec	Second(s)
SL	source level
SMM	Society for Marine Mammalogy
SURTASS	Surveillance Towed Array Sensor System
U.S.	United States
USFWS	U.S. Fish and Wildlife Service
WNP	Western North Pacific

C.1 Endangered Species Act-listed Marine Fishes

Chinook Salmon (*Oncorhynchus tshawytscha*)

A total of nine Chinook salmon Evolutionarily Significant Units (ESUs) are either listed as threatened or endangered under the Endangered Species Act (ESA) (59 Federal Register [FR] 440, January 4, 1994; 70 FR 37159, June 28, 2005; 79 FR 20802, April 14, 2017). Each ESA-listed ESU originates from streams and rivers in the Pacific Northwest or California regions. In the previous Supplemental Environmental Impact Statement/Supplemental Overseas Environmental Impact Statement (SEIS/SOEIS) (U.S. Department of Navy 2019) Biological Opinion (National Marine Fisheries Service, 2019), ESA-listed Chinook ESUs were assumed to overlap with the Surveillance Towed Array Sensor System (SURTASS) Study Area. However, an updated comprehensive review of available distribution literature, bycatch data, directed catch data, and tagging studies indicates that ESA-listed Chinook, which originate from eastern north Pacific river systems, have not been documented in the Study Area as they tend to prefer continental shelf habitats east of the Study Area (Beamish et al. 2023; Guthrie et al. 2022; Masuda et al. 2023; Masuda et al. 2024; Sato 2023a, 2024; Sato et al. 2024a; Sato 2023b; Sato et al. 2024b; Seitz and Courtney 2021, 2022, 2023, 2024; Seitz et al. 2019; Weitkamp 2010). Due to their absence from the Study Area, Chinook salmon are not discussed further.

Chum Salmon (*Oncorhynchus keta*)

Two chum salmon ESUs are listed under the ESA: the Columbia River and the Hood Canal summer-run (79 FR 20802, April 14, 2014). Chum salmon from both ESA-listed ESUs are listed as threatened and potentially occur in the North Pacific Ocean portion of the Study Area. Critical habitat for chum salmon has been designated, but it does not overlap with the Study Area. Therefore, it is not further discussed. Chum salmon are not listed under the International Union for Conservation of Nature (IUCN) Red List or under Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES).

The overall population size of the Hood Canal Summer-run ESU, which includes both naturally-spawning and hatchery fish, was estimated to be several thousand individuals in the early 2000s (Good et al. 2005; Weinheimer 2016). The 2019-2023 geometric mean for this population exceeds 20,000 fish annually (WDFW 2025b). Further, the 2025 forecast, excluding the hatchery fish included in this ESU, exceeds 67,000 summer-run chum salmon (WDFW 2025a). Although the population is increasing and the ESU considered on the path to recovery, the most recent viability trend, in 2022, for the Hood Canal summer-run ESU remains unchanged since 2015, as does their moderate to low extinction risk (Ford 2022). Historically, a few thousand chum salmon per year were estimated to return to the Columbia River Basin (Good et al. 2005; Homel and Alexander 2022). Three Major Population Groups remain within the Columbia River ESU. Although the abundances have not yet met recovery thresholds, , the most recent 5-year geometric mean for these populations is over 24,000 fish, with each Major Population Group demonstrating a “positive” or “strongly positive” long-term abundance trend (Ford 2022). Spawning, rearing, and mating for these ESU’s are not further discussed since they occur outside of the Study Area.

Like other Pacific salmon species, the chum salmon is anadromous and migrates from freshwater tributaries to saltwater (Salo 1991). Almost immediately after hatching, they migrate to estuarine and ocean waters where they remain for three to five years (Johnson et al. 1997; Salo 1991). Chum salmon have been recorded to migrate into the North Pacific region of the Study Area (Kaeriyama 2021; Myers et al. 2007). Although the fish most likely are not from the Columbia River or Hood Canal summer-run stocks, it is assumed that these stocks of concern could also migrate into the North Pacific region of the Study

Area. In the ocean, chum salmon forage upon small fishes, squid, krill, copepods, pteropods, jellyfish (medusa, ctenophores), salps, and more (Azuma 1992; Kovals 2006; Qin and Kaeriyama 2016).

Coho Salmon (*Oncorhynchus kisutch*)

Four of the seven coho salmon ESUs are listed under the ESA as either threatened (Lower Columbia River ESU, Oregon Coast ESU, Southern Oregon and Northern California Coasts ESU) or endangered (Central California Coast ESU) (79 FR 20802, April 14, 2014; 70 FR 37160, June 28, 2005). Critical habitat has been established for all four ESA-listed ESUs (64 FR 24049, May 5, 1999; 73 FR 7815, February 11, 2008; 81 FR 9251, February 24, 2016), but it does not occur within the Study Area. Therefore, critical habitat for coho salmon is not further discussed. ESA-listed coho salmon may occur in the North Pacific part of the Study Area. Coho salmon are not listed under the IUCN Red List or under CITES.

The overall population trends for the ESA-listed ESUs in recent years indicate either stable (South Oregon and Northern California coasts ESU), slight improvement (Central California Coast ESU), or negative abundance trends (Lower Columbia River and Oregon Coast ESUs) (Ford 2022; NOAA 2022a). Coho salmon have been recorded to migrate across the most northern portion of the North Pacific Ocean of the Study Area (Sandercock 1991; Walker 1991). Although the coho salmon most likely are not from the four ESUs of concern, we assume coho salmon from the Lower Columbia River, Oregon Coast, Southern Oregon and Northern California Coasts, and Central California Coast ESUs may occur within the Study Area.

Coho salmon exhibit a simple, three-year life cycle, spending the first 15 months of life developing in freshwater (Ford 2022; Sandercock 1991). Juveniles migrate into the waters of the North Pacific Ocean from spring through summer (April to August), with the peak of migration occurring in May (Emmett et al. 1991; Sandercock 1991). Upon entering the ocean, coho may spend several weeks or their entire first summer in coastal waters before migrating into open ocean waters (Sandercock 1991). Adult coho spend around sixteen months to two years in the ocean, where they feed upon crustaceans (e.g., copepods, amphipods), mollusks (e.g., octopus, gastropods), and fishes (e.g., Pacific sand lance [*Ammodytes hexapterus*], sockeye salmon [*Oncorhynchus nerka*], North Pacific hake [*Merluccius productus*]) (King and Beamish 2000; Sandercock 1991). Adult coho salmon return to freshwater, located outside of the Study Area, to complete their life cycle by spawning and dying (Sandercock 1991).

Giant Manta Ray (*Mobula birostris*)

The giant manta ray is listed as threated under the ESA throughout its range (83 FR 2916, January 22, 2018). There is no critical habitat designated for this species. The giant manta ray is listed as endangered under the IUCN Red List (Marshall et al., 2022), and it is listed under CITES Appendix II (CITES 2023). This species may be found in the Study Area south of approximately 40.45 degrees North latitude (°N) (Marshall et al. 2022).

The giant manta ray is the largest living ray and has a circumglobal distribution in tropical, subtropical, and temperate oceanic waters. This species has also been observed in nearshore, highly productive waters and in waters surrounding coastal and offshore islands (Couturier et al. 2012; Marshall et al. 2009; Stewart et al. 2017). Some regions the giant manta ray has been documented in the Pacific and Indian Oceans include near Guam, China, Japan, India, Hawaii, Sri Lanka, Australia, Indonesia, and Taiwan (Marshall et al. 2022).

The giant manta ray is considered a rare species throughout most of its range except in limited aggregation areas (Miller and Klimovich 2017). Overall population size for the giant manta ray is unknown, but subpopulations appear to have abundances ranging from under 100 to 1,500 individuals, and these subpopulations are sparsely distributed and highly fragmented (CITES 2013; Fernando 2018; Marshall et al. 2022; Miller and Klimovich 2017; Rambahiniarison et al. 2023). For example, an aggregation site in Thailand is the largest known aggregation in the Indian Ocean, with an estimated size of greater than 288 individuals in 2016 (Miller and Klimovich 2017).

The global population reduction is suspected to be between 50 and 80 percent over the last three generations (87 years) (Marshall et al. 2022). Regions of known giant manta ray decline include Indonesia, India, and Sri Lanka (CITES 2013; Couturier et al. 2012; Fernando and Stewart 2021; Miller and Klimovich 2017; White et al. 2006). There were 35 individuals reported across 11 fishery survey sites in Sri Lanka from August 2017 to August 2018 (Fernando 2018).

Giant manta rays appear to exhibit a high level of flexibility in their habitat use, especially regarding water depths. The giant manta ray often is found in surface waters to depths of 3,280 feet (ft; 1,000 meters [m]) (Marshall et al. 2022). This species historically has been considered a migratory species capable of traveling relatively long distances (e.g., up to 930 miles [mi]; 1,500 kilometers [km]) to feed, mate, or be cleaned (CITES 2013; Hearn et al. 2014). However, it has been suggested that long-distance migrations are rare (Stewart et al. 2016). For example, Stewart et al. (2016) tagged giant manta rays over a 20-month period in the Indo-Pacific and found that rays remained in the general region they were initially tagged. Giant manta rays may commonly occur in well-structured subpopulations that exhibit a high degree of residency, especially to cleaning stations and feeding sites (Stewart et al. 2016). Giant manta rays are filter feeders that forage on zooplankton and potentially small to moderate sized fishes (Burgess et al. 2016; Compagno and Last 1999).

Oceanic Whitetip Shark (*Carcharhinus longimanus*)

The oceanic whitetip shark is listed as threatened under the ESA throughout its range (83 FR 4153, January 30, 2018). No critical habitat has been designated for the oceanic whitetip shark. The oceanic whitetip shark is listed as critically endangered under the IUCN Red List (Rigby et al. 2019a), and it is listed under CITES Appendix II throughout its range (CITES 2023). This species would occur throughout the Study Area (Rigby et al. 2019a).

The oceanic whitetip shark was historically considered to be the most globally abundant and common pelagic shark in tropical waters (Backus et al. 1956; Mather and Day 1954; Strasburg 1962). Although no global abundance exists for this shark, the available data and information suggest that overall, this species has undergone a population decline that varies in extent regionally (NOAA 2023a; Rigby et al. 2019a; Young and Carlson 2020). Population abundances for the oceanic whitetip shark in the Indian Ocean are uncertain and less reliable due to limited data (NOAA 2023a). However, data from Japanese and Spanish longline fisheries suggest population declines range from 25 to 40 percent for the Indian Ocean since the late 1990s (Lopetegui-Eguren et al. 2022; Ramos-Cartelle et al. 2012; Yokawa and Semba 2012). More data are needed to make any conclusions regarding population status for oceanic whitetip sharks in the Indian Ocean (NOAA 2023a). In areas of the central and western Pacific Ocean, the abundance of oceanic whitetip sharks has declined by approximately 86 to 90 percent or more (Brodziak and Walsh 2013; Ramos-Cartelle et al. 2012; Rice and Harley 2012). Rice and Harley (2012) estimated the 2010 median biomass for the Western Central Pacific at 8,040 tons (7,295 metric tons), which is equal to approximately 200,000 individuals (FAO 2013). The most recent stock assessment estimated the annual average total biomass in 2010 to be around 19,840 tons (18,000 metric tons) and the 2016 total biomass to be around 11,025 tons (10,000 metric tons), showing a decline in total biomass (Tremblay-Boyer et al. 2019). The oceanic whitetip shark is considered to be in a severely depleted state for the whole central and western Pacific Ocean Study Area (Clarke 2011; NOAA 2023a).

The oceanic whitetip shark occurs worldwide in pelagic tropical and subtropical waters of the world (Rigby et al. 2019a; Young and Carlson 2020). The oceanic whitetip shark inhabits open ocean waters between 10 °N and 10 degrees South latitude (°S) and occurs in lower numbers in outer continental shelf waters and around deep-water oceanic islands, as well as oceanic waters between 30 °N and 35 °S (Compagno 1984; NOAA 2023a; Strasburg 1962). Oceanic whitetip sharks inhabit waters between 59 and 82 degrees Fahrenheit (°F; 15 and 28 degrees Celsius [°C]), and sharks exhibit a strong preference for the surface mixed layer when water temperatures are above 68 °F (20 °C) (Bonfil et al. 2008; Carlson and Gulak 2012; Howey-Jordan et al. 2013; Lopetegui-Eguren et al. 2022). This shark typically is found in the upper 656 ft (200 m) of the water column but has been documented diving to water depths of 840 ft (256 m), and even as deep as 3,583 ft (1,092 m) (Andrzejaczek et al. 2018; Carlson and Gulak 2012; Howey-Jordan et al. 2013; Howey et al. 2016; Lopetegui-Eguren et al. 2022).

The oceanic whitetip shark is known as a highly migratory species capable of making long distance movements (Bonfil et al. 2008; Howey-Jordan et al. 2013; Lopetegui-Eguren et al. 2022). In the Indian Ocean, two tagged individuals traveled horizontal distances of 684 and 4,039 mi (1,100 and 6,500 km), respectively (Filmalter et al. 2012). In the central North Pacific Ocean, tagged oceanic whitetip sharks have shown complex movement patterns that were generally limited to the tropical waters north of the North Equatorial Countercurrent (Musyl et al. 2011). However, some regional populations have been shown to exhibit some degree of site fidelity (Howey-Jordan et al. 2013; Tolotti et al. 2015). Oceanic whitetip sharks primarily forage upon bony fishes (e.g., oarfish [*Regalecus* spp.], lancetfish [*Alepisaurus* spp.], dolphinfish [*Coryphaena* spp.]) and cephalopods (IOTC 2007; NOAA 2023a). Other prey species include stingrays, sea turtles, sea birds, and mammalian carrion (IOTC 2007).

Sakhalin Sturgeon (*Acipenser mikadoi*)

The Sakhalin sturgeon, an ESA-listed Foreign species, is listed as endangered throughout its range under the ESA (79 FR 31222, June 2, 2014). No critical habitat is designated for the Sakhalin sturgeon. It is listed as critically endangered under the IUCN Red List (Chebanov et al. 2022), and it is listed under CITES Appendix II throughout its range (CITES 2023). The Sakhalin Sturgeon could occur within the North Pacific Ocean region of the Study Area.

The Sakhalin sturgeon occurs only in the waters of the western North Pacific Ocean, in the Sea of Japan (as far south as Hokkaido, Japan)**,** Tatar Strait, and various coastal rivers (Chebanov et al. 2022; Shmigirilov et al. 2007). Sakhalin sturgeon migrate into freshwater rivers to spawn. The Tumnin River in Russia is thought to be the only persistent spawning river for Sakhalin sturgeon, and they spawn here from June to July (Chebanov et al. 2022; NOAA 2023d). The population size of Sakhalin sturgeon has declined greater than 90 percent over the last 100 years (Chebanov et al. 2022). It is estimated that the wild population size consists of fewer than 250 mature fish (Chebanov et al. 2022). Juveniles remain in freshwater or estuaries to around four years of age, then they migrate to the sea (Koshelev et al. 2012; Mikodina and Ruban 2021). Sakhalin sturgeon forage on other fishes and on invertebrates (e.g., shrimp, amphipods, crabs) (NOAA 2023d; Shmigirilov et al. 2007).

Scalloped Hammerhead Shark (*Sphyrna lewini*)

The scalloped hammerhead shark is divided into six distinct population segments (DPSs), with four listed as endangered or threatened under the ESA. The only DPS that is ESA-listed that occurs within the Study Area is the Indo-West Pacific DPS which is listed as threatened (79 FR 38214, July 3, 2014) (Figure C-1). There is no critical habitat designated for this species. The scalloped hammerhead shark is listed as critically endangered under the IUCN Red List (Rigby et al. 2019b), and it is listed under CITES Appendix II throughout its range (CITES 2023).

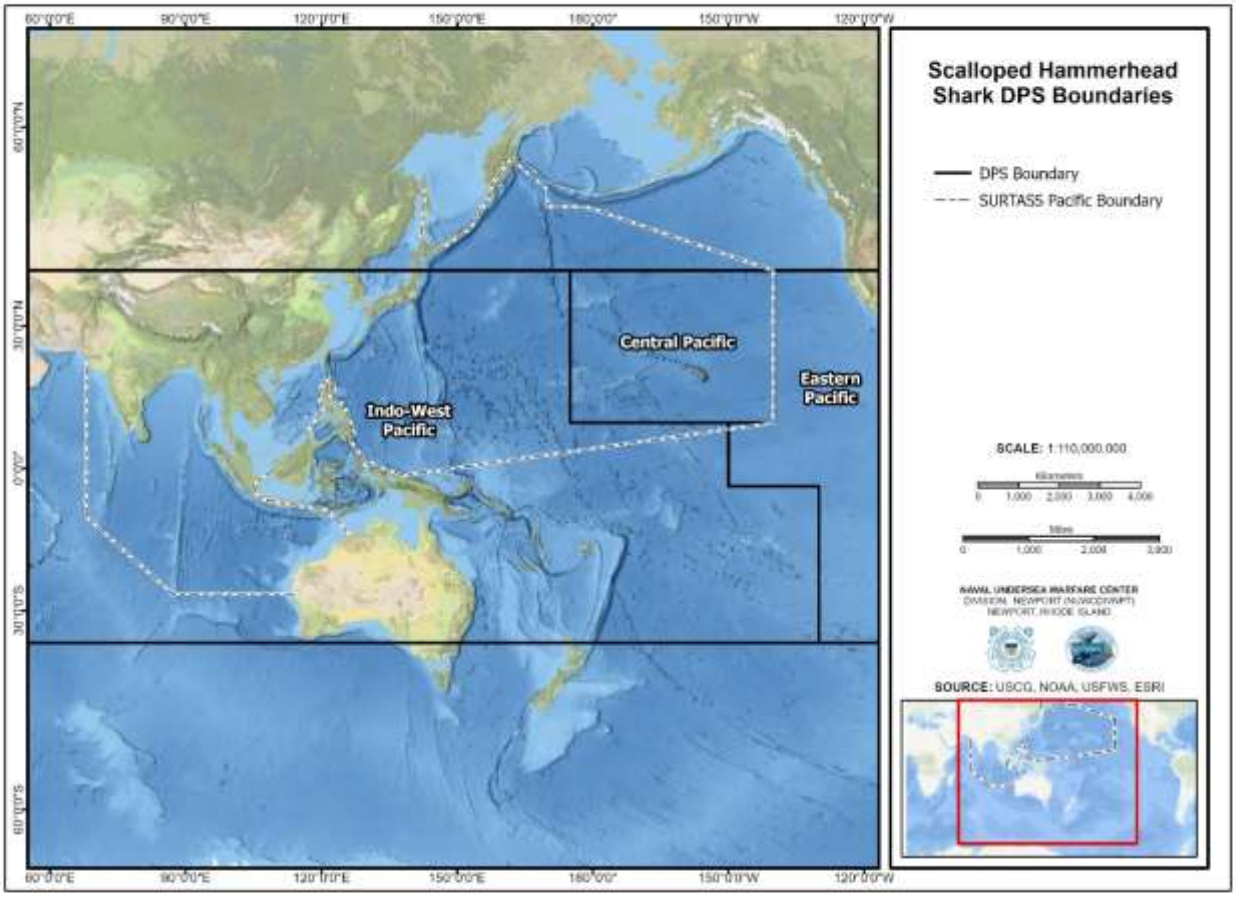

Figure C-1. Three Scalloped Hammerhead Shark DPS Boundaries that overlap with the Study Area

The Indo-West Pacific DPS is the only ESA-listed Scalloped Hammerhead DPS that occurs within the Study Area. The Central Pacific DPS is not ESA-listed.

No global population estimates for the scalloped hammerhead shark are available. The species is considered rare in some locations in the Indo-West Pacific, such as Guam (Budd et al. 2021), but it is common in other locations, such as near Indonesia (Simeon et al. 2021). The Queensland, Australia shark bather protection program indicated an annual rate of decline of 8.4 percent from 1964 to 2004 for scalloped hammerheads (Rigby et al. 2019b). The Indian Ocean Natal Sharks Board bather protection netting program reported a four percent annual rate of reduction in population abundance from 1987 to 2003 (Rigby et al. 2019b). From Asian shark fin market data and statistical analysis, Clarke et al. (2006) estimated that from one to three million hammerhead sharks (*Sphyrna* spp.) are traded per year.

The scalloped hammerhead shark is a coastal and semi-oceanic species with a circumglobal distribution in warm-temperate to tropical coastal and oceanic waters, including bays and estuaries, that may occur in waters as deep as 902 ft (275 m), with occasional dives to even deeper depths (3,419 ft [1,042 m]) (Compagno 1984; Hoffmayer et al. 2013; Miller et al. 2014; Moore and Gates 2015; Royer et al. 2023).

Scalloped hammerhead sharks favor oceanic regions of high productivity (Queiroz et al. 2016). In the western Pacific Ocean, the scalloped hammerhead shark occurs in the waters of Japan, China, Vietnam, Thailand, and Indonesia (Jacoby et al. 2022; Miller et al. 2014; Rigby et al. 2019b). In the Indian Ocean, populations of this shark occur in the waters of India, Sri Lanka, Myanmar, and western Australia (Miller et al. 2014; Rigby et al. 2019b).

Scalloped hammerheads are highly mobile and partially migratory (Miller et al. 2014; NOAA 2020b). Tagging and genetic studies indicate wide-ranging movements and occasional long-distance dispersals in waters with similar oceanographic conditions, but DPSs are isolated by bathymetric barriers and oceanographic conditions (Bessudo et al. 2011; Miller et al. 2014; Queiroz et al. 2016). Adult scalloped hammerheads have been noted to travel short distances (less than 0.2 mi [0.3 km]) (Coiraton et al. 2020; Ketchum et al. 2014) to maximum known travel distances of 1,205 mi (1,940 km) (Bessudo et al. 2011; Coiraton et al. 2020; Kohler and Turner 2001). Juveniles rear in coastal nursery areas (Duncan and Holland 2006) and rarely inhabit the open ocean (Kohler and Turner 2001).

Scalloped hammerheads forage on a number of fish species (e.g., goatfish [*Parupeneus cyclostomus*], wrasses [Labridae], blacktip reef sharks [*Carcharhinus melanopterus*]) and invertebrates (e.g., cephalopods, sea snails, crabs) (Compagno 1984). Juveniles feed mainly on coastal benthic prey as well as epipelagic and benthic squid (Galván-Magaña et al. 2013; Musick and Fowler 2007; Torres-Rojas et al. 2010; Torres-Rojas et al. 2014).

Sockeye Salmon (*Oncorhynchus nerka*)

Two of seven sockeye salmon ESUs in the United States (U.S.) have been listed under the ESA; the Ozette Lake ESU is listed as threatened while the Snake River ESU is listed as endangered (79 FR 20802, April 14, 2014). Sockeye salmon from both ESA-listed ESUs potentially occur in the North Pacific portion of the Study Area. Critical habitat has been designated for both ESUs (58 FR 68543, December 28, 1993; 70 FR 526129, September 2, 2005), but it is located outside of the Study Area**.** Therefore, critical habitat is not further discussed. Sockeye salmon are listed as least concern on the IUCN Red List of Threatened Species (Rand 2011), and they are not listed under CITES.

The abundance of the Snake River ESU shows a decreasing trend in the population over the last five years, with hatchery stock fish thought to have prevented this ESU from becoming extinct (Ford 2022; NOAA 2022b). However, biologists noted that 2022 was the second-highest return of fish, 749 individuals (wild and hatchery-reared fish, combined), in a decade to cross the Lower Granite Dam (450 mi [724 km] from sockeye spawning grounds) on the Snake River (Johnson et al. 2022; NMFS 2023c; Phillips 2022). The Ozette Lake ESU population status has only slightly improved over the last five years, with the wild spawning population estimated to include only 2,894 sockeye salmon (Ford 2022).

Sockeye salmon range from about 45—70 °N and from 140 degrees East longitude (°E)—125 degrees West longitude (°W) (Rand 2011), with portions of this range occurring within the Study Area. They occur around the northern Pacific Rim of the Pacific Ocean, ranging from the Columbia River to the Nome River, Alaska in the east and from Hokkaido, Japan to the Anadyr River, Russia in the west (Burgner 1991; Gustafson et al. 1997). Sockeye salmon prefer cooler ocean conditions than most other species of Pacific salmon. Sockeye mostly require lake environments for the first half of their lives, spending the remainder of their life cycle in estuarine and marine waters of the North Pacific Ocean (Burgner 1991; Gustafson et al. 1997).

Sockeye salmon are primarily anadromous and only spawn once before dying, but like Chinook salmon, they exhibit a more varied life history and ecology than other species of Pacific salmon. There are three ecotypes (i.e., locally-adapted population of a widespread species) of sockeye salmon (lake-type, sea-type/river-type, and kokanee). Kokanee are landlocked populations of sockeye salmon that are non-anadromous and spend their entire life cycle in freshwater habitats (Burgner 1991; Emmett et al. 1991), so they would not occur within the Study Area. Sockeye salmon forage in the ocean on zooplankton (e.g., krill, hyperiid amphipods, crab larvae), squid, and fishes (e.g., capelin [*Mallotus villosus*], rockfish [*Sebastes* spp.]) (Brodeur 1990; Daly et al. 2019).

Steelhead (*Oncorhynchus mykiss*)

Steelhead is an anadromous form of rainbow trout (*Oncorhynchus mykiss*) protected under the ESA. Eleven DPSs of steelhead are listed under the ESA as either threatened or endangered (71 FR 833, January 5, 2006; 79 FR 20802, April 14, 2014). Of the listed steelhead, it is extremely difficult to differentiate between stocks when considering steelhead offshore occurrence because they undergo substantial migrations (Light et al. 1989).

In the previous SEIS/SOEIS (U.S. Department of Navy 2019) and Biological Opinion (NMFS 2019), all eleven ESA-listed steelhead DPSs were assumed to overlap with the SURTASS Study Area. In their review of available literature, The National Marine Fisheries Service (NMFS) (2022) stated there was no information, including tagging data, that suggested steelhead from California or Southern Oregon occurred in the Gulf of Alaska. An updated review indicates that the two southernmost steelhead DPSs (Southern California Coast Steelhead DPS and the South-Central California Coast steelhead DPS) do not occur in the Study Area. Unlike northern steelhead populations, juveniles from southern California systems migrate north and south along the continental shelf to areas of ocean upwelling south of San Francisco Bay, CA, though some northern California-origin steelhead have been detected in Alaska (Barnhart 1991; Burgner et al. 1992; Moyle et al. 2017). Returning adult steelhead from southern California systems may remain in California waters for extended periods, opportunistically waiting for natal streams blocked by the formation of a sand/gravel bar at the mouth of the estuary to once again become passable (Barnhart 1991; Burgner et al. 1992; Busby et al. 1996; Moyle et al. 2017). Fewer barriers to upstream migration for northern California-origin steelhead populations may be one reason why they have more extensive at-sea migrations. Due to their broader distribution, the nine northernmost steelhead DPSs listed under the ESA in Table 34 have the potential to occur in the Study Area.

Critical habitat has been established for all 9 ESA-listed DPSs (81 FR 9252, February 24, 2016; 70 FR 52629 and 70 FR 52487, September 2, 2005), but it is outside of the Study Area. Therefore, critical habitat is not further discussed. Steelhead are not listed under the IUCN Red List or under CITES.

The estimated historical (1970 to 1987) average annual abundance of steelhead was 772,000 wild individuals and 799,000 hatchery stock individuals (Light 1987). Current west coast steelhead populations are considered to be a small portion of their historical abundances (NOAA 2016). The majority of the ESA-listed steelhead DPSs are considered to be unchanged over the last five years, with abundances remaining low (Ford 2022). The Puget Sound DPS has showed some recent improvement in viability, but even with improvements, most populations within the Puget Sound DPS have low abundance levels (Ford 2022). Though 2019 and 2020 indicated a small rebound from population lows in 2017, the Upper Willamette River DPS continues to decline in abundance relative to historic populations (Ford 2022).

Steelhead exhibit one of the most complex life histories of any salmonid species. They may exhibit either an anadromous lifestyle or spend their entire life in freshwater (where they are commonly referred to as rainbow trout) (Light et al. 1989; Myers 2018). Steelhead can be divided into two biological or reproductive ecotypes: stream-maturing and ocean-maturing. These ecotypes are differentiated by their state of sexual maturity at the time of return to freshwater and the duration of their spawning migration with summer-run steelheads being immature when entering freshwater from the ocean and winter-run steelhead being sexually mature when entering freshwater (Busby et al. 1996; Myers 2018).

Steelhead are the most long-lived of the salmon family, living as long as 11 years (NOAA 2023e). They typically migrate to marine waters after spending two to four years in freshwater, but some juveniles have been known to live up to seven years in freshwater before migrating to the ocean (Busby et al. 1996). Steelhead have been recorded in the Northern Pacific Ocean from 40—58 °N and from 145 °E—125 °W, with fish found further west potentially originating from Japan rather than North America (Light et al. 1989). Based on this distribution, steelhead occur within the North Pacific region of the Study Area.

Steelhead typically remain in marine waters for two to three years prior to returning to their natal stream to spawn (Busby et al. 1996). Unlike Pacific salmon, steelhead can be repeat spawners. Outmigrating kelts (most typically adult female steelhead that have spawned and are migrating back downstream to the ocean) from these systems also typically leave freshwater and re-enter the marine system by late spring (Moyle et al. 2017). Some populations of steelhead, known as half-pounders, return to freshwater after their first season in the ocean, do not spawn, and then return to the sea after one winter season in freshwater (Busby et al. 1996; Light et al. 1989). In the ocean, steelhead prey upon fish, squid, krill, amphipods, and pelagic polychaetes (Brodeur 1990).

C.2 Sea Turtles

Green Sea Turtle (*Chelonia mydas*)

The green sea turtle is ESA-listed (81 FR 20057; April 6, 2016), protected under Appendix I of CITES (UNEP 2023), and listed as endangered by the IUCN Red List, with decreasing populations (Seminoff 2004). Eleven worldwide DPSs for the green turtle have been designated as either threatened or endangered under the ESA. Five ESA-listed DPSs (Central West Pacific, Central North Pacific, East Indian-West Pacific, North Indian, and Southwest Indian DPSs) would be expected to occur in the Study Area (Table C-1; Figure C-2.) (Seminoff et al. 2015). Green turtles from multiple DPSs may be found on foraging grounds or in the pelagic ocean environment within the Study Area. However, this section focuses on the five DPSs that fall within the boundaries of the Study Area, as turtles from these DPSs are most likely to be encountered. No critical habitat has been designated within the Study Area.

Table C-1. Estimated Abundance DPSs that Occur in the Study Area

Green Turtle DPS	*ESA Status*	*Estimated Abundance of Nesting Females*[1, 2, 3]
Central West Pacific	Endangered	6,518
Central North Pacific	Threatened	3,846
East Indian-West Pacific	Threatened	77,009
North Indian	Threatened	55,243
Southwest Indian	Threatened	91,159

DPS = Distinct Population Segment; ESA = Endangered Species Act
[1] The estimated abundance of nesting females is calculated by: (Total Counted Females/Years of Monitoring) x Remigration Interval
[2] The number of total sites in each DPS analyzed ranged from 12 to 74.
[3] For most DPSs, only portions of the DPS occur within the Study Area
Reference: (Seminoff et al. 2015)

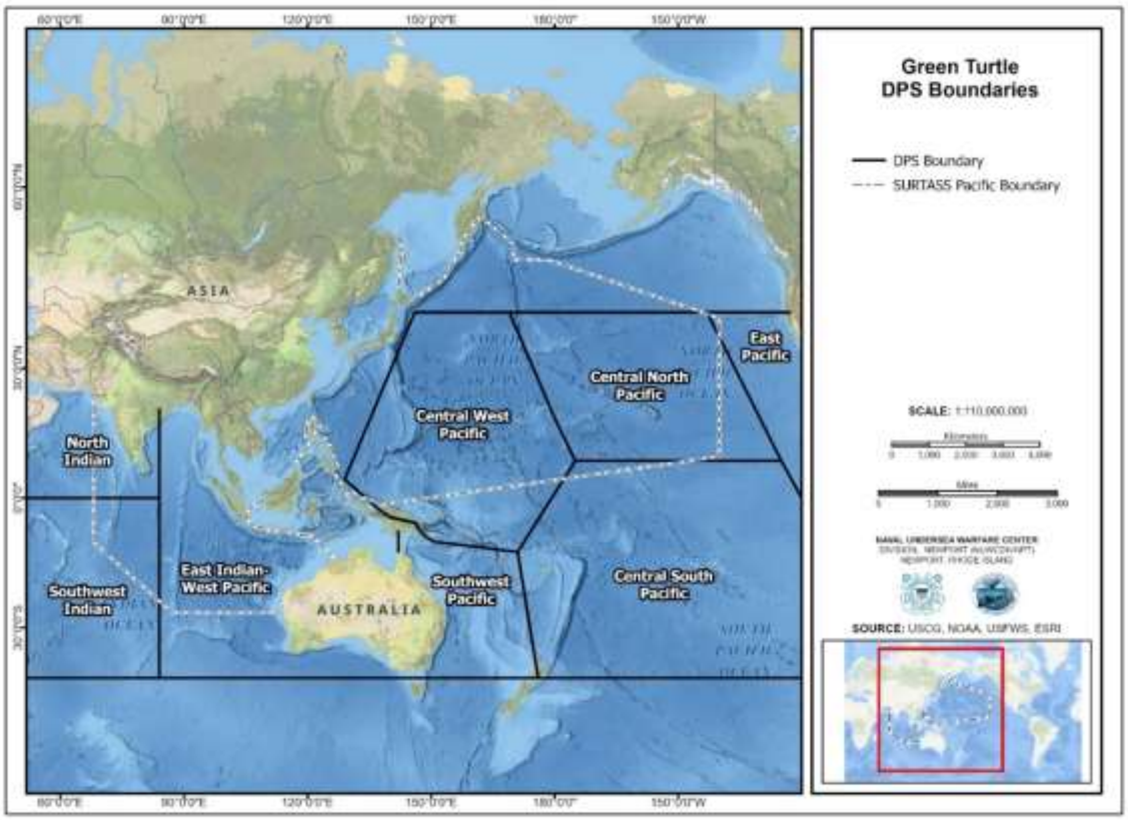

Figure C-2. Distribution of the Threatened and Endangered DPSs Listed Under the ESA for the Green Sea Turtle Relative to the Study Area (NOAA 2018b)

The DPS boundaries were derived based on genetic and demographic information (Seminoff et al. 2015). Demographic information includes green turtle nesting information, morphological and behavioral data, tagging and satellite telemetry data, oceanic features, geographical barriers, and anthropogenic effects. The five main DPSs within the Study Area include Southwest Indian, North Indian, East Indian-West Pacific, Central West Pacific, and Central North Pacific.

Green turtles are widespread throughout tropical, subtropical, and warm-temperate waters of the Atlantic, Pacific, and Indian Oceans and the Mediterranean Sea between 30 °N and 30 °S (Hirth 1997; Seminoff 2004). Adults make long pelagic migrations, including across the open ocean from foraging to nesting grounds (Balazs 1980; Lohmann and Lohmann 1996; Tanabe et al. 2023). In the neritic zone, turtles occur in nearshore and inshore waters where herbivorous adults forage primarily on sea grasses and algae (Balazs 1980; Bjorndal 1997; Bolten et al. 2003; Hirth 1997; Limpus 2008b). Green turtle nesting occurs in over 80 countries (Hirth 1997; NOAA 2023b). Turtles may nest more than once per season, remaining in the nesting vicinity between nesting periods (Hamann et al. 2002; Hirth 1997).

No complete global population estimates exist for the green sea turtle. However, estimates of the female nesting abundance for each green turtle DPS were derived, resulting in a best estimate of the global population as approximately 560,000 females (Seminoff et al. 2015). For most DPSs, only portions of the DPS occur within the Study Area. Some countries occur in multiple DPSs, as certain regions of a country may fall in one DPS and other regions of the country fall in another DPS. The best estimates of population size for each individual DPS (Table C-1) and the general location where nesting occurs within each individual DPS are discussed in more detail below. The information on each individual DPS is followed by a general overview of the green turtle post-hatchling oceanic life stage, dive depths, and swimming speeds.

The Central North Pacific DPS includes the Hawaiian Archipelago and Johnston Atoll. Green turtles are the most common turtle species found around the Hawaiian Islands (Balazs and Chaloupka 2004; Chaloupka et al. 2008). Nesting rookeries in the French Frigate Shoals are the largest in the Central North Pacific Ocean, with a nesting abundance of 3,710 nesting females (approximately 97 percent of the total Central North Pacific DPS nesting abundance) (Balazs 1980; Balazs and Chaloupka 2006; Seminoff et al. 2015). The Central North Pacific DPS has a total estimated abundance of 3,846 nesting females (Table C-1).

In the Central West Pacific DPS, large nesting areas for green turtles are located in Ogasawara Islands, Japan (1,301 nesting females) and in the Gielop and Iar Island, part of Ulithi Atoll, Yap State, Federated States of Micronesia (1,412 nesting females) (Maison et al. 2010; Seminoff et al. 2015). The waters of the main Japanese islands, as well as other areas of the Western North Pacific, are foraging grounds for green turtles that nest on the Ogasawara Islands (Hatase et al. 2006; Tachikawa et al. 1994). Green turtles occur and nest year-round in Guam and in the CNMI, particularly in the waters of Tinian and Saipan (Maison et al. 2010; Martin et al. 2019; Seminoff et al. 2015; Summers et al. 2018). The peak nesting season for CNMI is between March and July (Summers et al. 2018), and the peak nesting season for Guam is between May and August (Maison et al. 2010). The Central West Pacific DPS population size is estimated to be 6,518 nesting females (Seminoff et al. 2015) (Table C-1).

There are more than 58 nesting sites located in the East Indian-West Pacific DPS that occur in the countries of Australia, Malaysia, Indonesia, Philippines, Vietnam, India, Japan, China, and more (Seminoff et al. 2015). Ninagloo Reef, Western Australia is one of the largest rookeries in the DPS with greater than 6,000 nesting females (Seminoff et al. 2015). Song et al. (2002) noted that green turtles only nest on seven beaches in China, with post-nesting females from Chinese beaches having been observed migrating either into the South China Sea or to Okinawan waters. Various foraging grounds in the eastern Indian Ocean include waters around the Andaman and Nicobar Islands in India and the waters of Indonesia (Andrews et al. 2006c; Tapilatu et al. 2022). Overall, the East India-West Pacific DPS population size is estimated to be 77,009 nesting females.

The majority of the North Indian and Southwest Indian DPSs do not occur within the Study Area. Within the North Indian DPS turtle nesting occurs on the shores of India and Sri Lanka (Richardson et al. 2013;

Seminoff et al. 2015; Sivakumar 2002). In the Southwest Indian DPS nesting occurs in the Maldives (Hudgins et al. 2017; Seminoff et al. 2015). The estimated abundance of nesting females throughout the whole North Indian DPS is 55,243 nesters, and there are 91,159 nesters found throughout the whole Southwest Indian DPS (Seminoff et al. 2015) (Table C-1).

After green turtles hatch from their nests, they begin an oceanic life stage that spans several years (Hirth 1997). Post-hatchling turtles are omnivorous, and these turtles have been recorded to prey upon cnidarians (e.g., blue button jellyfish [*Porpita porpita*], hydrozoa), crustaceans (e.g., zooplankton species [*Hyperia* sp.], krill, barnacles, mollusks (e.g., pearl oyster [*Pinctada* sp.], floating sea snails [*Cavolinia* sp.]), insects, and floating plant matter (Boyle and Limpus 2008). Researchers have suggested that when late-stage juveniles migrate from the pelagic developmental habitat to neritic habitat, they select foraging areas proximal to their natal beaches (Bowen and Karl 2007; Naro-Maciel et al. 2007).

Green turtles are the shallowest diving sea turtle species (Hochscheid 2014). Green turtles typically make dives to no more than 82 ft (25 m) for less than 35 minutes (min), but dives in excess of 453 ft (138 m) and for durations greater than 5 hours have been recorded (Blanco et al. 2013; Brill et al. 1995; Broderick et al. 2007; Cheng et al. 2013; Hays et al. 2000; Hochscheid et al. 1999; Rice and Balazs 2008; Yasuda and Arai 2009). Deeper nocturnal dives have been reported for turtles around Hawaii and Taiwan (Cheng et al. 2013; Rice and Balazs 2008). For example, diurnal migrating turtles in Hawaii showed a maximum dive depth of 13 ft (4 m) occurring during the day and deeper dives with mean maximum dive depths of 115 to 180 ft (35 to 55 m) occurring at night (Rice and Balazs 2008). Green turtles exhibit dives that are U-, V-, and S-shaped (Cheng 2009; Hays et al. 2000; Hochscheid et al. 1999). Females often perform U-shaped dives (i.e., resting dives) during inter-nesting periods (Hays et al. 2000; Hochscheid et al. 1999). Green turtle open water, coastal, and foraging area speeds have been reported to occur between 1.35 and 2.06 miles per hour (mph; 2.20 and 3.31 kilometers per hour [kph]); 0.70 and 1.69 mph (1.12 and 2.71 kph); and 0.03 and 0.48 mph (0.05 and 0.77 kph), respectively (Al-Mansi et al. 2021; Godley et al. 2002). Cruising speeds of turtles have been recorded approximately between 0.61 and 1.37 mph (0.98 and 2.2 kph) (Kinoshita et al. 2021).

Hawksbill Sea Turtle (*Eretmochelys imbricata*)

The hawksbill sea turtle is listed as endangered throughout its range under the ESA (35 FR 8491; June 2, 1970). Critical habitat is designated for the hawksbill turtle outside of the Study Area (63 FR 46693; September 2, 1998), and therefore, it is not further discussed. Hawksbills turtles are listed as critically endangered by the IUCN Red List (Mortimer and Donnelly 2008) and are protected by CITES Appendix I (UNEP 2023). They can potentially be found throughout the Study Area between approximately 30 °N and 30 °S (NOAA 2025).

Hawksbill turtle nesting occurs in at least 70 different countries in low numbers (Mortimer and Donnelly 2008) and lay three to five nests per season that are around 130 to 160 eggs in size (NOAA 2025). In contrast to most sea turtle species, hawksbill turtles are often solitary nesters in mangrove estuaries (NOAA 2020a), or they may nest in low densities on dispersed, small beaches (Bowen and Karl 2007; Liles et al. 2011; Witzell 1983). This isolated nesting makes obtaining population estimates challenging. Although population data are generally lacking for hawksbill turtles, the best estimate of the number of annual nesting females worldwide is 22,004 to 29,035 turtles, which represents about 88 nesting areas in the Atlantic, Pacific, and Indian Oceans (NMFS 2013). Overall, hawksbill sea turtle populations were reported as decreasing in the early-mid 2000's (Mortimer and Donnelly 2008; NMFS 2013).

Hawksbill turtles typically occur in tropical and subtropical waters of the Atlantic, Pacific, and Indian Oceans and are mostly encountered in shallow waters less than 60 ft (18.3 m) deep (COTERC 2008; Gaos et al. 2012; Gaos et al. 2020; NMFS 2013; Stokes et al. 2023; Witzell 1983). Turtles inhabit inshore waters of mangrove-lined bays and estuaries, but they are typically associated with nearshore coral reef environments (Becker et al. 2019; Musick and Limpus 1997; NOAA 2020a; Witzell 1983). In the nearshore coastal environments, adult hawksbills feed on algae, seagrasses, and sponges (COTERC 2008; León and Bjorndal 2002; Limpus 2009). Nesting locations for Hawksbill turtles in the North Indian Ocean, Southeast Indian Ocean, West Pacific Ocean, and Central Pacific Ocean are discussed below and are followed by a general discussion of hawksbill turtles migratory and diving habits.

In the North Indian Ocean, hawksbill turtles nest in countries such as India, Sri Lanka, and Thailand. The population found in the Andaman and Nicobar Islands, India are the largest in the Northern Indian Ocean (Andrews et al. 2006a), however, exact population estimates have not been defined. There are a small number of annual nesting females (less than or equal to 10) in both Thailand and Sri Lanka (Mortimer and Donnelly 2008; NMFS 2013).

Large populations in the Southeast Indian Ocean are found in Indonesia and Australia. There are approximately 2,000 turtles that nest per season on the northwest coast of Australia (NMFS 2013). There are approximately 1,362 to 3,026 turtles that nest per season for the entire country of Indonesia (NMFS 2013).

There is a lack in recent data on the number of hawksbill females that nest in the Western Pacific Ocean. For countries where data does exist, low nesting numbers were recorded (NMFS 2013). A few nests (zero to six nests from 2002 to 2018) were found on Ishigakijima Island, Japan (Okuyama et al. 2020). As of 2003, hawksbill sea turtles no longer were found nesting on the Con Dao Islands, Vietnam and as of 2015 only one to two females were found nesting on the beaches of Bai Tu Long Bay, Vietnam (Cuong and Nguyen 2015). Hawksbill turtles are still considered to forage in Vietnam, although the foraging population size is unknown (Cuong and Nguyen 2015).

In the Central Pacific Ocean, there are a small number of annual nesting females (0 to less than 20 individuals) in Guam, Commonwealth of the Northern Mariana Islands (CNMI), and Hawaii (Gaos et al. 2021; Mortimer and Donnelly 2008; NMFS 2013; NOAA 2025; Seitz et al. 2012). The Hamakua Coast of Hawaii has been identified as an important foraging ground (Ellis et al. 2000; Parker et al. 2009). Additionally, since 2006, nesting trends have shown an increase in nesting females and nests in Hawaii (Gaos et al. 2021). Hawksbill turtles near CNMI consist primarily of juvenile and sub-adults, with no evidence of nesting (Summers et al. 2017; U.S. Department of Navy 2014). They are regularly found near CNMI, with an estimated 151 turtles around Pagan Island and 50 to 71 turtles reported around Tinian Island (U.S. Department of Navy 2014).

Some adult hawksbill turtles are considered non-migratory residents of reefs adjacent to their nesting beaches (NOAA 2020a; Witzell 1983). Other adults are considered highly migratory; for example, tagging, telemetry, and genetic studies indicate that some turtles migrate hundreds to thousands of miles between feeding and nesting grounds (Fossette et al. 2021; Meylan 1999). While the migratory habits of adult hawksbills vary in distance, it appears that turtle hatchlings and juveniles exhibit a pelagic phase where they spend years in the open ocean (Bolten et al. 2003; Witherington et al. 2012). After several years spent in the pelagic environment, turtles shift to coastal, neritic developmental and foraging habitats (Bolten et al. 2003). Juveniles remain in developmental habitats until they are reproductively mature, and then females migrate back to their natal beaches to mate and nest (Luschi et al. 2003; NOAA 2025). Gaos et al.

(2017) reported that the neritic foraging grounds of juvenile hawksbills were located near their natal beaches, indicating that these turtles have site fidelity to specific nearshore areas, not only for nesting and mating, but also for foraging. Hamilton et al. (2021) satellite tracked 30 adult females that migrated from nesting grounds on the Solomon Islands to various foraging grounds located throughout the Southern Indian Ocean (e.g. Western Australia, New Caledonia). Hawksbill turtles were found to travel an average of 24 mi per day (39 km per day), with a mean migration speed of 1.01 mph (1.63 kph) and a total distance traveled ranging from 159 to 2,118 mi (256 to 3,409 km) (Hamilton et al. 2021).

Hawksbill turtles appear to exhibit a diurnal diving strategy, actively foraging during the day and performing benthic resting dives (U-dives) at night (Blumenthal et al. 2009; Okuyama et al. 2010; Stokes et al. 2023). However, Gaos et al. (2012) potentially observed foraging dives during both the day and night. As mentioned above, hawksbills are generally found in shallow waters (less than 60 ft [18.3 m]) (Bell and Parmenter 2008; COTERC 2008; Gaos et al. 2012; Gaos et al. 2020; Stokes et al. 2023), but they can dive deeper. Hawksbill turtles (immature to adult life stages) typically perform shallow dives to water depths between less than 10 and 82 ft (3 and 25 m) (Gaos et al. 2012; Gaos et al. 2020; Stokes et al. 2023; Walcott et al. 2013; Witt et al. 2010). Walcott et al. (2013) recorded 5.8 percent of inter-nesting females diving to depths greater than 131 ft (40 m), with the majority of females diving to depths between 50 and 85 ft (15 and 25 m). The maximum dive depth recorded for this species was for a juvenile turtle, which had a dive depth of 299 ft (91 m) (Blumenthal et al. 2009). Hawksbills have long dive durations. Inter-nesting females have routine dives ranging from 31 to 74 min (Bell and Parmenter 2008; Starbird et al. 1999; Walcott et al. 2013). Storch et al. (2005) reported female descending and ascending dive speeds of 0.8 and 0.7 mph (1.3 and 1.1 kph), respectively.

Leatherback Sea Turtle (*Dermochelys coriacea*)

The leatherback sea turtle is listed as endangered throughout its range under the ESA (35 FR 8491, June 2, 1970). Critical habitat is designated for the leatherback turtle (77 FR 4170, January 26, 2012; 44 FR 17710; March 23, 1979), but the critical habitat is outside of the Study Area. Therefore, critical habitat is not further discussed. The leatherback is listed as vulnerable under the IUCN (Wallace et al. 2013), and it is protected under Appendix I of CITES (UNEP 2023). Seven DPSs are recognized by NMFS and U.S. Fish and Wildlife Service (USFWS) (2020); similarly, the IUCN classifies leatherback turtle subpopulations under the same designations as NMFS and USFWS (Figure C-3). Only two of these subpopulations, the West Pacific Ocean and the Northeast Indian Ocean, fall within the Study Area (Wallace et al. 2013). The IUCN Red List classifies the West Pacific subpopulation as critically endangered, while the Northeast Indian subpopulation is considered data deficient (Wallace et al. 2013). The leatherback turtle could occur throughout the whole Study Area.

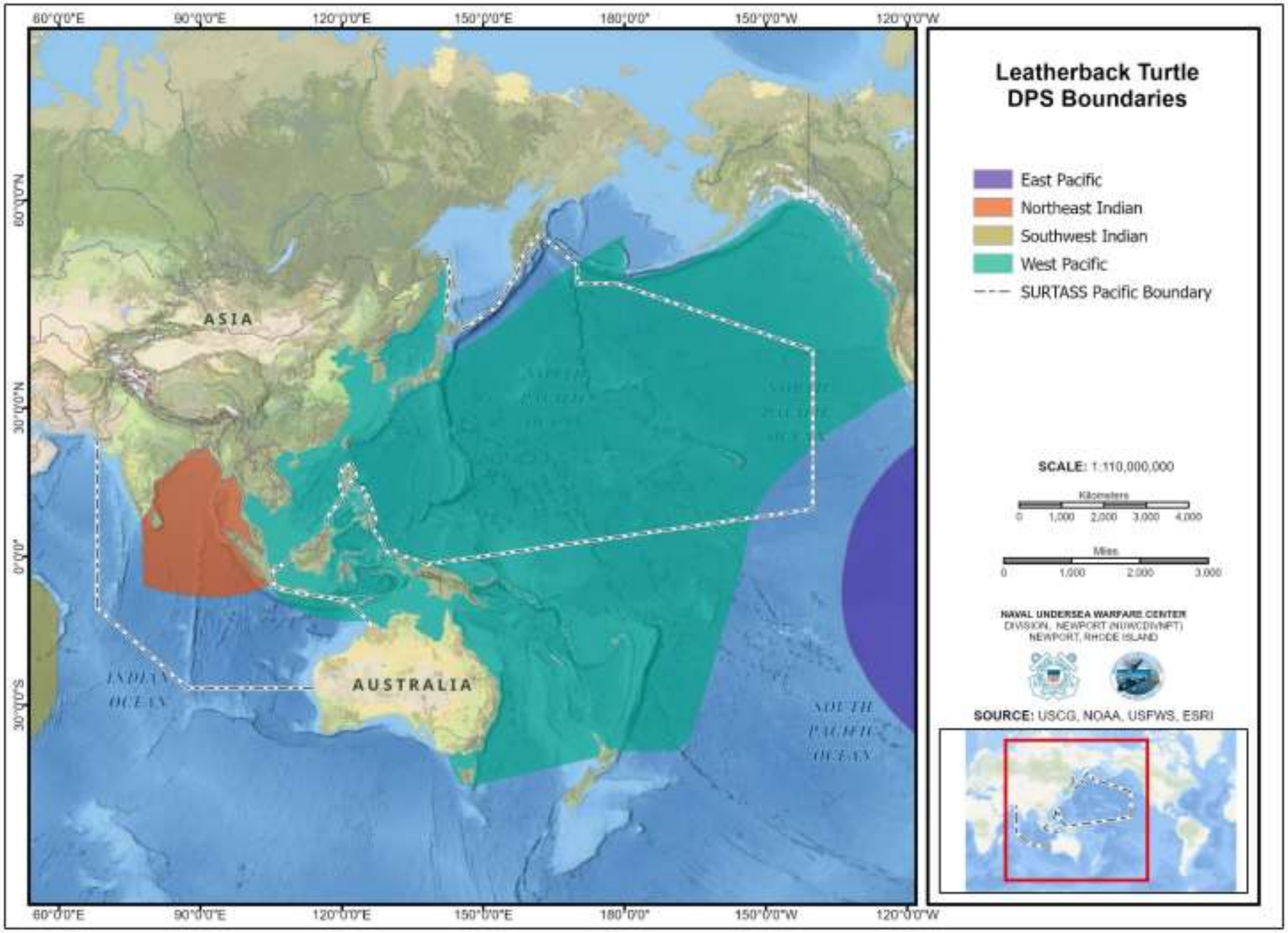

Figure C-3. Distribution of IUCN Designated Leatherback Sea Turtle Subpopulations Relative to the Study Area (Wallace et al. 2013)

Leatherback turtles are mainly pelagic and are the most widely distributed of any sea turtle. These turtles can be found circumglobally in temperate and tropical waters between 71 °N and 47 °S (Eckert et al. 2012; NMFS and USFWS 2020; Wallace et al. 2013). Leatherback turtles are highly migratory, and they make long-distance migrations between their nesting and feeding grounds. Determining an exact worldwide population size is complicated by inconsistencies and lack of data. Wallace et al. (2013) estimated the global population as an average of 54,262 nests per year based on available published data through 2010. They also suggested that the worldwide population of leatherbacks has decreased by 40 percent over the past 90 years prior to the publication (Wallace et al. 2013). NMFS and USFWS (2020) estimated the worldwide total index of nesting female abundance to be 32,174 females. Nesting locations for the West Pacific Ocean and Northeast Indian Ocean are discussed below, and this information is followed by a general overview of leatherback turtle foraging habits and diving patterns.

Leatherback turtles in the West Pacific DPS have been noted to spend around 45 to 78 percent of the year migrating in the high seas (Harrison et al. 2018), and they do not nest in many regions within the Study Area. Benson et al. (2011) found that the time of year when leatherback turtles nested in the West Pacific Ocean made a difference in the habitat used following nesting. Turtles nesting in the summer migrated into temperate waters of the North Pacific or tropical waters of the South China Sea, but winter nesters migrated into temperate and tropical waters of the Southern Hemisphere outside of the Study Area. Leatherback turtles have also been found to migrate from West Pacific nesting grounds to the East Pacific California Coast (Benson et al. 2011). This migration can take 10 to 12 months, or even multiple years to complete. Turtles make stops at different foraging or wintering areas en route (Benson et al. 2011). During their migration path, these turtles have been observed offshore of many regions, including CNMI, Guam, Hawaii, and Marshall Islands (Harrison et al. 2018).

Leatherback turtles are found in the waters of the Northeast and Southeast Indian Ocean (Hamann et al. 2006; NMFS and USFWS 2020). Additionally, Wallace et al. (2023) have noted expanded boundaries for leatherbacks ranging further south and west out of Andaman Islands than previously thought. Leatherbacks nest on Sri Lanka and have the largest nesting sites in the Northeast Indian Ocean on the Islands of Andaman and Nicobar, India (Andrews et al. 2006b; Hamann et al. 2006; Nel 2012). Some foraging regions within the Study Area of the Indian Ocean include the following: Western Australia, Sumatra, Indonesia, Bay of Bengal, and south of Sri Lanka into the southern reaches of the Indian Ocean (Hamann et al. 2006; Namboothri et al. 2012; NMFS and USFWS 2020; Swaminathan et al. 2019). NMFS and USFWS (2020) estimated the abundance nesting females on index beaches in the Northeast Indian Ocean to be 109 individuals, with 78 percent of the total found on Little Andaman Island, India.

Leatherbacks are the most oceanic of all sea turtles, but they may also be found seasonally in highly productive continental shelf and slope waters, where they may spend months foraging (Benson et al. 2011; Dodge et al. 2014). Adults, in general, forage on soft-bodied prey, such as jellyfish and salps (Heaslip et al. 2012; NOAA 2023c). During their migratory phases, leatherbacks have been documented to swim greater than 8,200 mi (13,200 km) between nesting and foraging grounds (NOAA 2023c; Swaminathan et al. 2019). Speeds of inter-nesting turtles have been modeled to range from 1.26 to 1.88 mph (2.02 to 3.03 kph), with absolute maximum speeds ranging from 4.25 to 6.26 mph (6.84 to 10.08 kph) (Eckert 2002).

Leatherback turtles make the deepest dives of any sea turtle, with dives recorded as deep as 4,200 ft (1,280 m) (Doyle et al. 2008). Mean or median dive depths from various studies within and outside of the Study Area have been recorded at depths of approximately 79 to 226 ft (24 to 69 m) (Bradshaw et al. 2007; Houghton et al. 2008; Migneault et al. 2023; Okuyama et al. 2021). Their longest dive duration recorded was greater than 94 min (Okuyama et al. 2021), but most dives are no more than 40 min (Bradshaw et al. 2007; Doyle et al. 2008). Okuyama et al. (2021) examined 49,461 dive profiles from 17 leatherbacks migrating across the North Pacific and found that they changed their dive behavior based on sea surface temperature and potential foraging areas. In warmer surface water, leatherbacks dove to greater depths likely for the purposes of reaching cooler water between 50 and 59 °F (10 to 15 °C) to combat overheating. V-dives, or gliding dives, were most common when turtles dove to deeper depths in the North Pacific (Okuyama et al. 2021). Mean dive descent rates between 0.45 and 1.21 mph (0.72 and 1.94 kph) have been recorded for leatherback turtles (Eckert 2002; Fossette et al. 2008; Migneault et al. 2023).

Loggerhead Turtle (*Caretta caretta*)

Under the ESA, nine loggerhead turtle DPSs have been identified and designated worldwide as endangered or threatened (76 FR 58868, September 22, 2011;Figure C-4). Four of the ESA-listed DPSs potentially occur in the Study Area (Table C-2.). This section will focus on the four DPSs found throughout the Study Area. Critical habitat is designated for the loggerhead turtle (79 FR 39855, July 10, 2014), but the critical habitat is outside of the Study Area. As a species, the loggerhead turtle is classified as vulnerable by the IUCN Red List. The IUCN identified 10 global subpopulations and individually classified the statuses of the subpopulations, ranging from species of least concern to critically endangered (Casale and Tucker 2017). The loggerhead turtle is protected under Appendix I of CITES (UNEP 2023).

Table C-2. Loggerhead Populations that Occur within the Study Area

Population Name	*ESA Status*	*IUCN Red List Conservation Status*	*Current IUCN Estimated Abundance (nests per year)*
NMFS-Designated DPS			
North Indian Ocean	Endangered		
North Pacific Ocean	Endangered	Least Concern	9,053
Southeast Indo-Pacific Ocean	Threatened		
Southwest Indian Ocean	Threatened	Near Threatened	4,600
Not a NMFS-Designated DPS			
Northwest Indian Ocean[1]		Critically Endangered	70,000
Southeast Indian Ocean[2]		Near Threatened	2,955

DPS = distinct population segment; ESA = Endangered Species Act; IUCN = International Union for Conservation of Nature
[1]Falls within the boundaries of the North Indian DPS
[2]Falls within the boundaries of the Southeast Indo-Pacific Ocean DPS
References: (Casale and Tucker 2017); 76 FR 58868, September 22, 2011

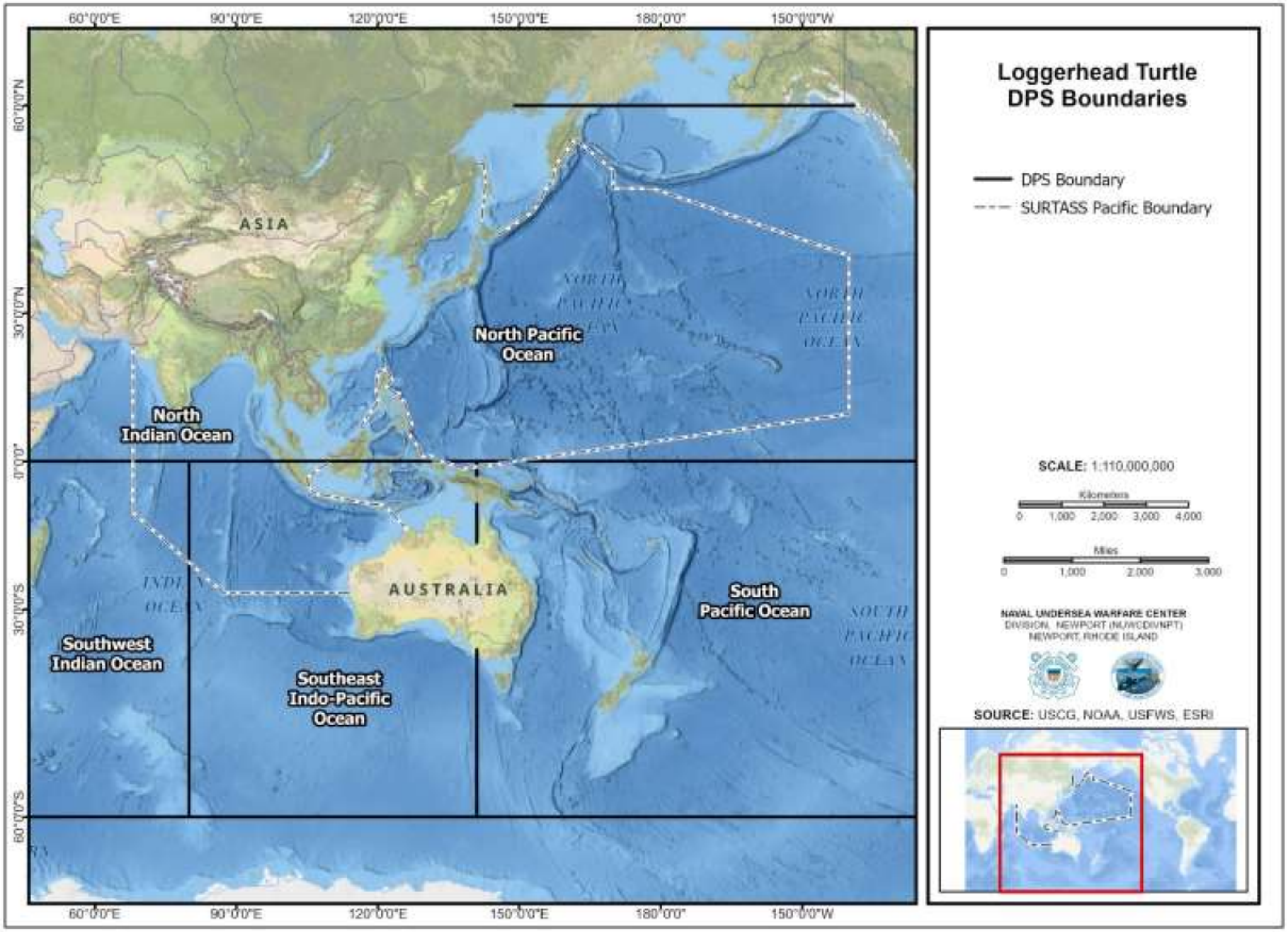

Figure C-4. Distribution of the NMFS Designated Distinct Population Segments (DPSs) of the Loggerhead Sea Turtle Relative to the Study Area

The loggerhead turtle potentially occurs throughout the entire Study Area. Loggerhead turtles are found in coastal to oceanic temperate, tropical, and subtropical waters of the Atlantic, Pacific, and Indian Oceans, as well as the Mediterranean Sea (Dodd 1988; Harrison et al. 2021; Parker et al. 2005). Habitat usage varies with life stage. Loggerheads are highly migratory, capable of traveling hundreds to thousands of miles between feeding and nesting grounds (Boyle et al. 2009; Nichols et al. 2000; Perez et al. 2022). Data support that most migration movements do not cross the equator (Eckert et al. 2008; Hatase et al. 2002; Limpus 2008a), except in the Indian Ocean (Monsinjon et al. 2023). No complete population estimate for each loggerhead DPS exists. Casale and Tucker (2017) estimated the size of each IUCN subpopulation and combined nesting counts for a minimum estimate of 200,246 loggerhead nesting turtles per year worldwide, and 86,608 nesting turtles per year within the Study Area (Table C-2.). Nesting locations for the Southeast Indo-Pacific Ocean DPS, North Indian Ocean DPS, and the North Pacific Ocean DPS are discussed below along with migration routes for turtles that nest in the North Pacific Ocean DPS. These sections are followed by a general overview of loggerhead turtle foraging habits and diving patterns.

Nesting for the Southeast Indo-Pacific Ocean DPS only occurs in Australia (Baldwin et al. 2003; Dodd 1988). Major nesting areas along Western Australia include the Shark Bay World Heritage Area (where Dirk Hartog Island is located), the Ningaloo Marine Park coast, the North West Cape, and the Muiron Islands (Baldwin et al. 2003; Hamann et al. 2013; Whiting 2016). One of the largest nesting aggregations is located on Dirk Hartog Island off the coast of Western Australia where as many as 1,000 to 3,000 loggerheads nest annually (Hamann et al. 2013). Similar in size, between 991 to 2,763 females nest in the Ningaloo region off the coast of Western Australia (Whiting 2016). However, there is significant variation in the number of females that nest in the Ningaloo region yearly (Whiting 2016). Adults within Western Australia forage in regions such as Sharks Bay, Exmouth Gulf, and in Indonesian waters (Baldwin et al. 2003; Perez et al. 2022).

The majority of North Indian Ocean DPS females nest in regions outside of the Study Area (NMFS and USFWS 2021). Within the Study Area, a low number of females nest on the beaches in Sri Lanka (Dodd 1988; Ekanayake et al. 2002; Kapurusinghe 2006).

Nesting for the North Pacific Ocean DPS only occurs in Japan. NMFS and USFWS (2021) estimated that in 2015 the total number of nesting females for the North Pacific Ocean DPS was between 7,834 and 9,736 females. Following nesting in Japan, satellite-tagged adult females were observed to migrate to two different foraging grounds of the Western North Pacific, the more neritic waters of the East China Sea and the oceanic waters along the perimeter of the Kuroshio Current (Hatase and Sakamoto 2004; Sakamoto et al. 1997). New research shows that many loggerheads that hatch on Japanese beaches do not make it all the way to Baja California, as previously thought (Bowen et al. 1995), and instead retain foraging habitats in the North Pacific gyre (Harrison et al. 2021). Relatively high densities of both juvenile and adult loggerhead turtles occur north of the Hawaiian Islands in association with the North Pacific Transition Zone (Briscoe et al. 2021; Polovina et al. 2000). As late juveniles or adults, loggerhead turtles make a return westward by migrating across the North Pacific Gyre to return to Japanese waters to mate and nest (Ishihara et al. 2011; Nichols et al. 2000; Polovina et al. 2004).

Loggerheads are known to forage on floating organisms or organisms on floating material in the pelagic zone, such as gastropods (*Janthina* spp.; *Carinaria cithara*), by-the-wind-sailor (*Vellela vellela*), gooseneck barnacles (*Lepas* spp.), and flotsam crab (*Planes cyaneus*) (Parker et al. 2005). Polovina et al. (2003) observed that loggerhead turtles spend about 40 percent of their time near the water's surface; most dives were within 16 ft (5 m) of the surface. Similarly, Howell et al. (2010) found that more than 80 percent of juvenile loggerhead dives in the North Pacific Ocean were to depths less than 15 ft (4.5 m), and more than 90 percent of dives were to depths less than 50 ft (15 m). In their study of free-ranging loggerhead turtles, Hochscheid et al. (2010) noted that the juveniles occasionally spent extended periods, lasting on average 90 min, at the sea surface during the day. This irregular behavior was suggestive of recovery from extensive anaerobic diving or as a means of rewarming their core body temperature after deep dives (Hochscheid et al. 2010). Sub-adult routine dives are from 30 to 72 ft (9 to 22 m) (Lutcavage and Lutz 1997). Tagged loggerheads in the central North Pacific Ocean dove as deep as 584 ft (178 m) (Polovina et al. 2003), and an adult female made the deepest recorded dive to 764 ft (233 m), staying submerged for 8 min (Sakamoto et al. 1990). Houghton et al. (2002), found that U-shapes dive (i.e., resting dive) were the most common for loggerhead turtles. The mean dive durations for inter-nesting loggerheads ranged from less than a min to 40 min for the different dive types (Houghton et al. 2002). The longest duration dive by a loggerhead turtle was over 10 hours during deep-bottom resting dives in the winter months (Broderick et al. 2007). Sakamoto et al. (1990) reported diving swim speeds that ranged from 0.5 to 2.2 mph (0.8 to 3.5 kph).

Olive ridley turtle (*Lepidochelys olivacea*)

The ESA classifies olive ridley turtles as two populations, the Mexico's Pacific coast breeding populations and all other populations. All other populations of olive ridley turtles occur within the Study Area are listed as threatened under the ESA (43 FR 32800, July 28, 1978), therefore there is just one population found within the Study Area. There is no critical habitat listed for this species. The global population of olive ridley turtles is protected under Appendix I of CITES (UNEP 2023), and the species is classified as vulnerable under the IUCN Red List (Abreu-Grobois and Plotkin 2008). Olive ridley turtles potentially occur throughout the whole Study Area.

Olive ridley turtles inhabit tropical to warm-temperate waters of the Pacific, Atlantic, and Indian Oceans (Abreu-Grobois and Plotkin 2008; Wallace et al. 2010). Information from tagged turtles indicate a preference for waters within a narrow temperature range of 72 to 82 °F (22 to 28 °C) (Polovina et al. 2004; Swimmer et al. 2006; 2010). Olive ridley turtles have been recorded in coastal waters of over 80 countries (Abreu-Grobois and Plotkin 2008). The 2008 estimated worldwide population of olive ridley turtles ranged from 841,309 to 851,590 nesting females (Abreu-Grobois and Plotkin 2008). Although this species is the most abundant sea turtle, many of its populations have declined or disappeared from historic areas (Cáceres-Farias et al. 2022; Shanker et al. 2021). It was estimated in 2008 that there had been a 30 to 50 percent decline in global population size from approximately the 1970's to early 2000's (Abreu-Grobois and Plotkin 2008).

Olive ridley turtles have different reproductive behaviors where they are considered either arribada nesters (i.e., nest in large groups), solitary nesters, or partake in both nesting strategies (Bernardo and Plotkin 2007; Fonseca et al. 2013; Malarvizhi and Mohan 2023). Solitary nesting occurs in approximately 40 countries worldwide; whereas arribada nesting only occurs on a few beaches worldwide (Cáceres-Farias et al. 2022; NOAA 2022; NMFS and USFWS 2014). Most of the major arribadas are located in the Eastern Pacific, outside of the Study Area (Abreu-Grobois and Plotkin 2008), but some are found in the Study Area. Nesting locations found within the Study Area are discussed below. The discussion is followed by a general description of olive ridley turtle's life history, migration trends, foraging habits, and diving depths.

In the Indian Ocean, some solitary nesting sites are in Indonesia, Thailand, Malaysia, and India (Abreu-Grobois and Plotkin 2008; Cáceres-Farias et al. 2022; NMFS and USFWS 2014). The solitary nesting site

Alas Purwo National Park, East Java, Indonesia has seen a massive increase in population size from 1984 (four nesting females) to 1993–1998 (92 nesting females) (Abreu-Grobois and Plotkin 2008; Halim et al. 2001; Maulany et al. 2012; Putrawidjaja 2000; Suwelo 1999). The arribada beaches Gahirmatha, Devi River, and Rushikulya in the Indian Ocean and Bay of Bengal are considered stable populations and one of the largest sets of arribada rookeries in the world, with total population estimates between 150,000 and 200,000 females annually (Abreu-Grobois and Plotkin 2008; NMFS and USFWS 2014; Shanker et al. 2003).

Olive ridley turtle's distribution in the Western and Central Pacific Oceans are mainly restricted to open-ocean waters. These turtles are not common in the Hawaiian Islands, CNMI, and Guam; nesting on any U.S. Pacific Island territory is extremely rare (NMFS and USFWS 1998; NOAA 2019; DoN 2015). Additionally, olive ridley turtle occurrences in Japanese waters are considered rare, and nesting has not been documented in Japan (Fukuoka et al. 2019; Kamezaki and Matsui 1997).

Olive ridley turtles exhibit a complex natural history, which is not well understood (NMFS and USFWS 2014). These turtles utilize a variety of oceanic habitats, depending upon their life stage and geography. Hatchlings begin a pelagic stage, during which they are transported by major ocean currents far from their natal beaches (Carr 1986). For example, olive ridleys found in the Eastern Pacific waters of Mexico had genetic signatures that matched turtles from the East Coast of India (Martín-del-Campo et al. 2023). It was hypothesized that olive ridley turtles at immature stages were transported via ocean currents to the Eastern Pacific waters rather than adults actively migrating to this region (Martín-del-Campo et al. 2023).

Juveniles also have a pelagic stage where they are believed to be transported by prevailing ocean currents and circulation (Martín-del-Campo et al. 2023; Polovina et al. 2004). Although some information is known about post-hatchlings and juvenile turtles, information is generally lacking on their dispersal (Luschi et al. 2003; Musick and Limpus 1997; NMFS and USFWS 2014).

At sexual maturity (i.e., adults), olive ridley turtles migrate and aggregate in shallow, coastal waters near nesting beaches (Pandav and Choudhury 2006; Tripathy 2013). Some males, however, do not migrate to the neritic environment, but they remain in the open ocean and mate with females en route to nesting beaches (Kopitsky et al. 2000).

The post-breeding and post-nesting migrations of adult turtles are complex and varied. Most olive ridley turtles are highly migratory and spend much of their non-breeding life cycle in the oceanic environment where they feed on plankton, crustaceans, and salps (Jones and Seminoff 2013; Wedemeyer-Strombel et al. 2015). Some turtles demonstrate a nomadic migratory behavior (e.g., Pacific Ocean), with no apparent migration routes (Martín-del-Campo et al. 2023; Plotkin 2003; 2010). Additionally, olive ridley turtles have been observed to inhabit coastal areas, including bays and estuaries, with no migration to the open ocean, where they mainly feed on invertebrates (e.g., jellyfish, tunicates, sea urchins, snails, crabs) (Behera et al. 2014; Cáceres-Farias et al. 2022; Petitet and Bugoni 2017; Plotkin 2010).

Migrating speeds of adults have been recorded to range from 0.54 to 0.96 mph (0.87 to 1.54 kph) in coastal regions of northern Australia (Fukuoka et al. 2022; Whiting et al. 2007). In the North Pacific Ocean, the average migrating speed was 1.59 mph (2.56 kph) for turtles traveling in the North Equatorial Current and 1.1 mph (1.7 kph) for turtles traveling outside of the North Equatorial Current (Plotkin 2003). Olive ridley turtles are capable of deep dives, with a recorded maximum dive depth of 1,785 ft (544 m) (Swimmer et al. 2002); although routine dives are commonly to depths from approximately 33 to 328 ft (10 to 100 m) (McMahon et al. 2007; Polovina et al. 2004; 2003; Swimmer et al. 2006; 2002;

Whiting et al. 2007). Polovina et al. (2004) reported that olive ridley turtles only remained at the surface for 20 percent of the time, with about 40 percent of their dives to depths greater than 130 ft (40 m). Swimmer et al. (2006) noted that olive ridleys spent nearly 100 percent of their time in the top 195 ft (60 m) of the water column, with very few dives exceeding 330 ft (100 m). Turtles dive depth correlated with their optimal temperature range. Olive ridley sea turtles exhibit longer dive times in warmer ocean temperatures (Fukuoka et al. 2022). The maximum dive duration measured for tagged olive ridley turtles was 200 min (mean durations ranged from 24.5 to 48 min) in waters for post-nesting and foraging turtles (McMahon et al. 2007).

C.3 Endangered Species Act-Listed Marine Mammals

Mysticetes

Blue Whale (*Balaenoptera musculus*) and Pygmy Blue Whale (*Balaenoptera musculus brevicauda*)

Multiple subspecies of blue whales exist worldwide, including the pygmy blue whale, the Antarctic blue whale (*B. m. intermedia*), and the Indian Ocean blue whale (*B. m. indica*) (SMM 2023). Of the three subspecies, only the pygmy blue whale is typically differentiated at sea; however, there is limited information available for the pygmy blue whale within the Study Area, so information on the blue whale is used as a proxy when information on the pygmy blue whale subspecies is lacking. The blue whale is listed as endangered under the ESA (35 FR 12222; July 30, 1970), depleted under the Marine Mammal Protection Act (MMPA), and protected under CITES Appendix I. Under the IUCN Red List, the blue whale is considered endangered, and an Antarctic blue subspecies is considered critically endangered (Cooke 2018c). No critical habitat has been designated.

The global population of blue whales is estimated to be between 10,000 and 25,000 individuals with 5,000 to 15,000 mature whales (Cooke 2018c). In the Hawaiian Islands exclusive economic zone (EEZ), 133 individuals (Coefficient of Variation [CV] = 1.09) are estimated (Bradford et al. 2017a; Carretta et al. 2023). The approximate number of whales in the Southern Hemisphere, excluding pygmy blue whales, is thought to be around 2,300 whales (IWC 2023). While regional stock abundances in the Southern Hemisphere are unknown, off Exmouth on the northwestern coast of Australia, there have been an estimated 662 to 1,559 pygmy blue whales passing along their migration route between Australia and the southern Indian Ocean (McCauley and Jenner 2010). In waters surrounding Sri Lanka during July 2018, there was estimated to be 513 (CV = 0.38) blue whales present (Kirumbara et al. 2022). Although seasonality of sightings in this region is highest in December to April (De Vos et al. 2014; Ilangakoon and Sathasivam 2012), acoustic detections in the western equatorial Indian Ocean, which match the acoustic identity to those in Sri Lanka (Stafford et al. 2023), indicate the potential for year-round presence in the Indian Ocean.

Blue whales are distributed in oceanic subpolar to tropical waters of the world's oceans and continental seas, with the exception of the Mediterranean Sea and Gulf of Mexico (Jefferson et al. 2015). Pygmy blue whales are limited to the Southern Hemisphere in temperate to sub-Antarctic regions, moving between approximately 42 °S and the Molucca Sea near the equator (Jefferson et al. 2015), with consistent movements from Western Australia to the Banda and Molucca Seas (Sahri et al. 2022; Thums et al. 2022). Blue whales primarily occur in open ocean waters; however, they are also found in neritic waters when foraging, as well as potentially when breeding. Blue whales occur in lower numbers in the central and western North Pacific than in the eastern North Pacific, but sightings have been reported in Hawaiian waters, in Kamchatka and the Kuril Islands, and in offshore Japan (Sears and Perrin 2018). Not all blue whales are migratory, and some whales are considered residential in certain areas. Residential whales do not move seasonally between calving/breeding and foraging grounds (Jefferson et al. 2015). For example, some blue whales in the Indian Ocean remain off Sri Lanka where oceanic upwelling conditions support sufficient productivity and prey throughout the year (De Vos et al. 2014).

Foraging dives are deeper and lasting longer, averaging (140 m) and 7.8 min, whereas non-foraging dives averaged (67.6 m) and 4.9 min (Croll et al. 2001). Dives up to 30 min are not unusual, with the longest dive recorded at 36 min (Jefferson et al. 2015; Sears and Perrin 2018). A maximum dive depth of 961 ft (293 m) has been reported (Calambokidis et al. 2007). A migrating pygmy blue whale was observed consistently diving to 43 ft (13 m) (Owen et al. 2016). Dive descent swim rates between 1.0 and 1.3 feet per second (ft/s; 0.3 and 0.4 meters per second [m/s]) have been recorded (Williams et al. 2000). Surface swim speeds are between 2 and 3 knot (kt; 2.5 to 3.5 mph); however, travel speeds of 4 to 11 kt (5 to 13 mph) are not unusual. The maximum swim speed reported was 19 kt (22 mph) (Sears and Perrin 2018).

Hearing sensitivity has not been measured for blue whales (Ketten 2000; Nummela and Yamato 2018). They produce a variety of low frequency vocalizations ranging from 10 to 20 hertz (Hz) throughout the year (Moore et al. 1999; Rivers 1997; Sears and Perrin 2018; Stafford et al. 1998; Stafford et al. 2001). The majority of vocalizations are infrasonic sounds from 17 to 20 Hz with a source level (SL) of 188 decibels referenced to 1 micropascal (dB re 1 μPa) at 1 m (Sears and Perrin 2018). In contrast, calls produced during foraging have been measured at lower SLs, ranging from 158 to 169 dB re 1 μPa at 1 m (Akamatsu et al. 2014). Short sequences of rapid frequency modulated (FM) calls, below 90 Hz, are associated with animals in social groups (Mellinger and Clark 2003). Off Australia, at least five types of pygmy blue whale calls were detected that consisted of amplitude modulated and FM components with frequencies ranging from 20 to 750 Hz and durations between 0.9 and 4.4 seconds (sec) (Recalde-Salas et al. 2014). Calls produced by foraging whales off Iceland were characterized by FM down sweeps with a frequency range of 105 Hz down to 48 Hz and durations of 1 to 2 sec (Akamatsu et al. 2014).

Blue whales also produce a variety of transient sounds (i.e., they do not occur in predictable patterns) in the 30 to 100 Hz band, sometimes referred to as "D" calls. These usually sweep down in frequency or are inflected (up-over-down), occur throughout the year, and are assumed to be associated with socializing when animals are in close proximity (Mellinger and Clark 2003). In the southern Indian Ocean, "D" calls are mainly detected around foraging grounds and in songs on wintering grounds (Maëlle et al. 2023). Blue whales also produce long, patterned hierarchically organized sequences that are characterized as songs. Songs are produced throughout most of the year with a peak period of singing overlapping with the general period of functional breeding. Song characteristics indicate some population structure (McDonald et al. 2006). In temperate waters, intense bouts of long, patterned sounds are common from fall through spring, but these also occur to a lesser extent during the summer in high-latitude feeding areas. Call rates during foraging may be very low, with one study recording only four calls for two different individuals during a 22-hour period (Akamatsu et al. 2014). Vocalization characteristics vary geographically and seasonally (Stafford et al. 2001).

Fin Whale (*Balaenoptera physalus*)

The fin whale is listed as endangered under the ESA (35 FR 18319; December 2, 1970), depleted under the MMPA, protected under CITES Appendix I, and vulnerable on the IUCN Red List (Cooke 2018d). No critical habitat has been designated. Archer et al. (2019) identified three different subspecies of fin whales exist via genetic analysis based on the ocean basins, which includes: the northern fin whale (*B. p. physalus*), the southern fin whale (*B. p. quoyi*), and the pygmy fin whale (*B. p. patachonica*). The Society for Marine Mammalogy (SMM) (2023) has differentiated Northern and Southern subspecies of fin whales. Since these subspecies are not differentiated at-sea or differentiated in available population data, hereafter the fin whale will only be referenced as a single species.

The global population of fin whales is estimated at as many as 100,000 whales (Cooke 2018d). The population of fin whales in the Hawaii stock is estimated to be 203 (CV = 0.99) whales (Carretta et al. 2021). There are currently no population estimates in the North Pacific as a whole, and western North Pacific stocks have not been estimated since the 1970's (Allen 1977; Cooke 2018d; Ohsumi and Wada 1974). Within the western North Pacific, a small isolated subpopulation of whales exists in the East China Sea (Fujino 1960).

Fin whales are widely distributed in all oceans of the world, from tropical to polar oceanic waters, but they are mostly absent from equatorial waters (Aguilar and García-Vernet 2018). They are sometimes observed in neritic waters, but they typically occur in areas where deep water approaches close to land (Jefferson et al. 2015). They have traditionally been considered migratory, and acoustic data suggests seasonality in their annual distribution (Watkins et al. 2000). Specific breeding areas are still unknown. Additionally, fin whale calls have been reported from the Central Pacific waters of Hawaii in all months except June and July (McDonald and Fox 1999; Thompson and Friedl 1982); however, sightings of fin whales in these waters is extremely rare (Muto et al. 2018).

Fin whales were recorded diving for a mean duration of 5.5 min to depths averaging 260 ft (78 m) (Croll et al. 2001). The deepest dive recorded was to a depth of at least 1,540 ft (470 m), but dives to less than 328 ft (100 m) were more common (Panigada et al. 1999). Whales forage at water depths between 328 and 656 ft (100 and 200 m), with dives lasting from 3 to 10 min (Aguilar and García-Vernet 2018; Witteveen et al. 2015). During non-foraging dives, whales have been recorded diving to an average of 190 ft (59 m) (Croll et al. 2001). Swimming speeds average between 5.0 to 7.99 kt (6 and 9.2 mph) (Aguilar 2009). The average speed of descent dives has been measured as 6.21 kt (7.2 mph), while the swim speed of ascending dives was 4.1 kt (5 mph) (Panigada et al. 1999). Sustained swimming speeds were at least 10 kt (11.5 mph), lasting for at least 20 min (Watkins 1981). Singing whales swam at average speeds of 2.9 to 4.8 kt (3.3 to 5.5 mph) (Varga et al. 2018).

Fin whales produce a variety of low frequency (LF) sounds that range from 10 to 200 Hz (Edds 1988; Watkins 1981; Watkins et al. 1987a). They produce 40 Hz down sweeps (Sirovic et al. 2013; Watkins 1981). Short sequences of rapid FM calls from 20 to 70 Hz are associated with animals in social groups (McDonald et al. 1995; Watkins 1981). The most common vocalization is referred to as the "20-Hz signal" or "call," which is a loud, long (0.5 to 1.5 sec), LF (18 to 35 Hz) patterned sequence signal centered at 20 Hz (Clark et al. 2002; Watkins et al. 1987a). The 20-Hz signal is common from fall through spring in most regions, but it also occurs to a lesser extent during the summer in high-latitude feeding areas (Clark et al. 2002; Clark and Fristrup 1997).

Fin whales produce the 20-Hz call in two forms: songs and call-counter calls (Buccowich 2014; McDonald et al. 1995; Varga et al. 2018; Watkins et al. 1987a). Males are associated with simple, regular patterns of 20-Hz (or sometimes higher) calls that are associated with reproductive behavior (Croll et al. 2002). Counter calls are irregular patterns of 20-Hz signals that likely have a general communication function and are produced by single or multiple fin whales in an area (McDonald and Fox 1999; McDonald et al. 1995). Estimated SLs of the 20-Hz signal range from 180 to 190 dB re 1 μPa at 1 m, with peak to peak at 194.8 dB re 1 μPa^2 at 1 m (Croll et al. 2002; Varga et al. 2018; Weirathmueller et al. 2013).

Gray Whale (*Eschrichtius robustus*; Western North Pacific Distinct Population Segment)

Gray whales are protected under the MMPA and CITES Appendix I. Two genetically distinct populations, the Western North Pacific (WNP) and Eastern North Pacific, exist in the Pacific Ocean (LeDuc et al. 2002). The WNP DPS of gray whales is small and remains listed as endangered under the ESA (35 FR 18319; December 2, 1970), depleted under the MMPA, and endangered under the IUCN Red List (Cooke 2018e). The Study Area is mostly comprised of WNP gray whales, primarily along the coast of eastern Asia. While a small area of overlap and mixing with Eastern North Pacific whales has been documented in feeding grounds off in Sakhalin Islands and off of the eastern side of Kamchatka, only WNP whales will be discussed further. A small population of 290 WNP gray whales has been estimated (Cooke 2018f). No critical habitat has been designated for this species.

Gray whales occur in shallow coastal waters of the North Pacific Ocean and adjacent seas, occurring as far south as southern China in the Western North Pacific (Jefferson et al. 2015). Whales annually migrate north-south from high latitude feeding grounds in the summer to low latitude breeding grounds in the winter. However, migratory information about the WNP DPS is not nearly as detailed as information about the Eastern North Pacific DPS. Historically, WNP whales feed off the northeastern coast of Sakhalin Island in the Sea of Okhotsk and in Pacific waters off Kamchatka during the summer, then they migrate southward to their winter breeding grounds in coastal waters off Honshu, Japan, eastern Russia, and Korea (Bröker et al. 2020; Kato and Kasuya 2002; Meier et al. 2007; Weller et al. 2002; Weller et al. 2008). Older whales off Sakhalin Island prefer offshore feeding areas (Schwarz et al. 2022). Satellite tagging, tracking, and photo-identification matching of WNP gray whales from the Sakhalin and Kamchatka feeding grounds show that a portion of the WNP whales migrate across the North Pacific Ocean, as they have been observed during winter in the Eastern Pacific waters of North America and Mexico (Cooke 2018e; Mate et al. 2015; Urbán R. et al. 2013; Weller et al. 2012). Alternatively, this evidence could show that some gray whales sighted in foraging areas of the WNP DPS, off of Sakhalin Island, actually belong to the Eastern North Pacific DPS and have migrated outside of their near-shore north-south migration route (Mate et al. 2015). This could indicate that the number of estimated WNP whales may be even less than 290 whales.

Since 1990, about 30 sightings and strandings have been documented in Japan, mainly off the Pacific Honshu coast (Kato et al. 2016). Two gray whales have also been recently sighted in Hawaii (Baird et al. 2022). United States Department of the Navy (Navy) acoustic detections of gray whales in relatively shallow waters of the East China Sea between September and March indicate that some WNP whales make seasonal migration movements through these waters (Marine Mammal Commission 2023). WNP gray whales regularly forage in eastern Kamchatka waters during summer. Additionally, sightings of mother-calf pairs feeding off southeastern Kamchatka in the Olga Harbor/Bay area suggest that the area may be used as a second nursery ground (Tyurneva et al. 2010; Yakovlev et al. 2011). Exact breeding and calving grounds are unknown for WNP gray whales; however, there is historical evidence that Hainan Island in the South China Sea is a possible location (Omura 1974).

Gray whales are typically considered shallow divers, making three to five shallow dives before a longer, deeper dive. They are bottom feeders that remain in shallow waters along the continental shelf to search for prey. The maximum known dive depth is 560 ft (170 m), with a maximum reported dive duration of 26 min (Swartz 2018). Typical dives are to depths less than 100 ft (30 m), with dives less than 33 ft (10 m) most common (Malcolm and Duffus 2000). Recorded mean dive durations lasted 2.2 min (Stelle et al. 2008). During summer, foraging whales exhibited dive times as long as 7 min, with a mean duration of 4 min (Würsig et al. 1986). In Alaska, feeding dives to the bottom have lasted up to 15 min

(Alaska Department of Fish and Game 2008). Swim speeds during migration average 2.4 to 4.9 kt—depending on the direction of travel—with pursued whales reaching speeds of 7 kt alongside short bursts that can reach 8.6 kt (Jones and Swartz 2009).

Hearing data is limited, but there is evidence that gray whales are most sensitive to tones between 1 and 1.5 kilohertz (kHz) (Dahlheim and Ljungblad 1990). Migrating gray whales showed avoidance responses at ranges of several hundred meters to LF playback SLs of 170 to 178 decibels (dB) when the source was placed within their migration path at about 1.1 nautical miles (NM) (2 km) from shore. This response ceased when the source was moved out of their migration path even though the received level (RL) remained similar to the earlier condition (Clark et al. 1999). Gray whales detected and responded to 21–25 kHz sonar signals, indicating their hearing frequency range extends to at least 21 kHz (Frankel and Stein 2020).

Gray whales produce a variety of sounds, with most calls ranging from 100 Hz to 4 kHz (Swartz 2018). The most common sounds recorded during foraging and breeding are knocks and pulses, which have frequencies from less than 100 Hz up to 2 kHz, with most energy concentrated between 327 and 825 Hz (Frankel 2018; Richardson et al. 1995). The SLs for sounds produced range between 167 and 188 dB re 1 µPa at 1 m (Frankel 2018).

Humpback Whale (*Megaptera novaeangliae*; Western North Pacific Distinct Population Segment)

NMFS has identified 14 worldwide DPSs based on their breeding grounds, four of which are listed as endangered (Arabian Sea, Cape Verde/Northwest Africa, WNP, and Central America) and one as threatened (Mexico) (81 FR 62260; September 8, 2016). Only one ESA-listed DPS, the WNP, occurs within the Study Area. The Hawaii DPS is also found within the Study Area but is not listed under the ESA. Details specific to the Hawaii DPS and details specific to non-ESA listed whales in other geographic regions within the Study Area are discussed in Table 39 and Section C.4. The WNP DPS and general behaviors applicable to all humpback whales are described in this section.

In contrast to DPSs, stocks of humpback whales are identified by geographic areas that include discrete or multiple feeding areas. In the North Pacific Ocean, stocks of humpbacks include the California-Oregon-Washington (CA-OR-WA) stock with feeding areas in the California-Oregon and the Washington-British Columbia regions. The Central North Pacific stock has feeding areas from southeast Alaska to the Alaskan Peninsula, and the WNP stock feeds in the Aleutian Islands, the Bering Sea, and Russia. Under the MMPA, the WNP stock, the Central North Pacific stock, and the CA-OR-WA stock are considered depleted. The species is also listed under CITES Appendix I and is considered a species of least concern on the IUCN Red List (Cooke 2018g). Critical habitat has been designated for the WNP DPSs (86 FR 21082; April 21, 2021); however, the boundaries occur outside of the Study Area.

The most current estimate of the humpback whale's global population is 135,000 individuals, with 84,000 being sexually mature (Taylor et al. 2007). The population of humpback whales in the entire North Pacific Ocean is estimated to be 21,808 whales (CV=0.04) (Barlow et al. 2011). In the Western North Pacific Ocean portion of the Study Area, the population of the WNP DPS is estimated to be around 1,000 individuals (Calambokidis et al. 2008).

Humpback whales are distributed throughout the world's oceans, but they are absent from high Arctic and some equatorial waters. They are rare in some parts of their former Pacific range, such as the coastal waters of Korea and the Barkley Sound, with no signs of a recovery in those locations (Gregr 2000; Gregr et al. 2000). Humpbacks occur in neritic and pelagic waters, with neritic occurrences happening on foraging grounds in the summer and in waters close to islands and reef systems in the winter (Clapham 2018). They are highly migratory and have been documented traveling over 5,292 NM (9,801 km) one way (Stevick et al. 2011). Humpback whales occupy cold, high latitude waters in the spring to feed, and then in winter, they move to warmer, low latitude waters to calve and breed. There is evidence that interbreeding of individuals from major ocean basins is rare, and whales from the Northern and Southern Hemispheres are differentiated by a number of characteristics, such as coloration, timing of reproduction and migratory behavior, diet, and molecular genetics (Stevick et al. 2016). Data indicate that not all humpbacks migrate annually from summer feeding to winter breeding sites and that some whales remain in certain areas year-round (Barco et al. 2002; Clapham et al. 1993; Murray et al. 2014).

Dolphin (1987) reported dive times at three to six min in duration for humpback whales. Burrows et al. (2016) recorded dive times ranging from 6 to 9.6 min, with a mean of 7.0 min. Dive times on the wintering grounds can be longer, with singing humpbacks typically diving between 10 and 25 min in duration (Chu 1988). More recently, in Hawaii wintering grounds mean dive times for two individuals were 12.8 and 13.5 min, with mean depths to 155.5 ft (47.4 m) and 155.1 ft (47.3 m), respectively (Henderson et al. 2021). During foraging dives, whales dove to depths from 130 to 512 ft (40 to 156 m) (Dolphin 1988; Goldbogen et al. 2008). The deepest recorded dive was 2,010 ft (616 m); however, most foraging dives range between 200 to 390 ft (60 and 120 m) (Derville et al. 2020; Dolphin 1987). During long-distance migrations, whales swam at speeds from 0.7 to 3.2 kt (1 to 4 mph) (Cerchio et al. 2016; Chaudry 2006; Horton et al. 2011). Mean swim speeds for singing whales was 1.2 kt (1.5 mph), while non-singing whales were 2.0 kt (2.5 mph) (Noad and Cato 2007).

No direct measurements of humpback whale hearing sensitivity exist (Ketten 2000; Thewissen 2002). Due to this lack of auditory sensitivity information, mathematical functions have been used to describe the frequency sensitivity of humpbacks by integrating the humpback basilar membrane position with known mammalian data. The results predicted the typical U-shaped audiogram, with sensitivity to frequencies from 700 Hz to 10 kHz and maximum sensitivity between 2 and 6 kHz (Houser et al. 2001).

Humpbacks produce a variety of sounds that fall into three main groups: (1) sounds associated with feeding, (2) social sounds, and (3) songs associated with reproduction. These vocalizations range in frequency from 20 Hz to 10 kHz. Feeding groups produce stereotyped feeding calls ranging from 20 Hz to 2 kHz, with dominant frequencies near 500 Hz (Frankel 2018; Thompson et al. 1986). Feeding calls were found to have SLs in excess of 175 dB re 1 µPa at 1 m (Richardson et al. 1995; Thompson et al. 1986). Humpback whales in the Northwest Atlantic Ocean produce “megaclicks,” which are click trains and buzzes associated with night-time foraging; most of the energy is below 2 kHz, with relatively low SLs of 143 to 154 dB re 1 µPa at 1 m (peak-peak) (Stimpert et al. 2007).

“Whup” calls—thought to be contact calls—are composed of a short AM growl followed by a rapid up sweep from 56 to 187 Hz (Wild and Gabriele 2014). Additional social sounds have been described that range from 70 Hz to 3.5 kHz, with a mean duration ranging from 0.8 to 16.7 sec (Fournet et al. 2015; Stimpert et al. 2011). Males produce social sounds in the winter breeding areas that range from 50 Hz to more than 10 kHz with most energy below 3 kHz (Silber 1986). Calves produce simple, short, low frequency (average of 220 Hz) sounds, known as “grunts” (Zoidis et al. 2008). On foraging grounds, calf calls averaged RLs of 143 dB re 1 µPa, with adults averaging 141 dB re 1 µPa (Zeh et al. 2024). Migrating humpbacks produce 34 types of calls ranging from 30 Hz to 2.4 kHz and between 0.2 and 2.5 sec in duration, with 21 of these call types being incorporated into songs (Dunlop et al. 2007). The median source level for these social vocalizations range from 123 to 158 dB re 1 µPa at 1 m (Dunlop et al. 2013).

During the breeding season, males sing long, complex songs with frequencies between 25 Hz and 5 kHz (Au et al. 2006; Frankel et al. 1995). Songs have been recorded on breeding grounds, along migration routes, and occasionally on feeding grounds (Clapham and Mattila 1990; Clark and Clapham 2004; Stanistreet et al. 2013; Van Opzeeland et al. 2013). Additionally, Gabriele and Frankel (2002) noted humpback whales singing more frequently in the late summer and early fall than previously observed.

North Pacific Right Whale (*Eubalaena japonica*)

The North Pacific right whale (NPRW) is listed as endangered under the ESA (73 FR 12024; March, 6, 2008), depleted under the MMPA, protected under the CITES Appendix I, and endangered under the IUCN Red List of Threatened Species (Cooke and Clapham 2018). Two stocks, or populations, of NPRWs have been identified, but only the WNP stock would occur within the Study Area. The WNP stock consists of right whales occurring in the Commander Islands, off the coast of Kamchatka, the Kuril Islands, and in the Sea of Okhotsk (Brownell et al. 2001; LeDuc et al. 2012). NMFS has designated critical habitat for the NPRW, but it occurs outside of the Study Area (73 FR 19000; April 8, 2008) and is not considered herein.

No overall population estimate for NPRWs is available, but likely less than 1,000 whales are currently living in the eastern population, taken from mark-recapture methods in the Bering Sea (Wade et al. 2011). Marques et al. (2011) used passive acoustic recordings to estimate and abundance of 25 individuals. There is no reliable estimate for the western population, with the last reliable estimate having a confidence interval ranging from 404 to 2,108 individuals (Miyashita and Katō 1998). NMFS (2024) recognizes that NPRWs are one of the most endangered whale species in the world, making it difficult to estimate basic population abundances.

NPRWs regularly occur in the Sea of Okhotsk and the southeastern Bering Sea, with rare occurrences documented in the waters of the Gulf of Alaska, Sea of Japan (off Republic of Korea), and North Pacific waters, which includes around the Ogasawara and Kuril Islands; around Hokkaido, Japan; and offshore of Kamchatka, Russia (Jefferson et al. 2015; Sekiguchi et al. 2014). The most recent sightings include two right whales off Hokkaido in 2013; one right whale documented in the Sea of Japan, off Namhae, Republic of Korea in 2015; and a whale who passed away during disentanglement in Volcano Bay, Hokkaido in 2016 (NMFS 2023b).

Exact swim speeds and dive profiles are unknown for NPRWs; however, Crance et al. (2017) recorded dive durations ranging from 41 sec to 12 min. NPRWs estimated dive depth is based on the depth at which vocalizations have been recorded, ranging from surface level to depths up to 82 ft (25 m) (Thode et al. 2017).

There is no direct measurement of hearing sensitivity for right whales (Ketten 2000; Thewissen 2002). Thickness measurements of the basilar membrane of North Atlantic right whales suggest a hearing range from 10 Hz to 22 kHz, based on established marine mammal models (Parks et al. 2007); this same range can be used as a proxy for NPRWs, which are anatomically similar.

The vocalizations of NPRWs in the eastern Bering Sea have been described by six categories: up-calls, down-up calls, down calls, constant calls, unclassified vocalizations, and a gunshot (Crance et al. 2017; McDonald and Moore 2002). In one study, the up-call was the predominant type of vocalization observed, which began at 90 Hz and rose to 150 Hz, while the down-up call was low in frequency, at 10 Hz, before it became a typical up-call to 20 Hz (McDonald and Moore 2002). The down and constant calls were typically interspersed with up-calls (McDonald and Moore 2002). Constant calls were further subdivided into two categories: single frequency tonal or a frequency waver of up and down, which varied by approximately 10 Hz. The down calls averaged 118 Hz, and constant calls averaged 94 Hz, making both lower in frequency than the up-calls (McDonald and Moore 2002). The gunshot is an impulsive signal that ranges from 50 Hz to 5.5 kHz, with an estimated average duration of 0.27 sec (Crance et al. 2017). The SL of up-calls typically ranged from 176 and 178 dB re 1 µPa at 1 m, with a frequency range of 90 to 170 Hz (Munger et al. 2011). Furthermore, male right whales have recently been noted to produce songs, comprised primarily of gunshot sounds, presumably as reproductive displays (Crance et al. 2019).

Sei Whale (*Balaenoptera borealis*)

The sei whale is listed as endangered under the ESA (35 FR 18319; December 2, 1970), depleted under the MMPA, protected under CITES Appendix I, and endangered on the IUCN Red List (Cooke 2018b). No critical habitat has been designated. While the Navy recognizes that there is a Northern and Southern sei whale subspecies, they are not differentiated at-sea nor in the available population data and information. Accordingly, all subsequent information presented herein about the sei whale is referenced to the species level.

The global population for the sei whale has been estimated by the IUCN to include 50,000 individuals (Cooke 2018b), while other sources have reported a population as large as 80,000 whales (Jefferson et al. 2015). The population of the Hawaii stock of sei whales is estimated as 391 whales (CV=0.90) (Bradford et al. 2017b; Carretta et al. 2023). Since 2008, based on updated survey efforts, the number of sei whales in the Western North Pacific has been estimated at 5,086, contributing to an overall North Pacific population of 34,718 individuals (Hakamada et al. 2017).

Sei whales occur in temperate, oceanic waters of all oceans, but they rarely occur in neritic waters, the Mediterranean Sea, and equatorial waters (Jefferson et al. 2015). They are a migratory species, seasonally traveling between low latitude calving grounds and high latitude foraging grounds (Jefferson et al. 2015). Konishi et al. (2024) was the first comprehensive study to note regions, particularly around the Marshall Islands and north of Micronesia (between 7 ° and 20 °N), that appear to be important breeding grounds for sei whales in the Pacific Ocean.

Sei whales have been documented to perform U- and V-shaped foraging dives to a maximum of 190 ft (57 m) during the day and 102 ft (31 m) at night, with maximum durations of 12 and 9 min, respectively (Ishii et al. 2017). Dive times of individual whales in Berkeley Sound and West Falkland reached 13.6 and 9.6 min, respectively (Weir et al. 2018). When foraging, whales made shallow dives, breathing at the surface every 20 to 30 sec before following with a deep dive, which lasted up to 15 min (Gambell 1985). Swim speeds have averaged 2.0 kt (2.5 mph), with a maximum speed of 14.8 kt (17 mph) (Olsen et al. 2009). For satellite-tagged whales, the mean swim speeds during migration were 4 kt (5 mph) and during “off-migration” were 3.3 kt (4 mph) (Prieto et al. 2014).

No direct measurements of sei whale hearing sensitivity exist (Ketten 2000; Thewissen 2002). Sei whale vocalizations in Hawaii were all reported as down sweeps, ranging on average from 100 to 44 Hz for “high frequency” calls and from 39 to 21 Hz for “low frequency” calls (Rankin and Barlow 2007). Nieukirk et al. (2020) also reported downsweep calls with averages sweeping from 73.1 Hz down to 29.1 Hz over 1.85 sec. In contrast, whales in Antarctica had an average call frequency of 433 Hz (McDonald et al. 2005). Additionally, a series of FM calls were recorded south of New Zealand with a frequency range of 34 to 87 Hz and an average duration of 1.1 sec (Calderan et al. 2014).

Odontocetes

False Killer Whale (*Pseudorca crassidens*; Main Hawaiian Islands Insular Distinct Population Segment)

Three populations of false killer whales have been identified in Hawaiian waters: the Northwestern Hawaiian Islands stock, the Pelagic stock, and the Main Hawaiian Islands (MHI) Insular stock. Only the MHI Insular false killer whales (IFKW) DPS is listed as endangered under the ESA and depleted under the MMPA (77 FR 70915; November 28, 2012). The MHI IFKW stock is comprised of whales from the same DPS. Specific details on non-ESA listed Hawaii Pelagic and Northwestern Hawaiian Islands stocks are described below. The species is also listed under Appendix II of CITES, and classified as near threatened under the IUCN Red List (Baird 2018b). Critical habitat has been designated for the MHI DPS that falls within the Study Area (83 FR 35062; July 24, 2018) (Figure C-5). The MHI DPS and general behaviors applicable to all false killer whales are described in this section.

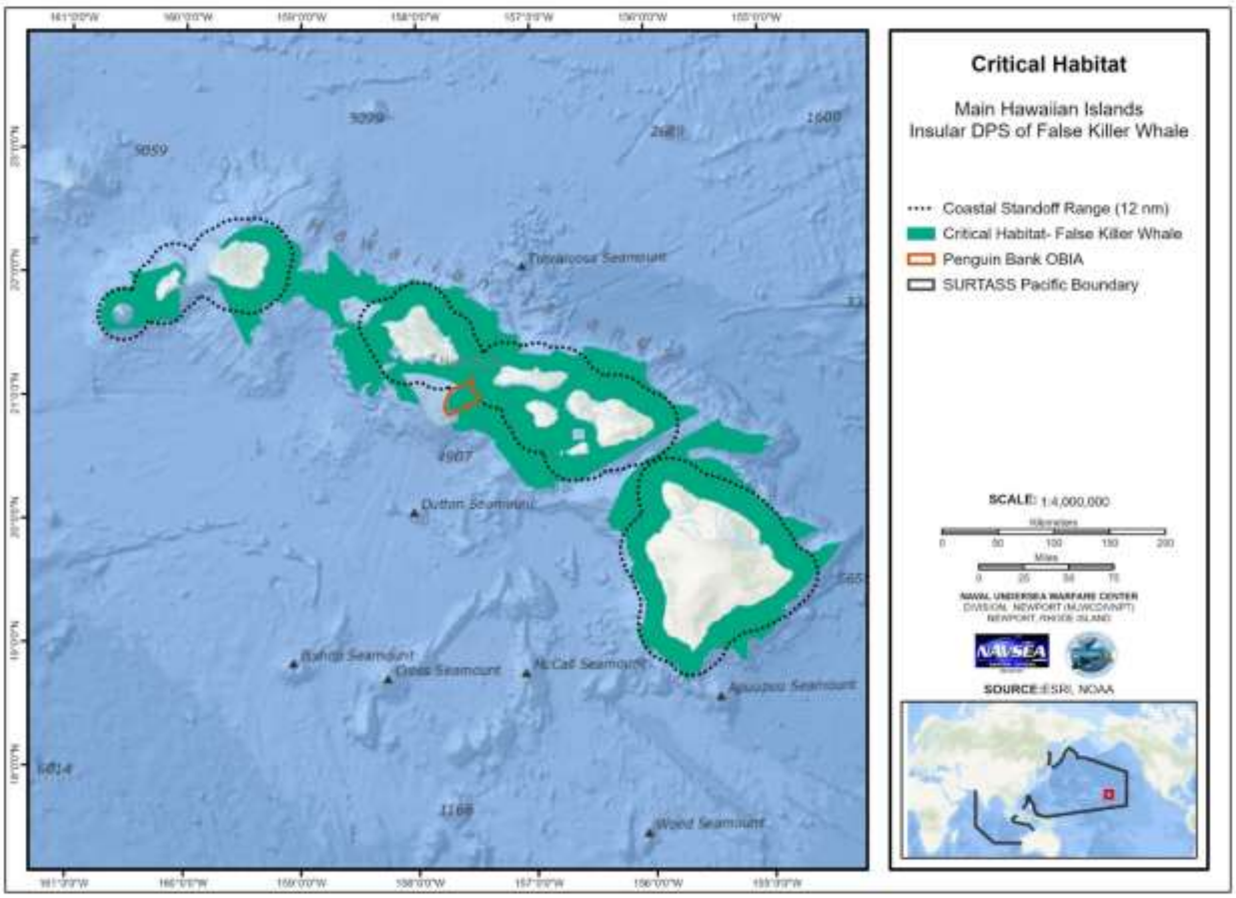

Figure C-5. Designated Critical Habitat for Main Hawaiian Islands Insular DPS of False Killer Whales within the Study Area

The populations of false killer whales occurring in the insular waters of the Hawaiian Islands have been shown to be genetically and behaviorally distinct from false killer whales found in oceanic or offshore waters (Chivers et al. 2010; Martien et al. 2011; NOAA 2012). The boundaries between the Hawaiian Island populations of false killer whales are complex and overlapping. The MHI IFKW DPS is found within a 20 NM (40 km) radius around the Main Hawaiian Islands, with the offshore extent of the DPS' outer boundary connected on the leeward sides of Hawaii Island and Ni'ihau to encompass the DPS' offshore movements within that region (Carretta et al. 2016). In comparison to other stocks, the MHI IFKW DPS is characterized by a very low abundance and very high density (Oleson et al. 2010). The global population for false killer whales is unknown. In Hawaiian waters, 138 (CV=0.08) whales have been estimated in the MHI IFKW stock (Badger et al. in review; (Carretta et al. 2024)).

False killer whales are found worldwide in tropical to warm temperate zones in deep (greater than 3,380 ft [1,000 m]) waters (Baird 2009a; Odell and McClune 1999; Stacey et al. 1994). Although a pelagic species, they approach close to shores of oceanic islands and regularly mass strand (Baird 2009a). In the waters of the Hawaiian Archipelago, four distinct population clusters exist in nearshore and pelagic waters, including waters surrounding Palmyra Atoll (Baird et al. 2008a; Baird et al. 2013; Barlow et al. 2008; Mahaffy et al. 2023). Breeding grounds and seasonal movements are unknown. Additionally, these whales do not have specific feeding grounds and are considered opportunistic foragers (Jefferson et al. 2015).

The physical or biological features of the designated critical habitat that are essential for the conservation of the MHI Insular DPS of false killer whales include: 1) island-associated marine habitat (productive, deeper, just offshore waters of varying water depths); 2) prey species (large pelagic fish and squid) 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 to MHI IFKW (i.e., good water quality) so that false killer whales can forage and reproduce free from disease and impairment; and 4) habitat free of anthropogenic noise that would significantly impair the value of the habitat for false killer whales' use or occupancy (i.e., no anthropogenic noise of a certain level, intensity, and duration that could alter the ability of false killer whales to detect, interpret, and utilize acoustic cues that support important life history functions, or can result in long-term habitat avoidance or abandonment) (NOAA 2018a).

False killer whales tagged in the western North Pacific make shallow and deep dives. Shallow dives had a mean duration of 103 sec and a mean maximum depth across individuals of 56 ft (17 m); while deep dives had a mean duration of 269 sec and a mean maximum depth across individuals of 554 ft (169 m) (Minamikawa et al. 2013). The longest dive lasted approximately 15 min, and the deepest went to approximately 2,130 ft (650 m). Dives were deeper during the day, suggesting that the whales are feeding on the deep scattering layer (Minamikawa et al. 2013). A maximum swim speed has been documented at 15.6 kt (18 mph) (Rohr et al. 2002).

False killer whales hear underwater sounds in ranges up to 115 kHz (Au 1993). Hearing has been measured using both behavioral and auditory evoked potentials audiograms. The behavioral data shows the most sensitive hearing between 16 and 24 kHz, with peak sensitivity at 20 kHz; whereas the auditory evoked potentials data show best hearing sensitivity from 16 to 22.5 kHz, with peak sensitivity at 22.5 kHz (Yuen et al. 2005). Additionally, based on data from the Acoustic Thermometry of Ocean Climate (ATOC) program, hearing thresholds for the false killer whale were 140.7 dB for the 75 Hz pure tone and 139.0 dB for the 75 Hz, 195 dB SL ATOC source (Au et al. 1997). Additionally, whales have been seen to have dampened conditioning of hearing in the anticipated appearance of loud sound, in an effort to protect its hearing; this is unlike a temporary threshold shift in the presence of an unconditioned effect of a loud sound, in which hearing thresholds increase (Nachtigall and Supin 2013).

False killer whales produce a wide variety of sounds from 4 to 130 kHz, with dominant frequencies from 25 to 30 kHz and 95 to 130 kHz (Busnel and Dziedzic 1968; Kamminga and Van Velden 1987; Murray et al. 1998; Rio 2023; Thomas and Turl 1990). Most signal types vary among whistles, burst-pulse sounds, and click trains (Murray et al. 1998). Whistles generally range between 4.7 and 6.1 kHz (Murray et al. 1998). Echolocation clicks are highly directional and range between 20 and 60 kHz and 100 and 130 kHz (Kamminga and Van Velden 1987; Madsen et al. 2004a; Thomas and Turl 1990). There are no available data regarding seasonal or geographical variation in their sound production. Estimated peak-to-peak SL of a captive animal's clicks is near 228 dB re 1 µPa at 1 m (Thomas and Turl 1990).

Sperm Whale (*Physeter macrocephalus*)

The sperm whale is considered endangered under the ESA (35 FR 18319; December 2, 1970), depleted under the MMPA, listed under CITES Appendix I, and listed as vulnerable on the IUCN Red List (Taylor et al. 2019). No critical habitat has been designated.

The most updated global estimate for sperm whales is 844,761 (CV = 0.209) individuals; although, there is much uncertainty associated with this estimation (Whitehead and Shin 2022). The stock in the western North Pacific Ocean has been estimated to include 102,112 individuals (CV=0.155); however, this estimate is positively skewed, and a reliable, updated abundance in the North Pacific is unavailable (Kato and Miyashita 1998; Muto et al. 2021). The abundance for the Hawaii stock is estimated to be 5,707 whales (CV=0.23) (Becker et al. 2021; Carretta et al. 2023).

With a large global distribution, sperm whales are primarily found in deep (greater than 3,280 ft [1,000 m]) polar, temperate, and tropical waters of the world's oceans, as well as in semi-enclosed waters (e.g., Sea of Japan) (Jefferson et al. 2015). Their migration patterns are not well understood. Some whales show seasonal north-south migrations, while others, particularly whales in warm equatorial waters, show no clear seasonal migration pattern (Whitehead 2018). In ocean waters between 40 and 45 °N, female and immature whales often remain on breeding grounds throughout the year, while males migrate between low-latitude breeding areas and higher-latitude feeding grounds (Whitehead 2003). In the Northern Hemisphere, "bachelor" groups comprised of males 15 to 21 years old generally leave warm waters at the beginning of summer to migrate to feeding grounds; then in fall and winter, these bachelors return south. However, some may remain in the colder northern waters for most of the year (Pierce et al. 2007). Specific breeding and foraging grounds are not clearly defined for this species.

Sperm whales make some of the longest and deepest dives of any mammal, with the maximum recorded dive reaching 4,900 ft (1,500 m) (Davis et al. 2007). Additional examination of stomach contents suggests that whales may dive as deep as 10,500 ft (3,200 m) (Clarke 1976). Foraging dives occur at depths between 932 and 4,701 ft (284 to 1,433 m) (Guerra et al. 2017). Dive durations range between 18.2 and 65.3 min (Watkins et al. 2002). Foraging dives last about 30 to 65 min, while non-foraging dives were measured at less than 30 min (Joyce et al. 2017; Papastavrou et al. 1989; Wahlberg 2002). Surface speeds averaged 0.7 to 2.2 kt (1 to 2.5 mph), with maximum speeds of about 5.1 kt (6 mph) (Jochens et al. 2008; Watkins et al. 2002; Whitehead 2018). Measured dive descent swim rates range from 2.8 to 5.45 kt (3 to 6.3 mph) (Lockyer 1997).

Direct measurements on hearing sensitivities in sperm whales is limited to a calf and stranded individual. Audiograms measured from a calf suggest a hearing range of 2.5 to 60 kHz, with best hearing sensitivity between 5 and 20 kHz (Ridgway and Carder 2001). Sperm whales produce broadband echolocation clicks with energy ranging from 100 Hz to 30 kHz (Goold and Jones 1995; Madsen et al. 2002b; Møhl et al. 2000; Thode et al. 2002). In the North Pacific, click rates change depending on the behavioral state of the group (Barkley et al. 2024). In addition to echolocation clicks, sperm whales produce a variety of sounds including creaks, squeals, and trumpets as well as social vocalizations, called codas, which are series of 3 to 20 clicks that last from 0.2 to 2 sec (Whitehead 2003; Whitehead 2018). Regular click trains and creaks have been recorded from foraging whales and are thought to be a function of echolocation (Jaquet et al. 2001; Madsen et al. 2002a; Whitehead and Weilgart 1991). Clicks are strongly directional, with SLs measured between 202 and 236 dB (Madsen and Møhl 2000; Møhl et al. 2003; Møhl et al. 2000). Zimmer et al. (2005b) reported SL of the high frequency (HF) component of clicks used to search for prey peaking at 229 dB.

Pinnipeds

Bearded seal (*Erignathus barbatus*)

Bearded seals are protected under the MMPA and listed as a species of least concern under the IUCN Red List (Kovacs 2016). The Beringia and Okhotsk DPSs are listed as threatened under the ESA and as depleted under the MMPA (77 FR 76740; December 28, 1012). Both DPSs occur outside of the Study Area, although sightings of vagrant individuals from these DPSs have occurred within the Study Area.

The global population of bearded seals is unknown. While outdated and based on 1990 survey efforts, the best estimate for the Okhotsk Sea population includes 95,000 seals (Cameron et al. 2010; Fedoseev 2000). Ver Hoef et al. (2014) estimated 61,800 seals in the Bering Sea, which was a limited estimation as sea ice habitat shifts rapidly, making it harder to detect and count seals that were hauled out on the ice. However, more recent abundances in the Bering Sea estimates there to be 301,836 seals based on extrapolation from a smaller sub-sample (Conn et al. 2014; Muto et al. 2021). Overall estimates of the Pacific bearded seal, including the Sea of Okhotsk, is estimated to be at least 250,000 seals (Kovacs 2016).

Bearded seals have a discontinuous circumpolar distribution, ranging from 80 °N in the Arctic, to as far south as 45 °N into subarctic areas of Hokkaido in the Western Pacific. Multiple sightings have occurred near the Sea of Japan, which is in the Study Area, and even one sighting on the eastern side of Japan, in Tokyo Bay (Naito 1976, 1979). They inhabit shallow continental shelf waters that are restricted to seasonal sea ice. In addition to sea ice, their seasonal distribution is limited by distribution of benthic prey. Bearded seals are not considered migratory; however, they do follow the advance and retreat of sea ice formation. Seals rely on sea ice for pupping in mid-March to early May. They then migrate north with the retreating ice and return south again in fall and winter as the ice advances (Jefferson et al. 2015).

Dive behavior of tagged seals found that most dives were shallow, with an average depth of 79 ft (24 m) deep and a maximum depth of 1,280 ft (391 m). Average durations were generally short (i.e., 6.6 min) with a maximum of 24 min (Hamilton et al. 2018). Gjertz et al. (2000) found bi-modal dive behavior, with peak diving activities shallower than 33 ft (10 m) and from 160 to 230 ft (50 to 70 m). Almost all dives were shorter than 10 min. Lactating mothers spent 92 percent of their time in the water, and approximately half of that time was spent diving (Krafft et al. 2000). The duration of dives averaged 2 min, with an average depth of 56 ft (17 m). Pups (0 to 17 days old) dove between 16 and 30 ft (5 and 9 m) deep, with durations 0.5 to 0.9 min (Watanabe et al. 2009). Swim speeds in pups ranged from 0.97 kt (0.5 m/s) in the smallest pup studied, up to 1.7 kt (0.9 m/s) in the largest pup studied (Watanabe et al. 2009).

There have been limited data on bearded seals' hearing abilities. Sills et al. (2020) was the first and only published study to investigate hearing abilities in two male bearded seals. Peak sensitivities were near 50 dB re 1 µPa, with a broad frequency range from approximately 0.3 to 45 kHz.

Bearded seal vocalization frequencies tend to be lower than other pinnipeds, with most vocalizations between 0.35 and 1.2 kHz (Heimrich et al. 2021; Madan et al. 2020; Scherdin et al. 2022). Call frequencies range between 0.19 and 3.99 kHz (Heimrich et al. 2021). Major call types across studies are categorized into four groups: trill, ascent, sweep, and moan (Risch et al. 2007; Van Parijs et al. 2003). Trills can further be classified as trill with ascent/plume, long trills, and short trills (Risch et al. 2007). At most sites, vocalizations happen during the breeding season (i.e., early April through mid-July), with males producing most of the sounds (Van Parijs et al. 2003). However, in the Bering Sea, seals have been recorded producing year-round sounds, regardless of sea ice presence or open water (MacIntyre et al. 2013). Geographical variations in call repertories have also been reported (Risch et al. 2007).

Hawaiian Monk Seal (*Neomonachus schauinslandi*)

Hawaiian monk seals are listed as endangered under the ESA (41 FR 51611; November 23, 1976), depleted under the MMPA, protected under CITES Appendix I, and as endangered under the IUCN Red List (Littnan et al. 2015). Critical habitat for the Hawaiian monk seal has been designated within the Study Area (53 FR 18990; May 26, 1988) and was expanded in 2015 (80 FR 50926; August 21, 2015; Figure C-6).

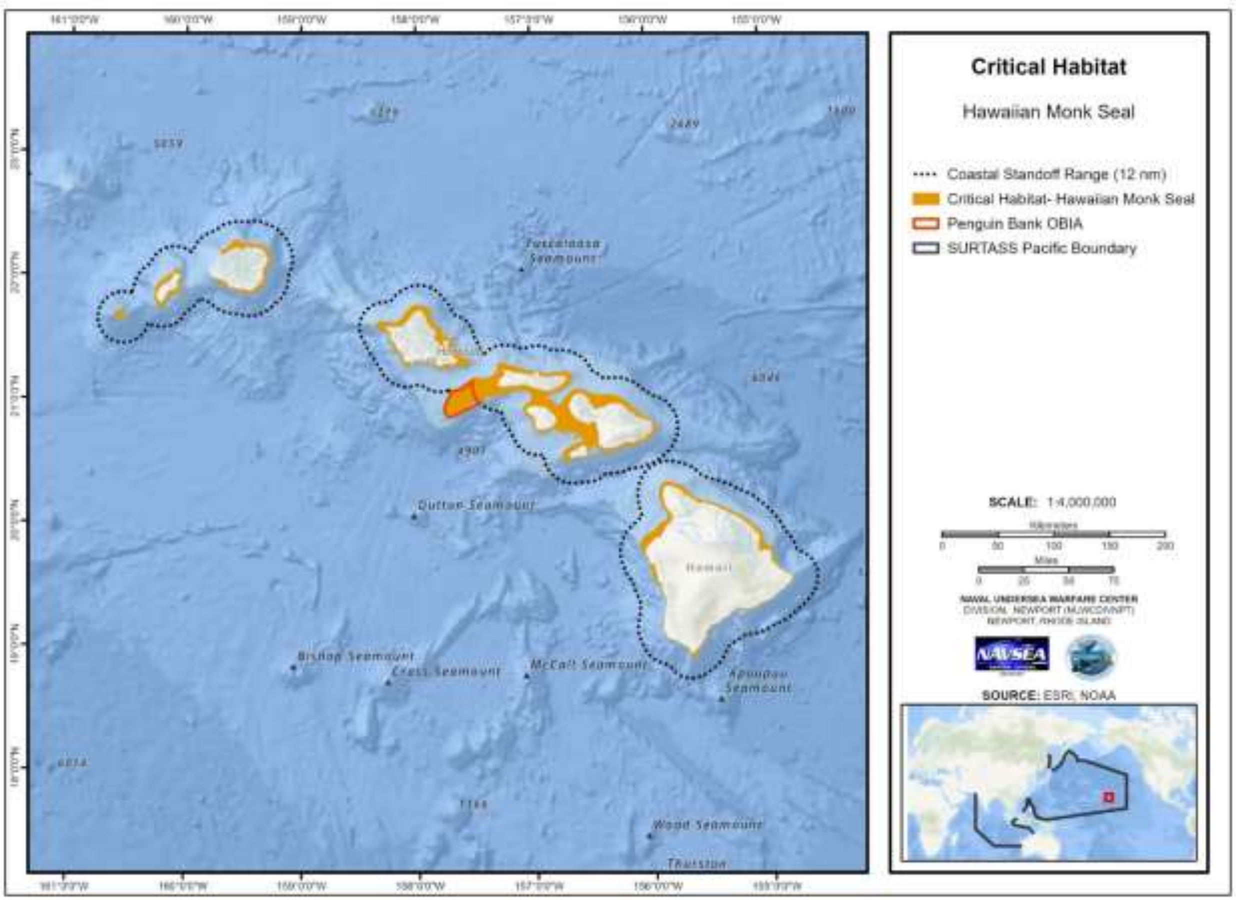

Figure C-6. Designated Critical Habitat for the Hawaiian Monk Seal within the Study Area

The Hawaiian monk seal is considered a single stock, which consists of two subpopulations: Northwest Hawaiian Islands and the MHI. The two subpopulations of Hawaiian monk seals are genetically differentiated, but remain connected through gene flow (Hauser et al. 2024). Seals move between the two subpopulations and island groups and the main difference in subpopulations comes from variations in demographic patterns (e.g. abundance trends and survival rates) (Johanos et al. 2014). Since the early 1990s, a small but increasing number of seals and an increasing number of annual births have been documented in the MHI stock (Antonelis et al. 2006).The subpopulation of Hawaiian monk seals that occurs in the Northwest Hawaiian Islands, which encompasses the majority of the overall population, is currently considered stable and possibly increasing. Six breeding groups within the Northwest Hawaiian Islands subpopulation have been identified: Kure Atoll, Midway Islands, Pearl and Hermes Reef, Lisianski Island, Laysan Islands, and French Frigate Shoals (Littnan et al. 2015). The best available population estimate for the Hawaii stock of Hawaiian monk seals is 1,564 (CV = 0.05) individuals (Carretta et al. 2024; Johanos 2023).

Hawaiian monk seals only occur throughout the subtropical waters of the Hawaiian Archipelago and Johnson Atoll, and they may be found in shelf waters, slope, and bank habitats (Gilmartin and Forcada 2009; Parrish et al. 2002). Hawaiian monk seals come ashore to haul out daily on a variety of substrates, including sandy beaches, rocky shores, rock ledges, and emergent reefs. Hawaiian monk seals exhibit site fidelity to their natal island (Gilmartin and Forcada 2009), and pupping only occurs on sandy beaches. Although not a migratory species, Hawaiian monk seals may travel distances up to at least 100 NM (200 km) to forage on neighboring banks (Abernathy 1999). In the previous SEIS/SOEIS, Hawaiian monk seals were considered to potentially range and forage as far west as Hancock Banks (U.S. Department of Navy 2019). However, Hawaiian monk seals have never been seen within this area, are unlikely to travel this far west, and are unlikely to feed in deep seamount waters (WPRFMC 2010).

The physical or biological features of the Hawaiian monk seal critical habitat that support the species' life history needs include (1) areas with characteristics preferred by monk seals for pupping and nursing; (2) shallow, sheltered nearshore marine areas preferred by monk seals for pupping and nursing; (3) marine areas up to 1,640 ft (500 m) in depth preferred by juvenile and adult monk seals for foraging; (4) areas with low levels of human disturbance; (5) marine areas with adequate prey quantity and quality; and (6) significant shore areas used by monk seals for hauling out, resting, or molting (NOAA 2015).

Hawaiian monk seals spend a greater proportion of their time at sea than on land. Wilson et al. (2017b) noted that, on average, Hawaiian monk seals spent 49 percent of their time diving, 19 percent at the sea surface, and 32 percent of their time hauled out on land. Hawaiian monk seals appear to exhibit a single dive type, which is a square-shaped, benthic dive pattern, with more than 50 percent of the dive time spent along the seafloor foraging in deeper, offshore waters. Most dives (70 percent) occurred during daylight hours (Wilson et al. 2017a). This species commonly dives to water depths less than 330 ft (100 m), but dives have been recorded as deep as 1,800 ft (550 m) (Parrish et al. 2002; Stewart et al. 2006). Wilson et al. (2017b) reported Hawaiian monk seal dives to water depths from 70 to 100 ft (20 to 50 m). Routine dives range from 3 to 7 min in primarily shallow water depths from 30 to 130 ft (10 to 40 m) (Stewart 2018; Wilson 2015). (Wilson et al. 2017a) reported Hawaiian monk seals with median dive durations of 4.9 min. Swim speed data on the Hawaiian monk seal are sparse. Hawaiian monk seals swim near the bottom while at sea (Parrish et al. 2008; Parrish et al. 2005). Parrish and Abernathy (2006) reported Hawaiian monk seals swimming with a velocity of 3.9 kt (5 mph).

An audiogram for an older, captive Hawaiian monk seal indicated relatively poor hearing sensitivity, a narrow range of best hearing sensitivity (12 to 28 kHz), and a relatively low upper frequency limit (Thomas et al. 1990a). Above 30 kHz, high-frequency hearing sensitivity dropped markedly (Thomas et al. 1990a). Sills et al. (2021) recorded the best underwater hearing to be between 0.2 and 33 kHz. Additionally, underwater sound recordings of Hawaiian monk seals found six different underwater calls, croaks, groans, growls, moans, rumbles, and whoops—all with energy less than 1 kHz (Sills et al. 2021). In-air vocalizations consist of a variety of sounds, including a liquid bubble sound (100 to 400 Hz), a guttural expiration (below 800 Hz) produced during short-distance agonistic (in conflict) encounters, a roar (less than 800 Hz) for long-distance threats, a belch-cough made by males when patrolling (less than 1 kHz), and sneezes/snorts/coughs of variable frequencies less than 4 kHz (Miller and Job 1992).

Ringed seal (*Pusa hispida*; Okhotsk Subspecies)

Ringed seals are protected under the MMPA and classified as a species of least concern under the IUCN Red List (Lowry 2016a). The Arctic subspecies (*P. h. hispida*), which includes seals in the Arctic and Bering Seas, and the Okhotsk subspecies (*P. h. ochotensis*), which includes seals in the Sea of Okhotsk and the northern Sea of Japan, both border the Study Area, are listed as threatened under the ESA, and depleted under the MMPA (77 FR 76706; December 28, 2012). While both subspecies occur outside of the Study Area, there have been sightings of vagrant individuals from these subspecies within the Study Area.

Estimates of the global population reach over 3 million seals. Calculations of stock abundances for ringed seals are limited due to difficulties accessing survey areas within the Arctic. The Arctic subspecies' population is estimated to be 1.45 million seals, and the Okhotsk subspecies' population is estimated to be 44,000 seals (Lowry 2016a). Within the U.S. Bering Sea, a minimum of 158,507 seals were estimated to be present (Conn et al. 2014; Muto et al. 2021).

Ringed seals have a continuous, circumpolar Arctic distribution that continues into the straits, Hudson Bay, and the Bering Sea. Isolated populations also exist outside the Arctic. A few rare sightings of single, vagrant ringed seals have been seen within the Yellow Sea of China. Ringed seal distributions strongly correlate with pack and shore-fast ice, depending on the season and time of year. Pack-ice is essential for breeding season, with pupping generally occurring March through April. Mature animals also utilize the ice for over-wintering and molting in June and July. Adults tend to remain solitary in these localized areas throughout the year. When not breeding or molting, seals engage in a steady, continuous pattern of foraging throughout the water column, under ice floes, or on the sea floor bottom in shallow waters. (Jefferson et al. 2015).

Dive behavior in ringed seals is driven by prey presence. Across individual seals, median dive durations were 10 min, with a maximum duration of 26.4 min. Maximum dive depths reached 728 ft (222 m) depth; however, this measurement may have been limited due to the maximum water depth within the respective study (Kelly and Wartzok 1996). Peaks in deep and long dives occurred in June and July, with the highest diving activity happening during the day at all times of the year (Harkonen et al. 2008). The greatest proportion of dives was less than 30 ft (10 m), with maximums reaching greater than 390 ft (120 m). The average daily depths year-round were 100 ft (40 m) for males and 82 ft (25 m) for females (Harkonen et al. 2008). Swim speeds for ringed seals ranged between 1.5 to 2.8 kt (2 to 3.2 mph) (Fish et al. 1988).

Underwater audiograms for two ringed seals found the best hearing frequencies to be 12.8 kHz and 25.6 kHz at thresholds of 49 and 50 dB re 1 µPa, respectively (Sills et al. 2015). At higher frequencies (greater than 25.6 kHz), the hearing of the younger female ringed seal was better than the male (Sills et al. 2015). Upper underwater hearing limits in ringed seals is thought to be around 60 kHz, with the best sensitivities between 16 and 45 kHz (Terhune and Ronald 1975a, 1975b). The best sensitivity in air is 4.5 kHz at -12 dB re 20 µPa (Sills et al. 2015).

Adults vocalize in air and in water. Four vocalizations have been identified: high-pitched barks, low-pitched barks, yelps, and chirps (Stirling 1973). Additionally, clicks, woofs, long snorts, and knocks have been identified in captive seals (Mizuguchi et al. 2016). Most ringed seal vocalizations were distinctively shorter than other seal species' vocalizations, with calls lasting less than 0.3 sec (Jones et al. 2014). Vocalizations ranged between 0.2 (clicks and woofs) and 30 kHz (clicks) (Southall et al. 2019). Howls ranged from 0.4 to 0.7 kHz (Southall et al. 2019). All vocalizations—with the exception of clicks—correlate with social behaviors, specifically male courtship, aggression, and submission. There were increases in vocalizations and calls during breeding season, typically late April to late June (Stirling 1973).

Spotted Seal (*Phoca largha*; Southern Distinct Population Segment)

Spotted, or largha, seals are protected under the MMPA and classified as a species of least concern under the IUCN red List (Boveng 2016). The Southern DPS of spotted seals, which consists of breeding concentrations in the Yellow Sea and Peter the Great Bay in the Sea of Japan, is listed as threatened under the ESA and depleted under the MMPA (75 FR 65239; October 22, 2010). No critical habitat has been designated for this DPS.

The global population of spotted seals is estimated to include 640,000 individuals (Boveng 2016). An estimated 180,000 to 240,000 seals occur in the Sea of Okhotsk (Fedoseev 2000). In the southern Sea of Okhotsk, off of Hokkaido, an average estimated abundance of 13,653 and 6,545 seals were reported during March and April 200, respectively (Mizuno et al. 2002). A relatively stable population of 3,200 to 3,600 seals was estimated in 2017 at Peter the Great Bay, which is within the Sea of Japan (Trukhin 2019).

Spotted seals occur in cold temperate and polar waters of the North Pacific and Arctic Oceans, including the Yellow Sea, East China Sea, Sea of Japan, Sea of Okhotsk, Bering Sea, and Chukchi Sea (Jefferson et al. 2015; Yang et al. 2023). They are found either in the open ocean or in pack-ice habitats throughout the year, including the ice over continental shelves during the winter and spring. They haul out on sea ice, but they also come ashore on land during the ice-free seasons of the year. Their range contracts and expands in correlation to ice cover, with their distribution being the most concentrated during colder, winter months. When the ice cover recedes in the Bering Sea, some seals migrate northward into the Chukchi and Beaufort Seas. As ice cover increases in the northern waters of their range, seals migrate southward through the Chukchi and Bering Seas to maintain ice association. Peak haul-out times are during molting and pupping months from February to May (Burns 2009).

Dives as deep as 1,000 to 1,300 ft (300 to 400 m) have been reported for adult spotted seals, with pups diving to 260 ft (80 m) (Bigg 1981). London et al. (2014) noted that most seal dives were to depths less than 230 ft (70 m), but dives from 230 to 650 ft (70 to 200 m) were observed primarily during the late winter and spring. Lowry et al. (1994) reported that seals in the Chukchi Sea dove to depths less than 328 ft (100 m), with a limited number of dives longer than 10 min in duration. Swim speeds range from 0.2 to 2.8 kt (0.2 to 3.2 mph), with an average speed of 1.1 kt (1.3 mph) (Lowry et al. 1998).

Sills et al. (2014) found the underwater hearing sensitivity in young seals ranges from 300 Hz to 56 kHz, with best sensitivity at 25.6 kHz. While in air, seals' hearing sensitivity ranges from 600 Hz to 11 kHz, with the best sensitivity at 3.2 kHz (Sills et al. 2014). Cunningham and Reichmuth (2016) measured the hearing ability of one 4 year-old seal to HF underwater sounds (i.e., 50 to 180 kHz); the seal was able to detect sounds up to 180 kHz, well beyond the limit of their presumed HF hearing capability. Adults have a broad range of best hearing (thresholds within 20 dB of best sensitivity) between approximately 300 Hz and 56 kHz (Sills and Reichmuth 2022).

Adult spotted seals vocalize in air and underwater. Underwater vocalization of captive spotted seals increased 1 to 2 weeks before mating. Vocalizations were more frequently produces by male seals rather than females. The sounds produced included growls, drums, snorts, chirps, and barks that ranged in frequency from 500 Hz to 3.5 kHz (Richardson et al. 1995). Yang et al. (2017) and Sills and Reichmuth (2022) reported that seals exhibit an extensive repertoire of underwater vocalizations, but the vocalizations show limited complexity, with all calls predominately in the low frequency range. The calls were described as short (12 to 270 milliseconds [msec]), LF pulsating (peak frequency less than 600 Hz), with narrow bandwidths (169 to 232 Hz) sound. Seven types of in-air vocalizations have been identified in captive seals, including pup calls, yearling calls, barks, growls, grunts, moos, and throat guttural calls. These in-air calls range from 139 Hz to 2.3 kHz with durations ranging from 92.8 to 1,208 msec and peak-to-peak SLs of 109 to 124 dB re 20 µPa, depending upon the age and sex of the individual (Zhang et al. 2016). Sills and Reichmuth (2022) also found clear diel patterns, with calling rates the highest at nighttime.

Steller Sea Lion (*Eumetopias jubatus*; Western Distinct Population Segment)

The Steller sea lion is taxonomically divided into two populations that represent the Western and Eastern DPSs of Steller sea lions; the Western DPS occurs within the Study Area. The Western DPS is considered both strategic and depleted under the MMPA, as well as endangered under the ESA (62 FR 24345; May 5, 1997). The Eastern DPS is not expected to occur within the Study Area; therefore, it is not further discussed. The Western Steller sea lion occurs west of Cape Suckling, Alaska (144 °W) (Loughlin 1997). Critical habitat for Western Steller sea lions has been designated under the ESA; however, it is outside of the Study Area (58 FR 45269; August 27, 1993).

A 2022 estimate for total abundance of the Western population is estimated to be approximately 17,342 non-pups and 6,032 pups from Russia/Asia (Burkanov 2020; Young et al. 2024). The most updated minimum population estimate of the U.S. Western stock is 49,837 sea lions (Young et al. 2024). As of 2022, the Western sea lions within Alaska waters includes 37,333 non-pups and 11,987 pups (Sweeney et al. 2022; Sweeney et al. 2023).

Steller sea lions are found in temperate and sub-polar waters. They are widely distributed throughout the North Pacific Ocean, ranging from central California, up and across the southern Bering Sea, down to Japan and Korea, including the Sea of Japan and Sea of Okhotsk (Jefferson et al. 2015). The northernmost rookery, which is comprised of Western DPS sea lions, is found at Seal Rocks in Prince William Sound, Alaska (Loughlin and Gelatt 2018). They occur in coastal to outer continental shelf waters and cross deep oceanic waters in parts of their range (Jefferson et al. 2015). Steller sea lions make long-distance movements, and they are generally considered non-migratory. However, some individuals, particularly females, have exhibited migratory behaviors (Pendleton and Jemison 2023). During the breeding season, they disperse widely over the North Pacific and typically return to their natal rookery site each year to mate (Loughlin 1997; York 1996). During the winter months sea lions disperse to more protected haul out sites, such as Benten-Jima Rock located off of Cape Soya, Hokkaido (Goto et al. 2022).

Pup and juvenile Steller sea lion dives tend to be short in duration (less than 2 min) and to shallow water depths (less than 33 ft [10 m]) (Pitcher et al. 2005). Juvenile and sub-adult sea lions dove to the maximum depth of at least 1,180 ft (360 m), which was the deepest measurable depth. The maximum durations for juvenile and sub-adult sea lions were 4.9 min and 13.2 min, respectively (Rehberg and Burns 2008). Female sea lions on foraging trips during the breeding season dove to the maximum dive depth of 774 ft (236 m), while the longest dive was longer than 16 min. The average dive depth for foraging females was 97.1 ft (29.6 m), and the average dive time was recorded at 1.8 min (Rehberg et al.

2009). The deepest dive on record was to 1,391 ft (424 m). Swim speed has been estimated at 1.52 kt (2 mph), with a range of 0.2 to 3.27 kt (0.2 to 3.8 mph) (Raum-Suryan et al. 2004). Three adult Steller sea lions were recorded with swim speeds from 3.5 to 4.5 kt (4 to 5 mph) (Hindle et al. 2010).

Using behavioral methods from underwater audiograms, maximum hearing sensitivity in a male Steller sea lion was at 1 kHz for 77 dB RL signals, with the range of best hearing between 1 and 16 kHz (Kastelein et al. 2005). The maximum hearing sensitivity for the female Steller sea lion was 25 kHz for a RL signal of 73 dB RL (Kastelein et al. 2005). The reasons for the differences in hearing capability between the male and female adult Steller sea lions was unknown. Mulsow and Reichmuth (2010) found aerial hearing ranges to be from 0.25 to 30 kHz, with the best sensitivity between 5 and 14.1 kHz.

Steller sea lions produce sounds both in air and underwater. The underwater sounds have been described as clicks and growls (Poulter 1968). The in-air sounds produced by male sea lions include belches, growls, snorts, scolds, hisses, and LF roars, which appear to be a part of territorial demonstrations during the breeding season (Kastelein et al. 2005). Females and their pups make in-air communication sounds that are described as bellows and bleats (Loughlin 2009). Female aerial contact calls with pups ranged in frequency from 30 to 3,000 Hz, with peak frequencies from 150 to 1,000 Hz (Campbell et al. 2002). No available data exist on seasonal or geographical variations in the sound production of this species.

C.4 Non ESA-Listed Marine Mammals

The humpback whale and false killer whale are species with multiple DPSs that have different ESA listings. For the humpback whale and false killer whale, general species information (e.g., geographic range, migration, distribution, diving behavior, swimming behavior, hearing and vocalizations) can be found above under their respective ESA sections.

Mysticetes

Antarctic Minke Whale (*Balaenoptera bonaerensis*)

Antarctic minke whales (AMW) are protected under the MMPA and CITES Appendix I, and they are considered near threatened under the IUCN Red List (Cooke et al. 2018). The most recent estimate for the entire population is 515,000 whales, based on 1993–2004 survey efforts (IWC 2023). The population of AMW occurring off Western Australia has been estimated as 90,000 whales (Bannister et al. 1996).

AMW are an oceanic species, occurring in waters beyond the continental shelf break (Perrin et al. 2018). They range from the waters of the Southern Ocean in Antarctica (south of 60 °S) to the ice edge during austral summer. In the austral winter, some whales overwinter in Antarctic waters (Perrin et al. 2018; Reilly et al. 2008).

In a study by Leatherwood et al. (1981), AMW were found to dive for durations between 9.7 and 10.8 min, with long dives separated by 1.3 to 3.5 min of shallow submergence or surface “rafting”. Friedlaender et al. (2014) recorded diving behavior for two foraging individuals, with three foraging dive types identified: short and shallow, under ice, and long and deep. The mean dive depths for the two individuals were 33 ft (10 m) for short and shallow dives, 98 ft (30 m) for under ice dives, and 190 ft (57 m) for long and deep dives. Dive times ranged from approximately 1 to 6 min (Friedlaender et al. 2014). Risch et al. (2014a) reported AMW making shallow dives to less than 130 ft (40 m) at night and deeper dives to over 200 ft (60 m) during the day. Since speeds have not been quantified, the common minke serves as a good comparison, reaching speeds of 4.5 kt (Stern 1992), with a reported "cruising" speed of 6.3 kt (Blix and Folkow 1995).

Hearing sensitivity of AMW has not been directly measured (Ketten 2000; Thewissen 2002). However, models of common minke whale middle ears predict their best hearing overlaps with their vocalization frequency range (Tubelli et al. 2012). AMW produce a variety of sounds, including whistles, clicks, screeches, grunts, down sweeps, calls that sound like a clanging bell, and a "bio-duck" sound (Leatherwood et al. 1981; Risch et al. 2014a). Down sweeps are intense, low frequency calls that sweep down from about 130 or 115 Hz to about 60 Hz (Schevill and Watkins 1972). The "bio-duck" sound resembles the quack of a duck. Bio-duck signals consist of a series of pulse trains of short down swept signals with a peak frequency of 154 Hz, and an average SL of 140 dB re 1 µPa at 1 m, sometimes with harmonics up to 1 kHz (Risch et al. 2014a). The bio-duck sound appears to be produced when whales are at the sea surface before foraging dives (Risch et al. 2014a); however, the function of the sound is largely unknown (Filún and van Opzeeland 2023). AMW have recently been noted to produce songs (Filún and van Opzeeland 2023).

Bryde's Whale (*Balaenoptera edeni*)

Two subspecies of Bryde's whale have been recognized: the larger, oceanic Bryde's whale (*B. edeni brydei*) and the smaller, coastal Eden's whale (*Bedeni edeni*) (Kato and Perrin 2018; Kershaw et al. 2013; Luksenburg et al. 2015; SMM 2023; Wada et al. 2003). The offshore Bryde's whale occurs globally in pelagic waters, while the Eden's whale typically occurs in nearshore waters of the Pacific and Indian oceans (Rice 1998). Both subspecies occur within the Study Area (Cooke and Brownell Jr 2018; De Boer et al. 2003). However, due to the lack of detailed published information on the two separate subspecies, the species will be considered herein as a whole.

The Bryde's whale is protected under the MMPA, under CITES Appendix I and classified as a species of least concern by the IUCN Red List (Cooke and Brownell Jr 2018). The International Whaling Commission recognizes three stocks of Bryde's whales in the North Pacific Ocean (Eastern, Western, and East China Sea) and three stocks in the South Pacific (Eastern, Western, and Solomon Islands) (IWC 1996). NMFS has identified a Hawaii stock in the central North Pacific Ocean. No global population estimates exist. In the Western North Pacific Ocean, the population is estimated as 41,000 whales (IWC 2023). The East China Sea stock is estimated as 137 whales (IWC 1996). In Hawaiian waters, the best estimate is 791 whales (CV=0.29) (Carretta et al. 2024).

Bryde's whales occur roughly between 40 °N and 40 °S throughout tropical and warm (greater than 61.3 °F [16.3 °C]) temperate waters year-round (Kato and Perrin 2018). Sightings indicate that the species' range is expanding poleward (Kerosky et al. 2012). They are distributed in the subarctic-subtropical transition area—the frontal boundary where subarctic waters intersect the warmer waters of the Kuroshio Current—of the Western North Pacific Ocean throughout summer. This region is thought to be a feeding area, where the foraging distribution is highly linked to the distribution of their prey (Sasaki et al. 2013; Watanabe et al. 2012). Most whales are believed to migrate seasonally toward the lower latitudes near the equator in winter and to high latitudes in summer (Kato and Perrin 2018). For example, two satellite-tagged whales in the offshore waters of the Western North Pacific Ocean did not remain in the subarctic-tropical transition feeding area throughout the summer; instead, they traveled southward to subtropical waters between 20 and 30 °N (Murase et al. 2015). Foraging grounds are not well known, although there is evidence that they feed on a wide range of food in both pelagic and nearshore areas (Niño-Torres et al. 2014).

Bryde's whales can dive to a water depth of about 1,000 ft (300 m) (Kato and Perrin 2018). The maximum dive time reported for two whales off Madeira Island was approximately 9.4 min, with average dive duration lasting 5 min (Alves et al. 2010). Additionally, routine dives occurred in water depths from 130 to 656 ft (40 to 200 m), with a maximum depth of 958 ft (292 m) (Alves et al. 2010). Bryde's whales are relatively fast swimmers. General swim speeds are between 1.1 and 3.8 kt (2 and 7 kph), with some whales moving as fast as 10 to 14 kt (20 to 25 kph) (Kato and Perrin 2018). Murase et al. (2015) reported a mean speed of 2.4 kt (4.4 kph) for two whales, with one individual averaging 3.0 kt (5.5 kph) and the other averaging 1.6 kt (2.9 kph) during travel. Whales tracked off Kauai, Hawaii swam at speeds that ranged from 0.08 to 8.6 kt (0.15 to 16 kph), with an overall mean swim speed of 3.2 kt (5.9 kph) (Helble et al. 2024; Helble et al. 2016).Bryde's whales can dive to a water depth of about 1,000 ft (300 m) (Kato and Perrin 2018). The maximum dive time reported for two whales off Madeira Island was approximately 9.4 min, with average dive duration lasting 5 min (Alves et al. 2010). Additionally, routine dives occurred in water depths from 130 to 656 ft (40 to 200 m), with a maximum depth of 958 ft (292 m) (Alves et al. 2010). Bryde's whales are relatively fast swimmers. General swim speeds are between 1.1 and 3.8 kt (2 and 7 kph), with some whales moving as fast as 10 to 14 kt (20 to 25 kph) (Kato and Perrin 2018). Murase et al. (2015) reported a mean speed of 2.4 kt (4.4 kph) for two whales, with one individual averaging 3.0 kt (5.5 kph) and the other averaging 1.6 kt (2.9 kph) during travel. Whales tracked off Kauai, Hawaii swam at speeds that ranged from 0.08 to 8.6 kt (0.15 to 16 kph), with an overall mean swim speed of 3.2 kt (5.9 kph) (Helble et al. 2024; Helble et al. 2016).

No direct measurements of Bryde's whales' hearing sensitivity have been conducted (Ketten 2000). They are known to produce a variety of LF sounds ranging from 20 to 900 Hz, with the higher frequencies coming from mother-calf pairs (Cummings 1985; Edds et al. 1993). Oleson et al. (2003) reported call types with fundamental frequencies below 60 Hz. Calves produce discrete pulses at 700 to 900 Hz (Edds et al. 1993). SLs range between 152 and 174 dB re 1 µPa at 1 m (Frankel 2018).

Common Minke Whale (*Balaenoptera acutorostrata*)

The taxonomy of the minke whale is not yet fully resolved. The common minke whale has separate subspecies designations in the North Pacific (*B. acutorostrata scammoni*) and the North Atlantic (*B. acutorostrata acutorostrata*) Oceans. Dwarf minke whale are an unnamed subspecies that occurs almost exclusively in the Southern Hemisphere. The North Pacific and dwarf minke subspecies are both found within the Study Area. Little to no subspecies-level data is available on the dwarf minke whale, so information is presented herein on the common minke whale is considered inclusive for the dwarf minke whale.

The common minke whale is protected under the MMPA and CITES Appendix I, and classified as a species of least concern by the IUCN Red List (Cooke 2018a). The International Whaling Commission has reevaluated the stock structure of common minke whales in the Western North Pacific Ocean, concluding that at least two stocks of common minke whales occur in the Western North Pacific Ocean: the J-stock (Yellow Sea, East China Sea, and Sea of Japan), and the O-stock (offshore waters of the Northwest Pacific Ocean and Okhotsk Sea) (Cooke 2018a). However, stock structure is not fully resolved as there is a lack of data for minke whales during winter on their reputed breeding grounds. Additionally, there have been a few reports of unidentified whales in the Northern Indian Ocean that may have been minke whales; however, none of these sightings have been confirmed (Perrin et al. 2018). Common minke whales have been detected acoustically and visually in the winter around the Hawaiian Islands in small numbers (Barlow 2003a; Rankin and Barlow 2005).

The most recent abundance estimate for the Western North Pacific (west of 170 °E) is from data collected from 2005–2012, totaling 27,000 individuals (CV=0.16), with 60 percent of whales being found in the Okhotsk Sea (Allison et al. 2014). The current minimum population for the J-stock is estimated to be 5,247 animals (Song 2016). Design-based abundance estimate in 2017 was 438 whales (CV=1.05) within the Hawaiian EEZ during the summer and fall (Bradford et al. 2021). Furthermore, line-transect surveys around the Mariana Islands estimated there to be a minimum of 80 to 91 minke whales in the area during the winter/spring season (Norris et al. 2017).

Minke whales occur mostly in tropical to polar coastal/neritic and inshore waters of the Atlantic, Pacific, and Indian Oceans, as well as more infrequently in pelagic waters. Common minke whales are considered rare in the Northern Indian Ocean (Jefferson et al. 2015; Sathasivam 2002). They are thought to be migratory in some areas. Although migration pathways are not well known, they generally move to higher latitudes to feed in the summer and return to lower latitudes to breed and calve in the winter (Víkingsson and Heide-Jørgensen 2015). Whales in some areas appear to be year-round residents (NMFS 2023a). Areas of winter aggregation are not known (Cooke 2018a).

Minke whales in the St. Lawrence River performed short (2 to 3 min) and long (4 to 6 min) dives (Christiansen et al. 2015). Some dives have range from 1 to 1.4 min in duration (Stockin et al. 2001), whereas other studies found a wider range of 1 to 6 min (Joyce et al. 1989). The dives of four tagged whales could be characterized as long/deep dives, intermediate dives, and short/shallow dives, accounting for 14, 29, and 57 percent of all baseline dives, respectively (Kvadsheim et al. 2017). Tagged whales dove to a maximum depth of 490 ft (150 m) but rarely dove deeper than 390 ft (120 m) (Kvadsheim et al. 2017). The mean swim speed for whales in Monterey Bay was 4.5 kt (Stern 1992), while their reported “cruising” speed was 6.32 kt (11.7 kph) (Blix and Folkow 1995). Helble et al. (2023) classified swim speeds as either “slow state” (mean = 2.75 ft/s [0.84 m/s]) or “fast state” (mean = 7.74 ft/s [2.36 m/s]). Additionally, minke whales pursued by killer whales swam at speeds ranging from 8.1 to 16 kt (15 to 30 kph) (Ford et al. 2005).

Beginning in summer 2022, a project in coordination with National Marine Mammal Foundation, the Norwegian Defence Research Establishment, and LKARTS-Norway set out to measure common minke whale hearing, via auditory brainstem response (ABR). Preliminary results suggest that the upper-frequency limit for minke whales is between 45 and 90 kHz (U.S. Department of Navy 2024). This hearing range is much higher than previously believed (NMMF 2023; U.S. Department of Navy 2024).

Sounds produced by common minke whales encompass a wide frequency range and variety of call types (Frankel 2018). Their sound variety includes moans, clicks, down sweeps, ratchets, pulse trains, grunts, and “boings” (80 Hz to 20 kHz) (Edds-Walton 2000; Frankel 2018; Mellinger et al. 2000). The signal features of their vocalizations consistently include LF, short-duration down sweeps from 250 to 50 Hz. The energy in pulse trains is concentrated in the 100 to 400 Hz band (Mellinger et al. 2000). Complex vocalizations recorded from whales found in Australian waters involve pulses ranging between 50 Hz and 9.4 kHz, followed by pulsed tones at 1.8 kHz and tonal calls shifting between 80 and 140 Hz (Gedamke et al. 2001). Boings begin with a brief pulse followed by a longer AM and FM signal (Rankin and Barlow 2005). SLs of calls ranged from 164 to 168 dB re 1 µPa at 1 m (Risch et al. 2014b). Geographical differences have been found among the sounds recorded (Rankin and Barlow 2005).

Humpback Whale (*Megaptera novaeangliae*)

Humpback whales found within the Study Area that are not ESA-listed, including the Hawaii DPS, are described here. DPS distinctions for humpback whales are based on breeding grounds. Only one breeding area, West Australia, has been identified in the western Indian Ocean (NOAA 2016). In contrast to DPSs, stocks of humpback whales are identified by geographic areas that include discrete or multiple feeding areas. In the North Pacific Ocean, stocks of humpbacks include the CA-OR-WA with feeding areas in the California-Oregon and the Washington-British Columbia regions. The Central North Pacific (CNP) stock has feeding areas from southeast Alaska to the Alaskan Peninsula, and the WNP stock feeds in the Aleutian Islands, the Bering Sea, and Russia.

Humpback whales from one breeding ground DPS migrate to feed in multiple feeding areas in varying numbers, causing intermingling and overlap of DPSs at feeding grounds. Hawaii DPS whales migrate and feed throughout the entire North Pacific region. Therefore, the WNP stock, CNP stock, and the CA-OR-WA stock all have Hawaii DPS whales within their respective feeding ground region. Under the MMPA, the WNP stock, the CNP stock, and the CA-OR-WA stock are considered depleted. The America Samoa stock, also found within the Study Area, has feeding areas in the Southern Ocean along the Antarctic Peninsula (Carretta et al. 2021). Only one breeding area, West Australia, has been identified in the western Indian Ocean (NOAA 2016).

The population of humpback whales in the entire North Pacific Ocean is estimated to be 21,808 whales (CV=0.04) (Barlow et al. 2011). In the Central North Pacific Ocean portion of the Study Area, the population of the Hawaii DPS is estimated as 10,103 whales . General information on humpback whale geographic range, migration, distribution, diving behavior, swimming behavior, hearing and vocalizations can be found in Section C.3 under the Humpback Whale (*Megaptera novaeangliae*; Western North Pacific Distinct Population Segment) above.

Omura's Whale (*Balaenoptera omurai*)

Omura's whale is protected under the MMPA, listed under CITES Appendix I, and considered data deficient by the IUCN (Cooke and Brownell Jr 2019). Omura's whales have only recently been described and differentiated from Bryde's whales via genetic analysis (Sasaki et al. 2006; Wada et al. 2003). Given that limited specimens have been collected, their recent reclassification as a separate species from Bryde's whales, and their unknown range, there are no global or regional abundances available.

Omura's whale is often observed in coastal and neritic waters, but these whales have also been observed in deep waters off the shelf (Cerchio et al. 2015; Cerchio and Yamada 2018), this species primarily inhabits warm-temperate and tropical locations in all oceans except for the eastern and central Pacific (Cerchio et al. 2019). The majority of records are located between 35 °N and 35 °S in waters of the Indo-Pacific. Omura's whale has been reported in the waters of countries such as Japan, Australia, Republic of Korea, and Indonesia (Cerchio et al. 2019; Kim et al. 2018). No information is available on the migratory behavior of Omura's whales. The presence of mothers and calves in northwestern Madagascar waters, as well as re-sightings of the same individuals the following year, suggests a resident breeding population (Cerchio et al. 2015). Swim speeds and dive behavior have not yet been documented for Omura's whales.

Hearing has not been measured for the Omura's whale; however, they are classified as low frequency hearing specialists, presumably capable of hearing sound within the range of 7 Hz to 35 kHz (NMFS 2018; Southall et al. 2019). They have been recorded producing long (mean duration of 9.2 sec), broadband, AM calls with energy concentrated in the 15 to 50 Hz band and a rhythmic sequence of 2 to 3 min intervals between utterances (Cerchio et al. 2015). Whale calls are thought to be suggestive of song display. Cerchio and Yamada (2018) observed calls that were rhythmically repeated at 130 to

180 sec intervals, with singing documented to last up to 12 hours without pause and five to six singers audible on a single hydrophone.

Odontocetes

Baird's Beaked Whale (*Berardius bairdii*)

Baird's beaked whale is protected under the MMPA, listed under CITES Appendix II, and classified as a species of least concern under the IUCN Red List (Taylor and Brownell Jr. 2020). Sightings of this species are rare; therefore, knowledge on stocks and abundances is limited. Off the Pacific Coast of Japan, the most recent population abundance estimate, based on 2017 surveys, is 3,596 (CV=0.82) whales (Sasaki et al. 2023). The population of the eastern Sea of Japan was estimated at 1,468 whales (Miyashita 1990). However, the Navy recognizes that these population estimates are old and unreliable, despite being the best available data for this region.

Baird's beaked whales occur in the North Pacific, including in the Bering and Okhotsk Seas and off the coast of California (Kasuya 1986; Yack et al. 2013). These whales inhabit deep waters and appear to be most abundant in areas of steep topographic relief, such as shelf breaks and seamounts (Dohl et al. 1983; Kasuya 1986). They have been documented as having an inshore-offshore movement off California beginning in July and ending around September/October (Dohl et al. 1983). Additionally, it is reported that whales migrate to the coastal waters of the Western North Pacific and the Southern Sea of Okhotsk in the summer (Ohizumi et al. 2003).

Kasuya (2009) reported that Baird's beaked whales in Pacific Japan had dives lasting up to 67 min, with 39 percent of dives lasting less than 11 min, 27 percent of dives lasting between 11 and 20 min, and 18 percent of dives between 21 and 30 min. Barlow (1999) reported average dive durations at 15.5 min (CV=0.13). A tagged whale in the Western North Pacific had a maximum dive time of 64.4 min and a maximum depth of 5,830 ft (1,777 m). The same whale's behavior consisted of deep dives (greater than 3,280 ft [1,000 m]), followed by several subsequent intermediate dives (328 to 3,280 ft [100 to 1,000 m]) and shallow dives (less than 328 ft [1,000 m]) (Minamikawa et al. 2007). Another tagged whale exhibited a maximum dive as long as 73 min and to 4,628 ft (1,411 m) deep (Stimpert et al. 2014). The same whale recorded speeds of 2.7 and 2.9 kt (1.4 m/s and 1.5 m/s) before and after sonar exposure, respectively. (DeAngelis et al. 2023) estimated average dive depths between 1,096 and 2,894 ft (334 and 882 m), based on echolocation depths picked up from hydrophones. Baseline swim speed data are limited due to Baird's beaked whales' elusive nature.

Direct measurements of Baird's beaked whale hearing sensitivity have not been identified (Ketten 2000; Thewissen 2002). This species produces a variety of sounds, mainly burst-pulse clicks and FM whistles. Whales have been recorded producing HF sounds between 12 and 134 kHz, with dominant frequencies between 23 and 24.6 kHz and 35 and 45 kHz (Dawson et al. 1998). They produce two different types of echolocation signals, an FM pulse—similar to other beaked whales—and a broadband click—similar to dolphins (Baumann-Pickering et al. 2013b). The different function of these two signals is still unknown. The FM echolocation pulses recorded a median peak frequency at 16.4 kHz and a median duration of 504 µs (Baumann-Pickering et al. 2013a). There is no available data regarding explicit seasonal or geographical variation in sound production; however, echolocation signals in the northeastern Pacific were recorded year round, indicating no seasonal patterns in this region (Baumann-Pickering et al. 2014). No estimated SLs have been documented.

Common Bottlenose Dolphin (*Tursiops truncatus*)

The common bottlenose dolphin is protected under the MMPA, listed under CITES Appendix II, and classified as a species of least concern under the IUCN Red List (Wells et al. 2019). The global population for the bottlenose dolphin is unknown. The abundance of common bottlenose dolphins in the WNP Northern Offshore stock, which includes bottlenose dolphins in the area of the WNP bounded by 30 to 42 °N and 145 to 180 °E, is estimated as 100,281 dolphins (Kasuya and Perrin 2017; Miyashita 1993). The portion of the WNP stock that occurs in Southern Offshore Japan, found in the area between 25 to 35 °N and 125 to 145 °E, has been estimated to include 40,769 dolphins (Kanaji et al. 2018). Dolphins occurring in Pacific coastal waters of Japan are part of the Japanese Coastal stock, which is estimated to include 3,516 dolphins (Kanaji et al. 2018). The WNP stock, which occurs in the Asian continental seas, includes 168,792 dolphins (Miyashita 1993). The Hawaii population of pelagic common bottlenose dolphins includes 24,669 individuals (CV=0.57) (Carretta et al. 2024); the insular Hawaiian stocks include an estimated 184 dolphins in the Kauai/Niihau stock, 743 in the Oahu stock, 191 in the 4-Island stock, and 128 in the Hawaii Island stock (Baird et al. 2009; Carretta et al. 2018). In Western Australia, 2,000 to 3,000 common bottlenose dolphins may occur in the waters off Western Australia (Preen et al. 1997).

The bottlenose dolphin is distributed worldwide in temperate to tropical waters. In North America, they inhabit waters with temperatures ranging from 50°F to 89 °F (10 °C to 32 °C) (Wells and Scott 2018). Common bottlenose dolphins are primarily found in coastal waters, but they also occur in diverse habitats ranging from rivers and protected bays to oceanic islands and the open ocean, over the continental shelf, and along the shelf break (Wells and Scott 2018). Seasonal movements vary between inshore and offshore locations and year-round home ranges (Croll et al. 1999; Shane et al. 1986; Wells and Scott 2018). Calving season is year-round with peaks occurring from early spring through early fall (Wells and Scott 2018). There are no known breeding grounds.

Bottlenose dolphin dive times as long as 10 min have been previously recorded (Ridgway 1986). Wild offshore dolphins have been reported to dive to depths greater than 1,500 ft (450 m) (Klatsky et al. 2007). More recently, Fahlman et al. (2023) reported that offshore dolphins commonly performed long (greater than 272 sec) and deep (greater than 653 ft [199 m]) dives. The deepest dive recorded for a bottlenose dolphin is 1,760 ft (535 m) by a trained individual (Ridgway 1986). Sustained swim speeds ranged between 2 and 10 kt (4 and 20 kph), with speeds recorded as high as 29 kt (54 kph) (Lockyer and Morris 1987). The most energetically efficient swim speed for dolphins is about 4.23 kt (2.18 m/s) (Bailey and Thompson 2010).

Bottlenose dolphins hear underwater sounds in the range of 150 Hz to 135 kHz (Johnson 1967; Ljungblad et al. 1982). Their best underwater hearing occurs between 15 and 110 kHz, where the RL threshold range is 42 to 52 dB (Au 1993). Ljungblad et al. (1982) measured sensitivities between 25 and 70 kHz, with peaks in sensitivity between 25 and 50 kHz. Bottlenose dolphins also have accurate sound location abilities and are thought to be able to voluntarily reduce their hearing sensitivity to loud sounds (Nachtigall and Supin 2015; Richardson et al. 1995).

Bottlenose dolphins produce a variety of whistles, echolocation clicks, low-frequency narrow, "bray" and burst-pulse sounds. Dolphins produce sounds as low as 50 Hz and as high as 150 kHz with dominant peak frequencies at 300 Hz to 14.5 kHz, 25 to 30 kHz, and 95 to 130 kHz (Croll et al. 1999). The maximum SL reported is 227.6 dB (Au 1993). Echolocation clicks with peak frequencies from 40 to 130 kHz are hypothesized to be used in navigation, foraging, and predator detection (Au 1993; Houser et al. 1999; Jones and Sayigh 2002). Sonar clicks are broadband, ranging in frequency from a few kHz to more than 150 kHz, with a 3 dB bandwidth of 30 to 60 kHz (Au 1993). Echolocation signals are 0.05 to 0.1 sec in duration with peak frequencies ranging from 30 to 100 kHz (Houser et al. 1999). Burst-pulses, or squawks, are commonly produced during social interactions. These sounds are broadband vocalizations that consist of rapid sequences of clicks.

Inter-click intervals (ICIs) vary to form different types of click patterns that include the following: (1) low-frequency clicks that have no regular repeating interval; (2) train clicks (ICI range=0.035–0.143 sec); (3) packed clicks (ICI range=0.002–0.005 sec); and (4) bursts (ICI range: 0.002–0.005 sec), which had more clicks than a packed click train (Buscaino et al. 2015). Burst-pulse sounds are typically used during escalations of aggression (Overstrom 1983). Whistles range in frequency from 1.5 to 23 kHz and have durations up to 4 sec (Díaz López 2011; Gridley et al. 2015). Each individual dolphin has a fixed, unique FM pattern, or contour whistle, called a signature whistle. These signal types have been well studied and are used for recognition, but they may have other social contexts (Janik et al. 2013; Kuczaj 2015). Signature whistles have a narrow-band sound with the frequency commonly between 4 and 20 kHz, duration between 0.1 and 3.6 sec, and an SL of 125 to 140 dB re 1 µPa at 1 m (Caldwell et al. 1990).

Common Dolphin (*Delphinus delphis delphis*) and Indo-Pacific Common Dolphin (*Delphinus delphis tropicalis*)

The SMM (2023) has resolved and revised the complex taxonomy of the common dolphin, which had formerly been divided into the short-beaked common dolphin and the long-beaked common dolphin. Although the Indo-Pacific common dolphin is retained as a subspecies, the SMM no longer recognizes the two, short-beaked and long-beaked, subspecies of common dolphins; these species are now simply the common dolphin. NMFS still distinguishes between the two species. This SEIS/OEIS follows the SMM definition of common dolphins, including the Indo-Pacific common dolphin subspecies. The Indo-Pacific common dolphin is a long-beaked variant that occurs in the Indian Ocean (SMM 2023). The details that define the common dolphin and Indo-Pacific subspecies are difficult to assess at-sea, and most at-sea observations only reported “common” dolphins, generically. Since little characterization is known to the subspecies level, information that follows refers to the species of common dolphins, inclusive of the Indo-Pacific subspecies.

The common dolphin is protected under the MMPA, listed under CITES Appendix II, and classified as a species of least concern under the IUCN Red List (Braulik et al. 2021). The global population for common dolphins is unknown.

Common dolphins are widely distributed worldwide in temperate, tropical, and subtropical oceans, primarily in neritic waters of the continental shelf and steep bank regions where upwelling occur (Jefferson et al. 2015; Perrin 2018a). These dolphins seem to be most common in the coastal waters of the Pacific Ocean, often occurring within 110 mi (180 km) of land (Jefferson et al. 2015).

Dive depths range between 30 and 656 ft (9 and 200 m), with most dives occurring to 30 to 160 ft (9 to 50 m) (Evans 1994). The deepest dive recorded for common dolphins was 846 ft (258 m) (Evans 1971). Swim speeds for *Delphinus* spp. have been measured at 3.1 kt (5.8 kph), with maximum speeds of 8.75 kt (16.2 kph) (Evans 1971). Common dolphins tracked off California swam at an average speed of 5 kt (9 kph) (Wiggins et al. 2013).

Little is known about hearing in common dolphins. The hearing threshold, using ABR on a single dolphin, was found to have a U-shaped audiogram, a steeper high-frequency branch, and an auditory range from 10 to 150 kHz, with greatest sensitivity between 60 and 70 kHz (Popov and Klishin 1998). It should be noted that the dolphin studied by Popov and Klishin (1998) was ill and eventually died in captivity after measurements were taken. Therefore, the measurements may not accurately represent a healthy dolphin's hearing. Houser et al. (2022) used auditory evoked potential (AEP) methods on a stranded 3-year-old long-beaked common dolphin and identified hearing thresholds at less than 65 dB re 1 µPa from 40 to 80 kHz. The upper frequency limit was at least 160 kHz, the highest frequency tested.

Common dolphins produce sounds as low as 0.2 kHz and as high as 150 kHz, with dominant frequencies between 0.5 to 18 kHz and 30 to 60 kHz (Au 1993; Moore and Ridgway 1995; Popper 1980). Signal types consist of clicks, squeaks, whistles, and creaks (Evans 1994). Whistles of the short-beaked common dolphin range between 3.6 and 23.5 kHz (Ansmann et al. 2007), while the whistles of long-beaked common dolphins range from 7.7 to 15.5 kHz (Oswald et al. 2003). Most of the energy of echolocation clicks is concentrated between 15 and 100 kHz (Evans and Awbrey 1988; Wood and Evans 1980). The maximum peak-to-peak SL of common dolphins is 180 dB (Popper 1980). In the North Atlantic, the mean SL was approximately 143 dB with a 154 dB maximum (Kaschner et al. 1997). There are no available data regarding seasonal or geographical variation in sound production.

Goose-Beaked Whale (*Ziphius cavirostris*)

The goose-beaked whale (previously known as Cuvier's beaked whale) is protected under the MMPA, listed in CITES Appendix II, and classified as a species of least concern under the IUCN Red List (Baird et al. 2020). No global abundance for this species is known but various studies have estimated population sizes for different regions of the world. Using data from the early 1990's to 2020, it was estimated that the global population size of goose-beaked whale is over 100,000 individuals (Baird et al. 2020; Barlow 2003b; Bradford et al. 2021; Ferguson and Barlow 2001; Wade and Gerrodette 1993). Abundance of goose-beaked whales for the Hawaii stock is estimated to be 4,431 individuals (CV=0.41) (Bradford et al. 2021).

The goose-beaked whale is the most cosmopolitan of all beaked whale species. Except for the high Arctic and Antarctic waters, they are widely distributed in tropical to polar oceanic waters of all oceans and major seas, including the Sea of Japan and Sea of Okhotsk (Heyning and Mead 2009; Jefferson et al. 2008). No data on breeding and calving grounds has been published.

Goose-beaked whales exhibit exceptionally long and deep foraging dives (Shearer et al. 2019). For foraging dives, Barlow et al. (2020) found the mean depth to be 3,878 ft (1,182 m). Quick et al. (2020) found the median duration of foraging dives to be 59 min, with only 5 percent of dives exceeding 77.7 min. Overall dive durations range between 20 and 87 min with an average dive time near 30 min (Baird et al. 2004; Jefferson et al. 1993). Schorr et al. (2014) reported a maximum dive depth of 9,816 ft (2,992 m) that lasted 137.5 min. (Joyce et al. 2017) found mean dive durations of 23.72 min, with a maximum duration of 90.14 min. They also exhibited long recovery times (or inter-dive intervals) with a median of 68 min at the surface between dive bouts (Joyce et al. 2017). Whales in the northwestern Atlantic Ocean off Cape Hatteras were reported to exhibit short surface intervals and highly bimodal dives. Deep dives went to a median water depth of 4,777 ft (1,456 m) and a median duration of 58.9 min; whereas, shallow dives went to a median depth of 920 ft (280 m) with a median duration of 18.7 min (Shearer et al. 2019). Swim speeds have been recorded between 2.7 and 3.3 kt (5 and 6 kph) (Houston 1991). During a dive, speeds were found to average 2.3 kt (1.1 m/s), but direction varied (Barlow et al. 2018).

Hearing sensitivity of goose-beaked whales has not been measured (Ketten 2000; Thewissen 2002). They were recorded producing HF clicks between 13 and 17 kHz; since these sounds were recorded during diving activity, clicks were assumed to be associated with echolocation (Frantzis et al. 2002).

Johnson et al. (2004) recorded frequencies of clicks ranging from about 12 to 40 kHz with associated SLs of 200 to 220 dB re 1 µPa at 1 m (peak-to-peak). Johnson et al. (2004) also found that whales do not vocalize when within 656 ft (200 m) of the surface. They started clicking at an average depth of 1,560 ft (475 m) and ceased clicking on the ascent at an average depth of 2,790 ft (850 m) with click intervals of about 0.4 sec. Zimmer et al. (2005a) also studied the echolocation clicks and recorded a SL of 214 dB re 1 µPa at 1 m (peak-to-peak). There are no available data regarding seasonal or geographical variation in sound production.

Dall's Porpoise (*Phocoenoides dalli*)

Dall's porpoise is protected under the MMPA, listed under CITES Appendix II, and listed as a species of least concern under the IUCN Red List (Jefferson and Braulik 2018). Dall's porpoises are separated taxonomically into two subspecies: *Phocoenoides dalli truei* and *Phocoenoides dalli dalli*, with both subspecies occurring in the Study Area. The global population of Dall's porpoise is estimated at 1.2 million (Jefferson et al. 2015). The population of the WNP *truei* subspecies of the Dall's porpoise is estimated as 178,157 individuals (CV=0.23) (Kasuya and Perrin 2017). The Sea of Japan *dalli* populations are estimated to include 173,638 porpoises (CV=0.21) (Kasuya and Perrin 2017). *Dalli* types in the western north Pacific include 162,000 porpoises (Kasuya and Perrin 2017; Miyashita 1991).

The Dall's porpoise is found exclusively in the North Pacific Ocean and adjacent seas (e.g., Bering Sea, Okhotsk Sea, and Sea of Japan) from Baja California and Japan in the south up to the Bering Sea in the north. This oceanic species is primarily found in deep waters from 30 to 62 °N, in areas where deep water comes close to shore, and in inshore waters of Washington, British Columbia, and Alaska (Jefferson et al. 2015). Distribution and seasonal movement is poorly understood (Jefferson et al. 2015).

Dall's porpoises are relatively deep divers, diving to 900 ft (275 m) for as long as 8 min (Hanson et al. 1998; Ridgway 1986). Thought to be one of the fastest swimming of the small cetaceans, average swim speeds range between 1.3 and 11.7 kt (2.4 and 21.6 kph) (Croll et al. 1999). Swim speeds within this range are dependent on the type of swimming behavior, which includes: slow rolling; fast rolling; or rooster-tailing, which characterized by a spray of water during brisk surface swimming. Outside of these behaviors, Dall's porpoises can reach speeds of 30 kt (55 kph) for quick bursts (Leatherwood and Reeves 1983).

Although there is no direct measurement of the hearing sensitivity of Dall's porpoises (Ketten 2000; Thewissen 2002), responses to sounds showed porpoise species to be insensitive to low-frequency sounds (less than 3 kHz), with distinct sensitivity to ultrasonic pulses of 20 to 143 kHz (Hatakeyama et al. 1994). They produce short, high frequency pulses ranging between 125 and 135 kHz, with LF sound clicks being rare (Awbrey et al. 1979; Evans and Awbrey 1984). Narrow band high frequency clicks are also produced with energy concentrated around 121 to 147 kHz with a duration of 53 to 251 microsecond (Kyhn et al. 2013). Their maximum peak-to-peak SL is 175 dB (Richardson et al. 1995).

Dwarf Sperm Whale (*Kogia sima*) and Pygmy Sperm Whale (*Kogia breviceps*)

Both the dwarf sperm whale and pygmy sperm whale are protected under the MMPA, listed under CITES Appendix II, and listed as species of least concern on the IUCN Red List (Kiszka and Braulik 2020a, 2020b). Population estimation by species is difficult due to challenges in distinguishing these species at-sea; therefore, data for both species are typically combined. Where possible, population data are presented by species herein.

Abundance estimates of the global population sizes for these species are unknown. The Hawaii stocks of the dwarf sperm whale and pygmy sperm whale are estimated as 53,421 individuals (CV=0.63) and 42,083 individuals (CV=0.64), respectively (Bradford et al. 2021). In the southwestern Indian Ocean, aerial survey data resulted in an abundance estimate of 683 for both *Kogia* spp., combined (Laran et al. 2017). However, this estimate comes with an availability bias, and an updated estimate for the Indian Ocean as a whole does not exist.

Pygmy and dwarf sperm whales are distributed worldwide, primarily in temperate to tropical deep waters, and they are especially common in waters along continental shelf breaks (Jefferson et al. 2008). Dwarf sperm whales prefer warmer waters than pygmy sperm whales (Caldwell and Caldwell 1989; Jefferson et al. 2008). Little evidence exists for seasonal movements in either species (McAlpine 2018).

As *Kogia* spp. are elusive in the field and rehabilitation tends to be unsuccessful, there is little published information on their diving behaviors. Dwarf sperm whales exhibited a maximum dive time of 43 min (Breese and Tershy 1993). Swim speeds vary, averaging 3 kts and reaching up to 5.9 kts (Scott et al. 2001).

Little to no data exist on the hearing sensitivity for pygmy or dwarf sperm whales. An ABR study on a pygmy sperm whale in rehabilitation indicated an underwater hearing range with greatest sensitivities between 90 and 150 kHz (Carder et al. 1995; Ridgway and Carder 2001). Using AEP methods on stranded whales, dwarf sperm whales showed good hearing sensitivity between 45 and 128 kHz, while pygmy sperm whales had a slightly higher range between 80 and 113 kHz (Houser et al. 2022).

Echolocation pulses of the rehabilitated pygmy sperm whale documented peak frequencies at 125 to 130 kHz (Ridgway and Carder 2001). Recordings of captive pygmy sperm whales show they produce sounds between 60 and 200 kHz, with peak frequencies at 120 to 130 kHz (Santoro et al. 1989). In Hawaii, a captive pygmy sperm whale produced an LF swept signal between 1.3 and 1.5 kHz (Thomas et al. 1990b). Other reported frequencies of dwarf whales ranged from 13 to 33 kHz with variable durations up to 0.5 sec (Jérémie et al. 2006). It has been recently reported that the sounds produced by captive and free-ranging dwarf sperm whales were similar to pygmy sperm whales; both vocalizations were characterized as narrow-band, HF clicks with mean frequencies from 127 to 129 kHz and inter-click intervals of 0.110 to 0.164 sec (Merkens et al. 2018).

False Killer Whale (*Pseudorca crassidens*)

Details specific to non-ESA listed false killer whales, including the Hawaii Pelagic and Northwestern Hawaiian Islands stocks, are described in this section. False killer whales are protected under the MMPA, listed under Appendix II of CITES, and classified as near threatened under the IUCN Red List (Baird 2018a). Three populations of false killer whales have been identified in Hawaiian waters: the Northwestern Hawaiian Islands stock, the Pelagic stock, and the MHI Insular stock. The MHI Insular stock is described in Section C.3 under the False Killer Whale (Main Hawaiian Islands Insular Distinct Population Segment) above.

The global population for false killer whales is unknown. Estimates of 16,668 (CV=0.26) whales have been documented in the northwestern Pacific (Miyashita 1993). Within this region, the population has been subdivided with 2,029 whales in the coastal area of Japan, 8,569 whales in the offshore area, and 6,070 in the southern area of the Western North Pacific (Kasuya and Perrin 2017). In Hawaiian waters, populations have been estimated as 1,540 (CV=0.66) whales in the Hawaii pelagic stock and 617 whales

(CV=1.11) in the Northwestern Hawaiian Islands stock (Bradford et al. 2020; Bradford et al. 2014; Bradford et al. 2015).

General information on false killer whale geographic range, migration, distribution, diving behavior, swimming behavior, hearing and vocalizations can be found above in Section C.3 under the False Killer Whale (*Pseudorca crassidens*; Main Hawaiian Islands Insular Distinct Population Segment).

Fraser's Dolphin (*Lagenodelphis hosei*)

Fraser's dolphins are protected under the MMPA, listed under CITES Appendix II, and classified as a species of least concern under the IUCN Red List (Kiszka and Braulik 2018b). The global population is unknown. In Hawaii, 40,960 dolphins (CV=0.70) have been estimated (Bradford et al. 2021).

Fraser's dolphins occur primarily in tropical and subtropical waters of the Atlantic, Pacific, and Indian Oceans (Croll et al. 1999; Dolar 2009). This oceanic species is most commonly found in deep waters (3,280–11,000 ft [1,000–3,500 m]), as well as areas where deep water approaches the coast, such as in the Philippines, Taiwan, and the Indonesian-Malay Archipelago (Dolar 2009; Jefferson et al. 2015). Breeding areas and calving seasonality for Fraser's dolphins have not been confirmed; however, calving appears to peak in the spring and potentially fall in Japan (Amano et al. 1996).

Little information on the diving ability of the Fraser's dolphin is available. Based on prey composition in the Eastern Tropical Pacific (ETP), it is believed that dolphins feed at two depth horizons: at least 820 ft (250 m) and at least 1,640 ft (500 m) depth (Robison and Craddock 1983). In the Sulu Sea, dolphins were observed having a wide vertical foraging range, feeding near the surface to as deep as 2,000 ft (600 m) (Dolar et al. 2003). Swim speeds have been recorded between 2 and 4 kts (Alling 1986).

Hearing sensitivity of Fraser's dolphins has not been measured (Ketten 2000; Thewissen 2002). Dolphins produce sounds ranging from 4.3 to over 40 kHz (Leatherwood et al. 1993; Watkins et al. 1994). Clicks are over 40 kHz (Watkins et al. 1994). Whistles occur between 4 and 24 kHz, lasting 0.06 to 2 sec in duration (Oswald et al. 2007; Watkins et al. 1994). Whistles in Australia's northwest coast occur from 1.5 to 7 kHz, lasing 0.7 to 3.5 sec in duration (Erbe et al. 2017). Whistles are thought to be communicative signals during social activity (Watkins et al. 1994). Data regarding source levels has not yet been reported. There are no available data regarding seasonal or geographical variation in sound production.

Harbor Porpoise (*Phocoena phocoena*)

Harbor porpoises are protected under the MMPA, listed under CITES Appendix II, and classified as a species of least concern under IUCN Red List (Braulik et al. 2023). Three major isolated populations exist in the North Pacific, the North Atlantic, and the Black Sea (Bjørge and Tolley 2009; Jefferson et al. 2015); only the North Pacific population would occur within the Study Area. Morphological and genetic data indicate different populations exist within these three regions (Bjørge and Tolley 2009). The global population is estimated to be at least 675,000 (Jefferson et al. 2015).

Harbor porpoises are found in cold temperate and sub-arctic neritic waters of the Northern Hemisphere (Jefferson et al. 1993). They are typically found in waters of about 41 to 61 °F (5 to 16 °C), with only a small percentage appearing in colder polar waters (32 to 39 °F [0 to 4 °C]) (Gaskin 1992). They are most frequently found in coastal waters, but they may occur in adjacent shallow and deep offshore waters (Gaskin 1992). Harbor porpoises show seasonal movement that may be related to oceanographic changes (Gaskin 1992; Heimlich-Boarn et al. 1998; Read and Westgate 1997). Although migration patterns have been inferred for the harbor porpoise, data between individuals is variable, suggesting seasonal movements are discrete and not temporally coordinated migrations (Read and Westgate 1997).

Dive times of the harbor porpoise range between 0.7 and 1.7 min with a maximum dive duration of 5.3 min (Westgate et al. 1995). Recently reported mean dive durations of tagged porpoises was 53 sec, with mean dive depths of 50.9 ft (15.5 m) (van Beest et al. 2018). Westgate et al. (1995) found mean dive depths ranged from 46 to 144 ft (14 to 44 m), with a maximum dive depth recorded of 741 ft (226 m). The average dive rate and depth for three tagged porpoises in shallow Danish waters was 44 dives per hour and 79 ft (24 m), respectively (Linnenschmidt et al. 2013). Maximum swim speeds ranged from 9.0 to 12.0 kt (Gaskin et al. 1974). A mean horizontal/surface swim speed of 1.2 kt (0.62 m/s) was reported for free-ranging harbor porpoises (van Beest et al. 2018).

Harbor porpoises can hear frequencies in the range of 125 Hz to 145 kHz (Kastelein et al. 2002; Kastelein et al. 2015; Villadsgaard et al. 2007). The best hearing range for a two-year-old male was 16 to 140 kHz (Kastelein et al. 2002). In a series of experiments designed to investigate harbor porpoise hearing, the hearing threshold for 1 to 2 kHz FM signals was 75 dB, without the presence of harmonics (Kastelein et al. 2011).

Harbor porpoises produce click and whistle vocalizations that cover a wide frequency range, from 40 Hz to at least 150 kHz (Verboom and Kastelein 1995). The click vocalizations consist of four major frequency components: a lower frequency component (1.4 to 2.5 kHz); a low amplitude middle frequency component (30 to 60 kHz); a broadband middle frequency component (13 to 100 kHz); and a higher frequency component (110 to 140 kHz) (Verboom and Kastelein 1995). Vocalization peak frequencies are similar for wild and captive porpoises, with the peak frequencies reported to range from 129 to 145 kHz and 128 to 135 kHz, respectively (Au et al. 2000; Kastelein et al. 2002; Villadsgaard et al. 2007). Maximum SLs vary between captive and wild dolphins, with SLs ranging from 157 to 172 dB re 1 µPa at 1 m in captive dolphins and range from 178 to 205 dB re 1 µPa at 1 m in wild dolphins (Au et al. 2000; Kastelein et al. 2002; Villadsgaard et al. 2007). Frequency range variations in click trains represent different functions associated with each activity.

Indo-Pacific Bottlenose Dolphin (*Tursiops aduncus*)

Indo-Pacific bottlenose dolphins are protected under the MMPA, listed under CITES Appendix II, and listed as near threatened under the IUCN Red List (Braulik et al. 2019). No global abundance estimates exist, and regional abundance estimates are few, even though it is the most commonly observed marine mammal species in some coastal regions of the world. Estimates of Indo-Pacific bottlenose dolphins include 218 animals in Japanese waters and 1,634 to 1,934 dolphins in Australian waters (Wang 2018). The population includes 44 dolphins in the northeast Philippines, at least 600 dolphins in Shark Bay, Australia, and at least 24 dolphins off Taiwan (Jefferson et al. 2015).

Indo-Pacific bottlenose dolphins occur in warm temperate to tropical waters of the Indian Ocean and southwestern Pacific Ocean, from South Africa—including the Red Sea and Persian Gulf—to southern Japan, Indonesia, Malaysia, and Australia (Jefferson et al. 2015). Considered principally a coastal species, dolphins occur predominantly over the continental shelf, in shallow coastal and inshore waters (Cribb et al. 2013; Jefferson et al. 2015). Occasional movements across deep, oceanic waters have been reported (Wang 2018).

Little information is known about the diving ability of the Indo-Pacific bottlenose dolphin, but dive depths and durations are thought to be less than 700 ft (200 m) and from 5 to 10 min. Swimming speeds range from 0.8 to 2.2 kt (1.5 to 4.1 kph), but bursts of higher speeds can reach 8.6 to 10 kt (16 to 19 kph). (Wang 2018).

Specific hearing sensitivity data are not yet available for the Indo-Pacific bottlenose dolphin. Indo-Pacific bottlenose dolphins produce whistle and pulsed call vocalizations. Whistles range in frequency from 4 to 12 kHz (Gridley et al. 2012; Morisaka et al. 2005). Variations in whistles between populations of dolphins found that less ambient noise was associated with greater whistle variability. Preliminary analyses suggest that Indo-Pacific bottlenose dolphins use signature whistles like the common bottlenose dolphin (Gridley et al. 2014). Indo-Pacific bottlenose dolphin echolocation clicks have peak-to-peak SLs that range between 177 and 219 dB, with durations between 8 and 48 microsecond , and peak frequencies that range from 45 to 141 kHz (de Freitas et al. 2015; Wahlberg et al. 2011b).

Killer Whale (*Orcinus orca*)

The killer whale is protected under the MMPA, listed under CITES Appendix II, and classified as data deficient under the IUCN Red List (Reeves et al. 2017). Three major ecotypes of killer whales have been identified: coastal residents (fish-eating), coastal transients (mammal-eating), and offshore ecotypes. Although no current global population estimates are available, there is estimated to be at least 50,000 individuals worldwide (Forney and Wade 2006). An abundance of 161 killer whales (CV=1.06) are currently estimated in the Hawaii stock (Bradford et al. 2021).

The killer whale is one of the most cosmopolitan of all marine mammals, found in all the world's oceans and marine regions, especially in cold-water areas of high productivity and in high latitude coastal areas (Forney and Wade 2006; Leatherwood and Dalheim 1978). Killer whales appear to be more common within 430 NM (800 km) of major continents in cold-temperate to subpolar waters (Mitchell 1975). Individual populations are known to migrate between high and low latitude waters (Dahlheim et al. 2008; Durban and Pitman 2012; Matthews et al. 2011). In the northwestern Pacific Ocean, along the southeastern coast of Kamchatka, fish-eating, coastal killer whales forage in Avachinskaya Bay (i.e., Avacha Bay), although some transient killer whales have been detected in these waters acoustically (Burdin et al. 2007). As of 2011, 640 killer whales were estimated to occur in Avacha Bay (Russian Orcas 2023) and have been categorized into at least three acoustic clans (Filatova et al. 2007; Ivkovich et al. 2010). The Avacha Bay killer whales were considered resident in the bay, but photo-ID matches with whales in the Commander Islands show some movement between the two locations. The Avacha Bay killer whales are now considered part of the Eastern Kamchatka resident group, which encompasses both Avacha Bay and the Commander Islands (Filatova et al. 2012a).

The diving behavior of killer whales differs between fish-eating and mammal-eating ecotypes. Southern resident killer whales in Washington State had a mean maximum dive depth of 463 ft (141 m) across individuals, with a maximum dive depth of 866 ft (264 m) (Baird et al. 2005a). Males dove more often, especially during the day, and remained submerged longer than females. Fish-eating killer whales in Antarctica dove to depths ranging from about 700 to 3,000 ft (200 to 800 m), with significantly deeper dives during the day than at night (Reisinger et al. 2015). Transient killer whale dives in Alaska were categorized as short and shallow or long and deep (Miller et al. 2010). Short dives lasted less than a minute and reached water depths less than 16 ft (5 m), while deep dives lasted 3 to 7 min and reached depths between 52 and 160 ft (16 and 50 m) (Miller et al. 2010). The mammal-eating whales dove shallower than the fish-eating whales, reflecting the distribution of their prey. Offshore ecotype diving characteristics have not been well-documented, however Schorr et al. (2022) found that offshore killer whales typically used waters deeper than the 660 ft (200 m) isobath and dove to or near the seafloor in the continental shelf habitat. Optimal swim speeds were estimated to be 6.0 kt (3.1 m/s) (Kriete 1994). Williams and Noren (2009) recorded an average swim speed of 3.1 kt (1.6 m/s).

Killer whales hear underwater sounds up to 120 kHz (Szymanski et al. 1999). Their best underwater hearing occurs between 15 and 42 kHz (Hall and Johnson 1972; Szymanski et al. 1999). Killer whales produce sounds as low as 80 Hz and as high as 85 kHz with dominant frequencies at 1 to 20 kHz (Diercks et al. 1973; Ford 1989). An average of 12 different call types—mostly repetitive discrete calls—exist for some pods (Ford 2009). Pulsed vocalizations tend to have the most energy between 1 and 6 kHz and may be used for socialization (Frankel 2018). Whistles range in frequency up to at least 75 kHz (Filatova et al. 2012b; Samarra et al. 2010; Simonis et al. 2012). Echolocation clicks are also included in whale repertoires, but those clicks are not a dominant signal type in comparison to pulsed calls (Diercks et al. 1971; Ford 1989; Schevill and Watkins 1966). Erbe (2002) recorded received broadband sound pressure levels of killer whales' burst-pulse calls that ranged between 105 and 124 dB RL at an estimated distance of 328 ft (100 m). Offshore killer whales tracked in the Southern California Bight had SLs for echolocation clicks of 170 to 205 dB re 1 µPa at 1 m (peak-peak) (Gassmann et al. 2013). Whistle source levels ranged between 185 and 193 dB re 1 µPa at 1 m. Pulse call source levels ranged between 146 and 158 dB re 1 µPa at 1 m.

While the basic structure of killer whale vocalizations is similar within all populations, geographic variation between populations does exist (Samarra et al. 2015). All pods within a clan have similar dialects of pulsed calls and whistles. Whales engaged in different activities produce a different proportion of calls, suggesting that high-frequency and biphonic calls are used for long range communication and LF monophonic calls are used for intra-pod signaling (Filatova et al. 2013). Intense LF pulsed calls (683 Hz, 169 to 192 dB re 1 µPa at 1 m; peak-peak) appear to be used to trick prey, thereby increasing foraging efficiency (Simon et al. 2006).

Longman's Beaked Whale (*Indopacetus pacificus*)

Longman's beaked whale, also known as the Indo-Pacific beaked whale, is protected under the MMPA, listed in CITES Appendix II, and classified as a species of least concern under the IUCN Red List (Pitman and Brownell Jr 2020a). Limited population data are available for this beaked whale. Although no global abundance estimate of this species is available, 2,550 Longman's beaked whales (CV=0.67) are estimated to occur in the entire Hawaii EEZ (Bradford et al. 2021).

This rare beaked whale is distributed in tropical waters of the Indo-Pacific Oceans (Jefferson et al. 2008; Pitman 2018a). Longman's beaked whales appear to be rare in the eastern Pacific and Indian Oceans, but they are more common in the western Pacific and western Indian Oceans, suggesting that this species prefers warmer waters found in western ocean basins (Pitman 2018a). Seasonal movements are unknown.

Due to the rarity of at-sea sightings, diving information is limited. Two dive duration periods were reported: short durations (11 to 18 min) and long durations (20 to 33 min) (Anderson et al. 2006). However, Anderson et al. (2006) reported one beaked whale that was possibly submerged as long as 45 min. No data are available on swim speeds.

No direct measurements of hearing sensitivity are available (Ketten 2000; Thewissen 2002). Longman's beaked whales' vocalizations include burst-pulses, echolocation clicks, and pulses. Echolocation clicks have three frequency groups: a 15 kHz click, a 25 kHz click, and a 25 kHz FM up sweep. Burst-pulses are long sequences of clicks lasting around 0.5 sec with a rate of approximately 240 clicks per sec (Rankin et al. 2011).

Melon-Headed Whale (*Peponocephala electra*)

Melon-headed whales are protected under the MMPA, listed under CITES Appendix II, and considered a species of least concern under the IUCN Red List (Kiszka and Brownell Jr 2019). The global population is unknown. Kanaji et al. (2018) estimated the population off the Pacific coast of Japan to include 56,213 whales, which is the best estimate for the number of individuals in the WNP. Two populations have been documented in Hawaiian waters: The Hawaiian Islands stock, with an estimated 40,647 whales (CV=0.74) (Bradford et al. 2021), and the Kohala resident population, with an estimated 447 whales (CV=0.12) (Aschettino 2010; Oleson et al. 2013).

Melon-headed whales occur in pelagic tropical and subtropical waters worldwide and are frequently associated with oceanic islands and archipelagoes (Brownell Jr et al. 2009; Jefferson and Barros 1997). They are rarely found nearshore, unless deep waters are present near the coast (Jefferson et al. 2015). Breeding areas and seasonal movements of this species have not been confirmed.

Few data are available on diving or swim speed for the melon-headed whale. They feed on mesopelagic squid found as deep as 4,900 ft (1,500 m), appearing to possess abilities to dive to this depth (Jefferson and Barros 1997). A tagged whale in Hawaiian waters dove near the seafloor at night to more than 1,000 ft (300 m) deep, but that whale stayed near the sea surface during the day, with no dives greater than 70 ft (20 m) (Mooney et al. 2012). Whales in the Caribbean appeared to have two modes of foraging diving, with a small percentage of foraging dives less than 328 ft (100 m), while most of the foraging dives ranged from 490 to 1,600 ft (150 to 500 m) (Joyce et al. 2017). Dive durations were as long as 39 min, but they averaged 10 min (Joyce et al. 2017). No swim speeds are available for this species.

Measurements on melon-headed whale hearing has only recently been quantified. Houser et al. (2022) found thresholds of a stranded individual to be less than 65 dB re 1 µPa across a two-octave range (20—80 kHz). Additionally, the upper frequency limit was greater than 160 kHz—the highest frequency tested. Wang et al. (2021) took AEP measurements on a stranded individual with known hearing loss. Hearing frequency ranged between 9.5 and 181 kHz, with thresholds between 20 and 65 dB higher than its closest recorded species (pygmy killer whale) for frequency ranges from 10 to 100 kHz.

Melon-headed whale's echolocation clicks have a frequency emphasis beginning at 13 kHz and extending to at least 100 kHz (Baumann-Pickering et al. 2015a; Frankel and Yin 2010). Dominant frequencies of whistles are 1 to 24 kHz, with simple FM up sweeps and down sweeps (Frankel and Yin 2010). Burst-pulse sounds had a mean duration of 586 msec (Frankel and Yin 2010). Changes in vocalization activity patterns suggest that whales may forage at night and rest during the day (Baumann-Pickering et al. 2015a). No available data exist regarding seasonal or geographical variation in sound production.

Mesoplodon Beaked Whales

Six species of *Mesoplodon* beaked whales occur in the Study Area: Blainville's (*Mesoplodon densirostris*), Deraniyagala's (*Mesoplodon hotaula*), ginkgo-toothed (*Mesoplodon ginkgodens*), Hubb's (*Mesoplodon carlshubbi*), spade-toothed (*Mesoplodon traversii*), and Stejneger's (*Mesoplodon stejnegeri*) beaked whales. *Mesoplodon* spp. are not well known due to difficulty in identifying individual species at-sea; therefore, most information presented about their behavior has been documented to genus level only.

All *Mesoplodon* spp. are protected under the MMPA and listed under CITES Appendix II. Most *Mesoplodon* spp. are classified as data deficient status by the IUCN. However, Blainville's beaked whale is listed as a species of least concern, and Stejneger's beaked whale is classified as not threatened on the IUCN Red List (Pitman and Brownell Jr 2020b, 2020c). The worldwide population sizes for all species of *Mesoplodon* spp. are unknown. Hawaii stock population for Blainville's beaked whales was estimated to be 1,132 whales (CV=0.99) (Bradford et al. 2021).

With the exception of cold, polar waters, *Mesoplodon* beaked whales are distributed in all of the world's oceans in deep (greater than 6,562 ft [2,000 m]) pelagic waters. The distribution of ginkgo-toothed beaked whales is thought to be restricted to the tropical and warm-temperate waters of the North Pacific; however, this assumption is based off of the location of stranded individuals (MacLeod et al. 2006). In the North Pacific Ocean, Stejneger's beaked whales occur in temperate to subarctic waters (Pitman and Brownell Jr 2020c). Hubbs' beaked whale is endemic to North Pacific waters, potentially with separate eastern and western populations (MacLeod et al. 2006). Spade-toothed beaked whales are thought to have a restricted distributional range in the southern Pacific Ocean and the southeastern Indian Ocean, ranging from Australia and New Zealand to Chile (MacLeod et al. 2006). Blainville's beaked whales are cosmopolitan and can be found in the Pacific and Indian Oceans in warm temperate and tropical waters (Pitman 2018b). Additionally, in regions where long-term tagging and photo-ID studies occur, it is believed that Blainville's beaked whales exhibit strong site fidelity, with limited migrations and movements (Baird 2019; Claridge 2013; Joyce et al. 2020; Reyes Suárez 2018). The lesser-known Deraniyagala beaked whale ranges throughout the tropical waters of the equatorial Indo-Pacific (Dalebout et al. 2014).

Dives of Blainville's beaked whales average 7.5 min during social interactions (Baird et al. 2004). Dives over 45 min have been recorded for some species, such as Blainville's (Jefferson et al. 1993). Dive depths are variable among *Mesoplodon* spp. and are not well documented. In Hawaii, a Blainville's beaked whale was observed to dive to a maximum water depth of 4,619 ft (1,408 m), with the dive duration ranging from 48 to 68 min (Baird et al. 2005b). Blainville's beaked whales in the Caribbean Sea performed dives with a mean depth of 3,704 ft (1,129 m) and mean duration of 46.1 min. The species' non-foraging dives reached approximately 1,150 ft (350 m) and lasted 40 min, while foraging dives ranged between 2,000 to 6,200 ft (600 and 1,900 m) with a duration between 30 and 70 min (Joyce et al. 2017). Few swim speed data are available for any beaked whale species. Blainville's beaked whales in Hawaii exhibited a horizontal swim speed of 0.4 to 0.8 kt (0.8 to 1.5 kph) with a maximum rate of 4.4 kt (8.1 kph) (Schorr et al. 2009).

Similar to diving behavior, hearing and vocalization studies on *Mesoplodon* spp. has only been quantified for Blainville's beaked whales. The hearing sensitivity of a stranded Blainville's found the best hearing response ranging between 40 and 50 kHz, with thresholds less than 50 dB (Pacini et al. 2011). Blainville's beaked whales make various types of echolocation clicks while foraging. The whales have a distinct search click that is in the form of an FM up sweep with a difference of 10 dB bandwidth from 26 to 51 kHz (Johnson et al. 2006). The second type of foraging click that Blainville's beaked whales make is a buzz click during the final stage of prey capture that has no FM structure, but exhibits a -10 dB bandwidth from 25 to 80 kHz or higher (Johnson et al. 2006). Additionally, no vocalizations were detected from any tagged Blainville's beaked whales when they were within 660 ft (200 m) of the surface (Johnson et al. 2004). Blainville's beaked whales started clicking at an average depth of 1,300 ft (400 m), and stopped clicking when they started their ascent at an average depth of 2,400 ft (720 m) (Johnson et al. 2004). The intervals between regular clicks were between 0.2 and 0.4 sec, with trains of clicks ending in a buzz. Blainville's beaked whales have a somewhat flat spectrum that was accurately sampled between 30 and 48 kHz, potentially with a slight decrease in the spectrum above 40 kHz (Johnson et al. 2004).

Northern Right Whale Dolphin (*Lissodelphis borealis*)

The northern right whale dolphin is protected under the MMPA, listed under CITES Appendix II, and classified as a species of least concern under the IUCN Red List (Braulik and Jefferson 2018).

This oceanic species is only found in temperate to subarctic regions of the North Pacific from roughly 34 to 54 °N and 118 to 145 °W (Jefferson et al. 2015). This range extends from the Kuril Islands south to Japan and from the Gulf of Alaska to southern California. Dolphins are commonly observed in waters ranging from 46 to 66 °F (8 to 19 °C) (Leatherwood and Walker 1979). Northern right whale dolphins are primarily found in deeper waters from the outer continental shelf to the oceanic region (Jefferson et al. 2015). They can occur near shore when submarine canyons or other such topographic features cause deep water to be located close to the coast. They exhibit inshore-offshore movements seasonally in some areas, such as California (Lipsky 2018). Dive and swim behavior data on northern right whale dolphins are limited. Dives can be as long as 6 min and reach up to 660 ft (200 m) deep where their prey of choice (e.g. small fish and cephalopods) is present in deep waters (Leatherwood and Walker 1979). Swim speeds average around 14 kt (26 kph), with short bursts reaching up to 19 kt (35 kph) (Lipsky 2018).

Only one study has been done on northern right whale dolphin hearing sensitivity. Using AEP methods on a stranded dolphin, Houser et al. (2022) found thresholds less than 65 dB re 1 µPa from 40 to 80 kHz. Additionally, the upper frequency limit was greater than 160 kHz—the highest frequency tested. These dolphins produce sounds from 1 to 40 kHz or more, with dominant frequencies at 1.8 and 3 kHz (Fish and Turl 1976; Leatherwood and Walker 1979). Echolocation clicks have peak frequencies that range from 23 to 41 kHz (Rankin et al. 2007). The maximum known peak-to-peak SL is 170 dB (Fish and Turl 1976). Northern right whale dolphins also produce burst-pulse sounds that are lower in frequency and shorter in duration than echolocation click sequences. The peak frequencies of burst-pulse signals range from 6 to 37 kHz with durations from 1 to 178 msec (Rankin et al. 2007). Northern right whale dolphins do not produce whistles (Oswald et al. 2008). No available data exist regarding seasonal or geographical variation in sound production.

Pacific White-sided Dolphin (*Lagenorhynchus obliquidens*)

Pacific white-sided dolphins are protected under the MMPA, listed under CITES Appendix II, and considered a species of least concern under the IUCN Red List (Ashe and Braulik 2018).

Pacific white-sided dolphins are mostly pelagic and have a primarily cold temperate distribution across the North Pacific. In the western North Pacific, this species occurs from Taiwan north to the Commander and Kuril Islands (Black 2009; Jefferson et al. 2015). Pacific white-sided dolphins are distributed within continental shelf and slope waters generally within 100 NM (185 km) of shore, often moving into coastal and inshore waters. No breeding grounds are known for this species, but their distribution changes seasonally, linked to water temperatures and prey abundance (Rechsteiner 2012).

From studies of the ecology of their prey, Pacific white-sided dolphins are presumed to dive from 300 to 920 ft (90 to 280 m), with most of their foraging dives lasting about 24 sec (Black 1994; Miller and Lea

1972). Captive dolphins were recorded swimming as fast as 15 kt for 2 sec intervals, with a mean travel speed of 4.1 kt (Black 1994; Lang and Daybell 1963).

Pacific white-sided dolphins hear in the frequency range of 2 to 128 kHz when the sounds are equal or softer than 90 dB RL (Tremel et al. 1998). This species is not sensitive to LF sounds (i.e., 100 Hz to 1 kHz) (Tremel et al. 1998). Pacific white-sided dolphins produce broad-band clicks in the frequency range of 60 to 80 kHz with a SL at 180 dB re 1 µPa at 1 m (Richardson et al. 1995). These clicks have spectral peaks at 22.2, 26.6, 33.7, and 37.3 kHz with spectral notches at 19.0, 24.5, and 29.7 kHz, which can be used to identify the species from recordings (Soldevilla et al. 2008). There are no available data regarding seasonal or geographical variation in sound production.

Pantropical Spotted Dolphin (*Stenella attenuata*)

The pantropical spotted dolphin is one of the most abundant dolphin species in the world. This species is protected under the MMPA, listed under CITES Appendix II, and considered a species of least concern under the IUCN Red List (Kiszka and Braulik 2018c). Based on line transect survey data off the Pacific coast of Japan, there is an estimated population of 130,002, which is used as the best estimate for the WNP stock (Kanaji et al. 2018). Pantropical dolphins in the CNP stock, which encompasses the Hawaii pelagic stock, is estimated to be 67,313 (CV=0.27) individuals (Carretta et al. 2024).

Pantropical spotted dolphins occur throughout tropical and sub-tropical waters from roughly 40 °N to 40 °S in the Pacific and Indian Oceans. These dolphins typically are oceanic, but they can be found close to shore in areas where deep water approaches the coast, such as in Taiwan and Hawaii (Jefferson et al. 2015).

Pantropical spotted dolphins dive to at least 560 ft (170 m); however, most of their dives are between 160 and 328 ft (50 and 100 m) for 2 to 4 min, with foraging dives occurring at night (Stewart 2018). Off Hawaii, pantropical spotted dolphins have been recorded to dive to a maximum depth of 400 ft (122 m) during the day and 699 ft (213 m) during the night, with more time at greater depths during the night (Baird et al. 2001). Pelagic dolphins in the ETP had daytimes dives that averaged 1.26 min to a mean depth of 72.5 ft (22.1 m), while nighttime dives averaged 1.68 min to an average depth of 78.7 ft (24.0 m) (Scott and Chivers 2009). Dives up to 3.4 min have been recorded (Jefferson et al. 2015). Pantropical spotted dolphins have been recorded swimming at speeds of 2 to 5.6 kt (3 to 12 kph), with bursts up to 12 kt (22 kph) (Jefferson et al. 2015; Scott and Chivers 2009).

A study of hearing thresholds of a pantropical spotted dolphin using AEP and behavioral methods found the peak hearing sensitivity at 10 kHz, with a cutoff frequency between 14 and 20 kHz (Greenhow et al. 2016). Pantropical spotted dolphins produce whistles with a frequency range of 3.1 to 21.4 kHz (Richardson et al. 1995). Similarly, Silva et al. (2016) found whistle frequencies ranging from 9.7 to 19.8 kHz, with mean duration of 0.7 sec. Another study by Pires et al. (2021) found whistles with a maximum frequency of 31.1 kHz. Click sounds are typically bimodal in frequency with peaks at 40 to 60 kHz and 120 to 140 kHz with SLs up to 220 dB re 1 µPa (Schotten et al. 2004). Echolocation signals had a mean frequency of 89 kHz, with mean peak-to-peak SLs of 190 dB re 1 µPa at 1 m (Gong et al. 2019). Gong et al. (2019) also found geographic variation in clicks between dolphins found in the South China Sea and Hawaii. There are no available data regarding seasonal variation in sound production.

Pygmy Killer Whale (*Feresa attenuata*)

Pygmy killer whales are protected under the MMPA, listed under CITES Appendix II, and classified as a species of least concern under the IUCN Red List (Braulik 2018a). Pygmy killer whales are one of the least studied cetaceans. Sightings are rare throughout their range; therefore, the global population is unknown. One estimate of the Hawaiian population is 10,328 whales (CV=0.75) (Bradford et al. 2021).

Pygmy killer whales have been sighted in oceanic tropical and subtropical waters of all oceans (Donahue and Perryman 2009). These whales are sighted relatively frequently in the ETP, the Hawaiian archipelago, and off Japan (Donahue and Perryman 2009). The population in Hawaiian waters shows high site fidelity and is considered to be a resident population (McSweeney et al. 2009). No data are available to confirm seasonal migration patterns or the locations of breeding or calving grounds.

Diving behavior has only recently been recorded for pygmy killer whales. Currently, the only recorded dive behavior is from rehabilitated adult pygmy killer whales, which exhibited dives as deep as 1,210 ft (368 m) for as long as 9 min in duration (Pulis et al. 2018). Deep dives occurred more often at nighttime (Pulis et al. 2018). Two tagged pygmy killer whales in Hawaiian waters swam at median speeds of 1.5 kt (2.7 kph) and 1.7 kt (3.1 kph), respectively (Baird et al. 2011).

Little information is available on the hearing sensitivity of pygmy killer whales. Previously, AEP-derived audiograms were obtained on two stranded whales during rehabilitation. The U-shaped audiograms showed that best hearing sensitivity occurred at 40 kHz with lowest hearing thresholds having occurred between 20 and 60 kHz (Montie et al. 2011). These stranded animals did not hear well at higher frequencies (90 and 96 dB at 100 kHz) (Montie et al. 2011). AEP methods found thresholds less than 70 dB re 1 µPa from 20 to 80 kHz in one whale and less than 80 dB re 1 µPa from 20 to 80 kHz in the other whale (Houser et al. 2022). The peak frequencies of wild pygmy killer whale clicks ranged from 45 to 117 kHz, with peak-to-peak SLs that ranged from 197 to 223 dB (Madsen et al. 2004b). ABR experiments found click peaks at 400 Hz and 1.2 kHz (Houser et al. 2022). Besides clicks and whistles, whales have been documented to produce what is described as a LF “growl” sound (Pryor et al. 1965).

Sato’s Beaked Whale (*Berardius minimus*)

Sato’s beaked whale is protected under the MMPA and classified as near threatened under the IUCN Red List (Brownell Jr 2020). Sato’s beaked whale was recently described as a new beaked whale species in 2017 and taxonomically recognized by the Society for Marine Mammalogy in August 2019 (Morin et al. 2017; Yamada et al. 2019); therefore, historical evidence, abundances, and information on the species is limited. Genetic and morphological sampling has designated this species as distinctive from Baird’s beaked whales. Similar physical features to Baird’s beaked whale have made this species difficult to identify at-sea. Therefore, known information about Sato’s beaked whale is limited only to stranding records.

Based on samplings of previous strandings, distribution appears to be between 40 and 60 °N, and 140 °E and 160 °W (Morin et al. 2017; Yamada et al. 2019). It is also believed that these whales could occur farther south than previously hypothesized, due to the numerous bites on stranded individuals from cookie-cutter sharks (*Isistius brasiliensis*), a species found mainly in tropical to warm, temperate waters (Yamada et al. 2019). Additionally, due to the absence of samples in Commander Islands, Russia, it appears there is a distinct gap between the western and eastern North Pacific groups (Brownell Jr 2020). There are no available population abundance estimates for this species.

Sato’s beaked whales are hypothesized to utilize habitat similar to Baird’s beaked whales, which are found on or near the continental slope and oceanic seamounts in cold-temperate waters. Diving and acoustic behaviors have not yet been quantified or studied for Sato’s beaked whales. However, they are hypothesized to have similar diving (less than 328 ft [100 m] to greater than 5,800 ft [1770 m]) and acoustic behaviors (produce HF sounds between 12 and 134 kHz) to Baird's beaked whales (Brownell Jr and Kasuya 2021) (Refer to: Section C.3 for the Baird's Beaked Whale (*Berardius bairdii*)).

Southern Bottlenose Whale (*Hyperoodon planifrons*)

The southern bottlenose whale is protected under the MMPA, listed under CITES Appendix I, and classified as a species of least concern under the IUCN Red List (Lowry and Brownell Jr 2020). The population south of the Antarctic Convergence has been estimated as 500,000 whales, making it the most commonly observed beaked whale in Antarctic waters (Jefferson et al. 2015).

Southern bottlenose whales are found south of 30 °S, with a circumpolar distribution (Jefferson et al. 2015). Evidence of seasonal migration shows a northward movement near South Africa in February and southward movement back towards the Antarctic in October (Sekiguchi et al. 1993). They are commonly found beyond the continental shelf and over submarine canyons in deep waters, where their choice of prey, oceanic squids, are found (MacLeod et al. 2003). Santora and Brown (2010) found that most sightings occurred in waters 3,000 to 14,800 ft (1,000 to 4,500 m) in depth, with peak sighting rates in the 4,900 to 6,600 ft (1,500 to 2,000 m) and 11,500 to 13,000 ft (3,500 to 4,000 m) depth ranges. Calving and breeding grounds are unknown.

Although there is no dive data for this species, dives have been documented for the closely related northern bottlenose whale (*Hyperoodon ampullatus*). Hooker and Baird (1999) noted northern bottlenose whales dove regularly to 2,600 ft (800 m) and found a maximum dive depth to 4,767 ft (1,453 m); these deep dives have been associated with foraging behavior. Northern bottlenose whales have been reported to have a mean dive depth of 5,157 ft (1,572 m) and a mean dive duration of 49 min (Martín López et al. 2015). Dive durations have been recorded close to 70 min. Southern bottlenose whales have been observed diving from 11 to 46 min, with an average duration of 25.3 min (Sekiguchi et al. 1993); however, this information has not been confirmed and was based on visual observation. Northern bottlenose whale swim speeds were recorded to at least 3 kt (5 kph) underwater; however, this speed was documented in an enclosed harbor, rather than the open ocean (Kastelein and Gerrits 1991).

There is no direct measurement of hearing sensitivity for northern or southern bottlenose whales (Ketten 2000; Thewissen 2002). There are no available data for the sound production of southern bottlenose whales. Off Nova Scotia, deep diving northern bottlenose whales produced regular click series (consistent inter-click intervals) at depth, with peak frequencies of 6 to 8 kHz and 16 to 20 kHz (Hooker and Whitehead 1998). Click trains, characterized by inconsistent inter-click intervals, were produced during social interactions at the surface; peak intensities ranged from 2 to 4 kHz and 10 to 12 kHz. Additional measurements report that the whales produce FM sweeps from 20 to 55 kHz, with root mean square (rms) SLs between 175 and 202 dB re 1 µPa at 1 m (Wahlberg et al. 2011a). There is no seasonal or geographical variation in vocalizations documented.

Risso's Dolphin (*Grampus griseus*)

Risso's dolphins are protected under the MMPA, listed under CITES Appendix II, and classified as a species of least concern under the IUCN Red List (Kiszka and Braulik 2018a). No global population abundance exists for the Risso's dolphin. Line-transect surveys off the Pacific coast of Japan estimated there to be 143,374 individuals (CV=0.69), which is the best estimate for the WNP and Inshore Archipelago stocks (Kanaji et al. 2018). The Inshore Archipelago stock occurs in the Asian continental seas. For the Hawaii stock, 6,979 (CV=0.29) dolphins have been used as the best estimate (Carretta et al. 2024).

Risso's dolphins inhabit deep oceanic and continental slope waters from the tropics through the temperate regions (Baird 2009b; Jefferson et al. 1993). These dolphins occur predominantly at steep shelf-edge habitats, in waters between 1,000 and 3,000 ft (400 and 1,000 m) deep and in temperatures ranging from 59 to 68 °F (15 to 20 °C), rarely in waters below 50 °F (10 °C) (Baird 2009b). Dolphins have exhibited seasonal migrations in Japan; however, seasonal variations in movements have not been studied elsewhere (Kasuya 1971; Mitchell 1975). No data on breeding grounds are available. Dolphins have been known to calve year-round, but peak timing differs by habitat. For example, calving in Japan peaks in the summer-fall; whereas in California, it peaks in the fall-winter (Jefferson et al. 2015).

Dive times up to 30 min have been reported for Risso's dolphins (Jefferson et al. 2015). Rone et al. (2022) found a median dive time of 5.6 min. During foraging dives, dolphins echolocate throughout the dive, spending 1 to 3 min at the surface in between foraging dives (Arranz et al. 2018). Out of 37 foraging dives observed from tagged Risso's dolphins, 57 percent dove to shallow water depths (less than 300 ft [90 m]), and 12 percent dove to deep water layers (1,100 to 1,500 ft [350 to 450 m]) (Arranz et al. 2018). Additionally, while deep dives (greater than 1,640 ft [500 m]) occurred at all times of the day, there were twice as many dives to any depths at night, as compared to the daytime (Rone et al. 2022). Foraging dive descent speeds ranged from 6.50 to 8.10 ft/s (1.98 to 2.47 m/s) and foraging ascent speeds ranged from 7.15 to 7.55 ft/s (2.18 to 2.30 m/s), depending on if the dolphin exhibited spins in the dive or not (Visser et al. 2021). Typical swimming speeds are 3 to 4 kt (6 to 7 kph) (Kruse et al. 1999). Tag data from a rehabilitated and released dolphin in the Gulf of Mexico indicate an average swimming speed of 3.9 kt (7.2 kph), and the majority (95 percent) of dives were within 160 ft (50 m) of the sea surface, with the deepest to 1,640 ft (500 m) (Wells et al. 2009).

Audiograms for Risso's dolphins indicate that their hearing RLs were equal to or less than approximately 125 dB in frequencies ranging from 1.6 to 110 kHz (Nachtigall et al. 1995). They are capable of hearing frequencies up to 80 kHz; however, after 80 kHz, sensitivities drop off drastically (Nachtigall et al. 1995; Philips et al. 2003). The ATOC source found the hearing sensitivity and thresholds to be 142.2 dB RL for the 75 Hz pure tone signal and 140.8 dB RL for the ATOC signal (Au et al. 1997). Another individual had the best hearing sensitivities at 11 kHz and between 40 and 80 kHz (Mooney et al. 2015). These values are comparable to those previously reported by Nachtigall et al. (1995) and Nachtigall et al. (2005). Furthermore, Risso's dolphins have been reported to "eavesdrop" by listening in on conspecific communication to determine whether to approach or avoid another group (Barluet de Beauchesne et al. 2022).

Risso's dolphins produce broadband clicks, barks, buzzes, grunts, chirps, whistles, and a hybrid whistle/burst-pulse sound (Corkeron and Van Parijs 2001). Dolphins produce sounds as low as 0.1 kHz and as high as 65 kHz, with dominant frequencies between 2 to 5 kHz and 65 kHz (Au 1993; Croll et al. 1999; Watkins 1967). Echolocation clicks have peak frequencies around 50 kHz and centroid frequencies ranging from 60 to 90 kHz, with peak-to-peak SLs of 202 to 222 dB re 1 µPa at 1 m (Madsen et al. 2004a). Philips et al. (2003) quantified echolocation clicks with mean peak frequencies of 47.9 kHz, mean center frequencies of 56.5 kHz, 3-dB bandwidths mean frequencies of 39.7 kHz, and rms bandwidth mean frequencies of 23.2 kHz. Click amplitudes averaged 192.6 dB re 1 µPa, with SLs up to 216 dB re 1 µPa at 1 m. Bark vocalizations are highly variable burst pulses, with frequency ranges from 2 to 20 kHz (Corkeron and Van Parijs 2001). Buzzes consisted of a short burst pulse of sound, around 2 sec in duration, with a frequency range of 2.1 to greater than 22 kHz. Low frequency, narrowband grunt vocalizations ranged from 400 to 800 Hz. Chirp vocalizations ranged from 2 to 4 kHz. There are no available data regarding seasonal or geographical variation in the sound production of Risso's dolphins.

Rough-toothed Dolphin (*Steno bredanensis*)

The rough-toothed dolphin is protected under the MMPA, listed under CITES Appendix II, and classified as a species of least concern under the IUCN Red List (Kiszka and Braulik 2019). Globally, few population estimates are available. Line-transect surveys off the Pacific coast of Japan estimated there to be 5,002 individuals (CV = 1.24), which is the best estimate for the WNP (Kanaji et al. 2018); while the Hawaii stock was estimated to include 83,915 individuals (CV=0.49) (Carretta et al. 2024).

Rough-toothed dolphins occur in oceanic tropical and warm-temperate waters around the world. These dolphins are found in deep, offshore waters that lack major upwelling (Jefferson 2018). In the Pacific, dolphins inhabit waters from central Japan to northern Australia and from Baja California, Mexico, south to Peru. Rough toothed dolphins are also found in the Indian Ocean, from the southern tip of Africa across to Australia (Jefferson et al. 2015). Seasonal movements and breeding areas for this species have not been confirmed; however, high site-fidelity is hypothesized. For example, dolphins in Hawaii are documented to have limited movements between islands (Baird et al. 2008b).

Rough-toothed dolphins can dive to 100 to 230 ft (30 to 70 m) with dive durations ranging from 0.5 to 3.5 min (Ritter 2002; Watkins et al. 1987b). Additionally, nine dolphins tagged off of the Hawaiian Islands had a median dive depth and duration of 222 ft (67.5 m) and 3.1 min (Shaff and Baird 2021). Dives up to 15 min have been recorded for groups (Miyazaki and Perrin 1994). Dive rates vary depending on the time of day, with the highest rates at dusk and night and the lowest rates at dawn and daytime (Shaff and Baird 2021). Rough-toothed dolphins are not known to be fast swimmers, often skimming the surface at a moderate speed (Jefferson 2018). Swim speeds vary from 3.0 to 8.6 kt (Ritter 2002; Watkins et al. 1987b).

Very little information is available on the hearing sensitivity of rough-toothed dolphins. Cook et al. (2005) performed AEPs on five stranded dolphins and found that they could detect sounds between 5 and 80 kHz. They produce sounds ranging from 0.1 to over 200 kHz (Miyazaki and Perrin 1994; Norris and Evans 1967). Clicks have peak energy at 25 kHz, while whistles have a maximum energy between 2 to 14 kHz (Norris 1969; Oswald et al. 2007). Similar to Risso's dolphins, rough-toothed dolphins are thought to "eavesdrop" when in large groups (Götz et al. 2006). There are no available data regarding seasonal or geographical variation in sound production.

Short-finned Pilot Whale (*Globicephala macrorhynchus*)

The short-finned pilot whale is protected under the MMPA, listed under CITES Appendix II, and classified as a species of least concern under the IUCN Red List (Minton et al. 2018). Two ecotypes of short-finned pilot whales occur in the western North Pacific Ocean off Japan, the northern (Shiho) and southern (Naisa) ecotypes, which are distinguishable by morphological, genetic, acoustic, and geographical characteristics (Kasuya and Perrin 2017; Olson 2018; Van Cise et al. 2016; Van Cise et al. 2017b). The northern ecotype is distinguished at-sea by a saddle patch near the dorsal fin, and the two ecotypes are restricted to the waters off northern and southern Japan, by the Kuroshio Front (Kasuya and Perrin 2017). The northern ecotype of the short-finned pilot whale is located in the area roughly between 35 and 43 °N while the southern ecotype is found from about 23 to 35 °N (Kasuya and Perrin 2017; Miyashita 1993). Research indicates that, genetically, the Hawaiian short-finned pilot whale is similar to the southern ecotype found off Japan (Van Cise et al. 2016).

A global population estimate of short-finned pilot whales is unknown. In the North Pacific Ocean, an abundance of 19,242 (CV=0.23) whales is estimated for the Hawaii stock (Carretta et al. 2024). In the WNP Ocean, two stocks are recognized, the WNP Northern and WNP Southern, with respective abundances estimated as 20,884 and 31,396 individuals (Kanaji et al. 2018).

Short-finned pilot whales occur from nearshore to pelagic and tropical to warm-temperate waters of the Pacific and Indian Oceans. Short-finned pilot whales are considered nomadic, although resident populations are known to occur in the Hawaiian Islands (Olson 2018). Additionally, two populations are likely in the Main Hawaiian Islands: (1) an insular, inshore population; and (2) a pelagic, offshore population to the northwest (Carretta et al. 2018; Mahaffy et al. 2015; Van Cise et al. 2017a).

Short-finned pilot whales are considered deep divers, feeding primarily on fish and squid (Croll et al. 1999). Adamczak et al. (2021) found a maximum dive depth to 3,533 ft (1,077 m), lasting 20.6 min. Pilot whales off Tenerife showed a bimodal dive behavior with a large number of dives to 984 ft (300 m) or shallower, with limited dives between 984 and 1,640 ft (300 and 500 m) as well as frequent deeper dives to a maximum depth of 3,343 ft (1,019 m) (Aguilar Soto et al. 2008). Data from Madeira Island show that dives can last as long as 20 min and as deep as 3,241 ft (988 m), although the majority of recorded dives were much shorter and shallower; most dives occurred during the daytime (Alves et al. 2013). Of the dives for two stranded whales, 93 percent of dives were tracked to less than 328 ft (100 m) (Wells 2013). Traveling schools of short-finned pilot whales have swim speeds averaging between 4 and 5 kt (Norris and Prescott 1961). Whales performed underwater “sprints,” with velocities up to 17 kt (9.0 m/s). These sprints were associated with foraging attempts (Aguilar Soto et al. 2008).

AEPs were used to measure the hearing sensitivity of two short-finned pilot whales—one captive and one stranded. The range of best hearing sensitivity for the captive whale was between 40 and 56 kHz (thresholds of 78 and 79 dB re 1 µPa, respectively), with the upper limit of functional hearing between 80 and 100 kHz. The only measurable detection threshold for the stranded whale was 108 dB re 1 µPa at 10 kHz, suggesting severe hearing loss above 10 kHz (Schlundt et al. 2011). Four other stranded whales were tested with AEP. The greatest sensitivity was around 40 kHz, with thresholds for adults being 25 to 61 dB higher at 80 kHz than for the juveniles (Greenhow et al. 2014).

Short-finned pilot whales produce low- and medium-frequency calls (1.7 and 2.9 kHz, respectively), two-component calls (2 and 9 kHz), rasps (short, slow burst-pulses), and buzzes (occurs with body acceleration during foraging) (Pérez et al. 2017). The mean call frequency produced by short-finned pilot whales is 7.87 kHz (Rendell et al. 1999). Pilot whales vocalize with other school members, as there is evidence of group specific call repertoires and specific call types being repeated (Olson 2018; Sayigh et al. 2013). SLs of clicks have been measured as high as 180 dB (Fish and Turl 1976). The center frequency of their clicks is 25 kHz, with a mean 10 dB bandwidth of 10 kHz and a mean click duration of 545 microsecond (Baumann-Pickering et al. 2015b). There are little available data regarding seasonal or geographical variation in the sound production of the short-finned pilot whale.

Spinner Dolphin (*Stenella longirostris*)

Spinner dolphins are protected under the MMPA, listed under CITES Appendix II, and classified as a species of least concern under the IUCN Red List (Braulik and Reeves 2018). Within Hawaii, the island-associated populations include the Kauai and Niihau stock of 601 (CV = 0.20) individuals, the Hawaii Island stock of 665 (CV = 0.09) individuals, the Oahu/4-Islands stock of 355 (0.09) individuals, and the Midway Atoll stock of 260 dolphins (Andrews et al. 2007; Carretta et al. 2017; Hill et al. 2011;

Karczmarski et al. 2005). All of these estimated though are greater than eight years old and are therefore no longer used for NMFS stock assessments.

Spinner dolphins are pantropical, occurring in tropical and subtropical oceanic waters from about 40 °S to 40 °N (Jefferson et al. 2015). Spinner dolphins are found in coastal regions of Hawaii, the eastern Pacific, Indian Ocean, and off Southeast Asia, usually resting in the shallow waters of bays of oceanic islands and atolls (Perrin 2018b). Various geographical forms exist, such as the Gray's spinner dolphin, Eastern spinner dolphin, Central American spinner dolphin, whitebelly spinner dolphin, and dwarf spinner dolphin (Jefferson et al. 2015).

Based on where their prey, which includes small fish, shrimp, and squid, is located in the water column, spinner dolphins can dive up to 2,000 ft (600 m) deep (Perrin 2018b). Dive durations are unknown for this species. Spinner dolphins are known for their aerial behavior, spinning up to seven times during one aerial leap from the water, reaching heights of 10 ft (3 m) above the water surface with an airborne time of 1.25 sec (Hester et al. 1963; Perrin 2018b). Hawaiian spinner dolphins have swim speeds that rarely exceed 5 to 5.98 kt (9 to 11 kph) (Norris et al. 1994).

Similar to other dolphins, the hearing threshold of a rehabilitated spinner dolphin, using AEP methods, had a reported peak sensitivity at 40 kHz and functional hearing up to 120 kHz (Greenhow et al. 2016). Spinner dolphins produce burst pulse calls, echolocation clicks, whistles, and screams (Bazúa-Durán and Au 2002; Norris et al. 1994). The fundamental frequency contours of whistles occur in the human hearing range, but the harmonics typically reach 50 kHz and beyond. The whistle contours of near shore dolphins in Hawaii show geographic variation between groups depending on residence, movements along shore, and movements between islands/regions (Bazúa-Durán and Au 2004). Additionally, the burst pulse signals are predominantly ultrasonic, often with little or no energy below 20 kHz (Lammers et al. 2003). Echolocation clicks show the typical delphinid broadband character, with center frequencies ranging from 34 to 58 kHz, peak frequencies from 27 to 41 kHz, and durations of 140 to 620 µs (Baumann-Pickering et al. 2010).

Striped Dolphin (*Stenella coeruleoalba*)

Striped dolphins are protected under the MMPA, listed under CITES Appendix II, and classified as a species of least concern under the IUCN Red List (Braulik 2018b). The most updated estimate for the Hawaii stock includes 64,343 striped dolphins (CV=0.28) (Carretta et al. 2024). The WNP population of striped dolphins is divided into Northern offshore, Southern offshore, and Japanese coastal stocks, with 497,725; 52,682; and 19,631 whales, estimated for each stock, respectively (Kasuya and Perrin 2017; Miyashita 1993).

Striped dolphins are common in tropical and warm-temperate oceanic waters of the Pacific and Indian Oceans between roughly 50 °N and 40 °S, as well as adjacent seas (Jefferson et al. 2015). Striped dolphins may be found in coastal waters in areas with very narrow continental shelves or where deep waters are found close to shore. Their occurrence appears to be associated with oceanographic fronts or circulation features in many upwelling regions, such as the ETP. Striped dolphins occur farther north than other *Stenella* species. Although in the western North Pacific Ocean, striped dolphins rarely occur in the Sea of Japan, East China Sea, Yellow Sea, and Okhotsk Sea (Kasuya and Perrin 2017). The offshore Northern and Southern stocks of striped dolphins are separated at about 35 °N, while the Japanese Coastal stock is located west of the Northern and Southern stocks in the Pacific waters southeast of the main Japanese Islands of Honshu, Kyushu, and Shikoku (Kasuya and Perrin 2017).

Dive times are unknown for this species. Based on preferred prey, which includes fish and cephalopods (e.g., squid and octopus), it is predicted that striped dolphins may be diving between 700 and 2,300 ft (200 and 700 m) to feed (Archer 2009). Average swim speeds of 6.10 kt (11.3 kph) were measured from striped dolphins in the Mediterranean (Lafortuna et al. 1993).

The behavioral audiogram shows hearing capabilities from 0.5 to 160 kHz, with the best underwater hearing from 29 to 123 kHz (Kastelein et al. 2003). Striped dolphins produce whistle vocalizations lasting up to 3 sec, with frequencies ranging from 1.5 to greater than 24 kHz (Azzolin et al. 2013). Oswald et al. (2004) reported vocalizations frequencies between 10.8 kHz and 17.8 kHz. Bosquez (2013) found that most whistle contours were characterized as either of two types: (1) a rise, which begins at 7.1 kHz and rises to 14.81 kHz; or (2) a hill, which begins at 9.13 kHz, increases to 16.86 kHz, and decreases again to 8.89 kHz. An examination of whistle structure within the Mediterranean Sea found geographic variation between different eastern and western sub-populations (Azzolin et al. 2013).

Pinnipeds

Harbor seal (*Phoca vitulina*)

Harbor seals are protected under the MMPA and classified as a species of least concern under the IUCN Red List (Lowry 2016b). The total worldwide population is estimated to be between 610,000 and 640,000 individuals(Bjørge et al. 2010). There is estimated to be less than 10,000 seals in the Kuril Islands region. The population estimate of seals in the Aleutian Islands is 5,588 (Muto et al. 2021). Only the Western Aleutian Islands (islands from Attu east to Buldir) border the edge of the Study Area, and there is an estimated 259 harbor seals in these Western Aleutian Islands based on 1999 aerial surveys (Small et al. 2008). Within the Kuril population, Kobayashi et al. (2014) estimated there to be 600 to 800 seals present during the pupping season, based on counts each year at haul-out sites from 1974 to 2010. During the molting period, Kobayashi et al. (2014) estimated 1,000 seals present, based on counts during the molting season from 1983 to 2010. Regionally in Japan, there are two genetically-distinct populations, with 524 seals present in Erimo and 565 present in eastern Hokkaido, based on 2008 surveys (Kobayashi et al. 2014; Mizuno et al. 2020).

Harbor seals are widespread in coastal areas of the continental shelf and slope, as well as in bays, rivers, estuaries, and intertidal areas. They are found in temperate and polar regions in the Northern Hemisphere. Within the Study Area, seals are found from the Aleutian Islands across to the Commander Islands, Russia, down south to Kamchtaka through the Kuril Islands to Hokkaido, Japan. Harbor seals are considered non-migratory, although tagging evidence suggests they can travel far outside of their natal ranges for seasonally available food sources or to give birth. They are highly gregarious at haul out sites, with daily haul outs, based on tidal cycles. Foraging trips can last up to a few days at times. Mating occurs in water during the breeding season from February to October, with pupping peaks from April to July. Molting occurs after the breeding season, with more time spent hauled out during this period. (Jefferson et al. 2015).

Dives as deep as 1,580 ft (480 m) and as long as 35.3 min were recorded for harbor seals (Eguchi and Harvey 2005) . Wilson et al. (2014) found similar mean dive durations of 35 min. Rosing-Asvid et al. (2020) found 63 percent of dives were within the upper 160 ft (50 m) of the water column. Dives deeper than 1,300 ft (400 m) made up less than 1 percent of dives; however, the deepest dive on record was to 2,070 ft (630 m), lasting between 20 and 25 min. Davis et al. (1991) estimated average swim speeds to be 5.83 kt (3.0 m/s), based on maximum oxygen consumption.

In-air audiograms of harbor seals recorded hearing sensitivity between 6 and 12 kHz, with best sensitivity at 8 kHz at 8.1 decibels referenced to 1 micropascal squared per second (dB re 20 µPa^2-s) (Wolski et al. 2003). Aerial sound detection thresholds ranged from 100 Hz to 6.4 kHz, with curve peaks just at 1 kHz (Kastak and Schusterman 1998; Kastelein et al. 2009). Kastelein et al. (2009) found the maximum sensitivity underwater to be 1 kHz at 54 dB re 1 µPa rms and the range of best hearing to be between 0.5 and 40 kHz within 10 dB of maximum sensitivity. Underwater hearing thresholds have also ranged from 40 kHz at 75 dB re 1 µPa up to 180 kHz at 140 dB re 1 µPa (Cunningham and Reichmuth 2016).

Harbor seals produce a variety of sounds on land, including barks, grunts, growls, roars, moans, and mother-pup contact calls. Sounds underwater are comprised mainly of roars. Male vocalizations, mostly underwater roars, are thought to be exhibited during male-male competition and to attract females. The vocalization frequency of male underwater roars varies. Sabinsky et al. (2017) reports peaks between 155 and 208 kHz in southern Scandinavia, whereas Bjørgesæter et al. (2004) reported peaks at 280 Hz in Norway and Orkney Islands. Breeding vocalizations in Glacier Bay National Park and Preserve averaged a minimum frequency of 78 kHz. SL estimates ranged from 129 to 149 dB_{RMS} re 1 µPa (Matthews et al. 2017). Pups vocalizations have fundamental frequencies between 200 and 600 Hz, with aggressive calls ranging from 200 Hz to 2 kHz (Khan et al. 2006).

Northern Fur Seal (*Callorhinus ursinus*)

Northern fur seals are protected under the MMPA and are classified as vulnerable under the IUCN Red List (Gelatt et al. 2015). The global population in 2014 was estimated to be 1.29 million seals, representing a population decline of about 30 percent since 1976 (Gelatt et al. 2015). The Western Pacific stock is estimated to include 503,609 individuals (Gelatt et al. 2015; Kuzin 2014).

Northern fur seals are widely distributed in pelagic waters across the North Pacific Ocean from about 35 °N northward to the Bering Sea, including the Sea of Okhotsk and the Sea of Japan (Jefferson et al. 2015). Primary breeding sites include the Commander Islands, Kuril Islands, Pribilof Islands, Robben Island, Bogoslof Island, Farallon Islands, and San Miguel Island (Gentry 2009). Adults come ashore for about 40 days during the breeding season and remain on land during most of that period. In late fall, seals leave their rookeries and migrate southward to foraging areas for the winter. Seals from Tyuleny Island, the Commander Islands, and Kuril Islands migrate southward into the Sea of Japan and into Pacific waters off the eastern side of Japan (Gentry 2009; Horimoto et al. 2017; Horimoto et al. 2016). In the Sea of Japan, adult male northern fur seals are predominant in waters over the narrow continental shelf, which drops steeply to 6,560 ft (2,000 m) deep waters. Adult female and juvenile northern fur seals are predominant in Pacific waters of Northern Japan, adult female and juvenile northern fur seals dominate (Horimoto et al. 2017; Horimoto et al. 2016).

Juvenile seals in the Bering Sea had an average dive time of 1.24 min at an average depth of 57.4 ft (17.5 m) (Sterling and Ream 2004). Kooyman et al. (1976) measured shallow dives to 70 ft (20 m) deep, lasting less than 1 min, while deeper dives to 460 ft (140 m) lasted 2 to 5 min in duration. The measured durations were less than 2 min for shallow dives and 3 to 5 min for deep dives (Ponganis et al. 1992). Additionally, deeper dives occurred at night during the full moon (Ream et al. 2005). Routine migration swim speeds were 1.54 kt (2.85 kph); during foraging, swim speeds averaged between 0.48 and 1.23 kt (0.89 and 2.28 kph) (Ream et al. 2005).

The northern fur seal can hear sounds in the range of 500 Hz to 40 kHz, with best hearing ranging from 2 to 29 kHz (Gentry 2009; Moore and Schusterman 1987). Moore and Schusterman (1987) measured northern fur seal in-air hearing sensitivity as 500 Hz to 32 kHz and the in-water hearing sensitivity from 2 to 28 kHz. Babushina et al. (1991) reported that underwater hearing sensitivity is 15 to 20 dB better than in-air hearing sensitivity. Northern fur seals are known to produce clicks and high-frequency bleating sounds underwater (Frankel 2018). On land during breeding season, males make low growls and roars. Female seals emit calls when returning from foraging trips to attract and locate their pups (Bartholomew 1959).

Ribbon Seal (*Histriophoca fasciata*)

Ribbon seals are protected under the MMPA and classified as a species of least concern under the IUCN Red List (Lowry 2016a). The most recent population estimate of seals occurring in the Sea of Okhotsk is 181,179 individuals (Chernook et al. 2014). The Bering Sea population is estimated to include 184,000 seals (Conn et al. 2014; Muto et al. 2021). Lowry (2016a) combined these Bering Sea and Sea of Okhotsk estimates for a total North Pacific population estimate of 365,000 seals; in contrast, Boveng and Lowry (2018) estimated 500,000 seals in the North Pacific.

The ribbon seal is a pagophilic (ice-loving) species with a distribution limited to the northernmost Pacific Ocean and Arctic Ocean including the Chukchi Sea, with predominant occurrences in the Bering Sea and Sea of Okhotsk (Fedoseev 2000; Jefferson et al. 2015). Ribbon seals are associated with the southern edge of the pack ice from winter through early summer, where they pup and molt on the ice (Fedoseev 2000). During the summer months, seals tend to be more pelagic, encompassing a broader distributional range less associated with the sea ice (Jefferson et al. 2015).

Few dive and swim speed data are known for the ribbon seal. Boveng et al. (2013) noted that diving patterns are tied to season, with a tendency for the dive depths to increase as the ice edge expands south, closer to the continental shelf break. When ribbon seals on are on the sea ice in shallow waters during spring, dives tend to be shallower, typically to depths of 230 to 300 ft (70 to 100 m). When not tied to sea ice, seals dive deeper, up to 1,600 ft (500 m), but they rarely dive past 2,000 ft (600 m) (Boveng et al. 2013); London et al. (2014) reported that seals often dove to water depths deeper than 700 ft (200 m), with some dives even exceeding 2,000 ft (600 m). Dive duration data are unavailable for ribbon seals.

There is no direct measurement of auditory threshold for the hearing sensitivity of the ribbon seal (Thewissen 2002). Ribbon seals produce two types of underwater vocalizations: (1) downsweeps, with varying frequencies from 7 to 0.1 kHz; and (2) broadband puffs, with frequencies below 5 kHz and lasting less than 1 sec (Watkins and Ray 1977). Watkins and Ray (1977) hypothesized that the sounds ribbon seals produce are associated with social interactions during the mating season and may be part of territorial displays. Ribbon seals also produce grunts, roars, growls, and hisses (Jones et al. 2014; Miksis-Olds and Parks 2011). Miksis-Olds and Parks (2011) noted that ribbon seal vocalizations were only recorded when ice cover was greater than 80 percent, typically during the winter when ice platforms were stable enough to support breeding activities. Otsuki et al. (2016) also found a decrease in vocalizations underwater during periods when sea ice decreased.

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Appendix D: Acoustic Effects Analysis for Marine Mammals in the SURTASS LFA Study Area

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Acronyms and Abbreviations

Acronym	Definition
µPa	microPascal
AIM	Acoustic Integration Model
AINJ	auditory injury
AMW	Antarctic minke whale
CNP	Central North Pacific
dB	decibel
DPS	distinct population segment
ESA	Endangered Species Act
ft	feet
HF	High Frequency (hearing group)
HF/M3	High frequency/marine mammal monitoring
Hz	hertz
kHz	kilohertz
km	kilometer(s)
LF	Low Frequency (hearing group)
LFA	Low Frequency Active
LOA	Letter of Authorization
MAI	Marine Acoustics, Inc.
MF	Mid Frequency (hearing group)
MHI	Main Hawaiian Islands
MMPA	Marine Mammal Protection Act
NAEMO	Navy Acoustic Effects Model
NMFS	National Marine Fisheries Service

Acronym	Definition
Nsd	no stock designation
OCW	Otariids and Other Marine Carnivores In Water (hearing group)
OEIS	Overseas Environmental Impact Statement
PCW	Phocid In Water (hearing group)
PTS	Permanent Threshold Shift
rms	Root-mean-square
SAR	Stock Assessment Report
sec	second(s)
SEIS	Supplemental Environmental Impact Statement
SOEIS	Supplemental Overseas Environmental Impact Statement
SPL	Sound Pressure Level
SURTASS	Surveillance Towed Array Sensor System
T-AGOS	Tactical-Auxiliary General Ocean Surveillance
TR	Technical Report
TTS	Temporary Threshold Shift
VHF	Very High Frequency (hearing group)
VLF	Very Low Frequency (hearing group)
WNP	Western North Pacific
yd	yard(s)

1 INTRODUCTION

This analysis presents impacts to marine species due to non-impulsive acoustic transmissions (low-frequency and high-frequency sonar) under a maximum year of military readiness activities conducted at sea under the Surveillance Towed Array Sensor System (SURTASS) Low-Frequency Active (LFA) Sonar Training and Testing Proposed Action.

1.1 INFORMATION REFERENCED IN THIS ANALYSIS

The acoustic impact analysis provided here relies on information presented in other sections and appendices of the Letter of Authorization (LOA) and the SURTASS LFA Draft Supplemental Environmental Impact Statement (SEIS)/Overseas Environmental Impact Statement (OEIS), and relevant technical reports (TRs). The following lists contain abbreviated names for each of these supporting sections and briefly describes the content therein. The impact analysis refers to these supporting sections using the italicized names noted here.

Sections that provide details and descriptions of the Proposed Action include:

- The *Proposed Action and Alternatives* section (Chapter 2) of the Draft SEIS/OEIS.

Sections that provide general background information:

- The *Acoustic Impacts Supporting Information* sections in Appendix B of the Draft SEIS/OEIS describe acoustic concepts and terminology to provide context to the analysis herein.
- The *Marine Mammal Background* sections in Appendix C of the Draft SEIS/OEIS describe species present in the Study Area, general biology, ecology, and status of each species.
- The *Marine Mammal Hearing* section (Section 3.6.1.1.3) of the Draft SEIS/OEIS summarizes the best available science on impacts to marine mammals from exposure to acoustic and explosive stressors.

TRs and analyses that provide details on the quantitative process and show specific data inputs to the models (all are available for download at https://www.nepa.navy.mil/surtass-lfa/):

- The *Quantitative Analysis TR* refers to the technical report titled *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase IV Training and Testing* (U.S. Department of the Navy 2024) which describes the modeling methods used to quantify impacts to marine mammals and sea turtles from exposure to sonar, air guns, and explosives. Impacts due to pile driving were modeled outside of the Navy Acoustic Effects Model (NAEMO) using a static area-density model and are also described in this technical report.
- The *Criteria and Thresholds TR* refers to the technical report titled *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase IV)* (U.S. Department of the Navy 2025) which describes the development of criteria and thresholds used to predict impacts on marine mammals and sea turtles.
- The *Density TR* refers to the technical report titled *Navy Marine Species Density Database for the Surveillance Towed Array Sensor System (SURTASS) Low Frequency Active (LFA) Sonar Systems* (U.S. Department of the Navy (DoN) 2024) which describes the spatial density distributions for each species or stock in the Study Area. The density models have been updated with new data since the prior analysis. The appendix to the density technical report includes figures showing the change in spatial density for each species since the prior analysis.

- The *Dive Profile and Group Size TR* refers to the technical report titled *Dive Distribution and Group Size Parameters for Marine Species Occurring in the U.S. Navy's Surveillance Towed Array Sensor System (SURTASS) Low Frequency Active (LFA) Study Area* (Oliveira et al. 2025) which describes the dive profile and group size for each species. There are no substantive changes from the prior analysis.

Mitigation information includes:

- The *Mitigation* section refers to Chapter 4 of the Draft SEIS/OEIS which describes the actions taken to avoid, reduce, or minimize potential impacts from acoustic stressors.

1.2 Changes from Prior Analyses

Changes in the predicted acoustic impacts to protected species since the Navy's 2019 SURTASS LFA Final SEIS/Supplemental OEIS (SOEIS) analysis are primarily due to the following:

- Updates to data on marine mammal presence, including estimated density of each species or stock (number of animals per unit area), group size, and depth distribution. Any substantial changes that are affecting the quantified impacts in this analysis are discussed for each species or stock below. For additional details, including maps showing the relative density changes between this analysis and the prior analysis for this Study Area, see the *Density TR* and *Dive Profile TR*.
- Updates to criteria used to determine if an exposure to sound may cause auditory effects, non-auditory injuries, and behavioral responses. The changes in impact thresholds between this analysis and the prior analysis in the Study Area are shown in the applicable sections below. For additional details, see the technical report *Criteria and Thresholds TR*.
- Revisions to the modeling of acoustic effects due to proposed sound-producing activities in NAEMO. An overview of notable changes is provided in relevant sections below. For additional details, see the technical report *Quantitative Analysis TR*.
- The use of NAEMO for quantitative modeling of marine mammal acoustic exposures to SURTASS LFA. The 2019 Final SEIS/SOEIS used the Acoustic Integration Model (AIM), developed by Marine Acoustics, Inc. (MAI), to complete the quantitative analysis; a full discussion of the elements of AIM can be found in Appendix B of the 2019 Final SEIS/SOEIS.

One primary change that is reflected in the analysis in this report is the use of NAEMO to model acoustic exposures to marine mammals. AIM, as described in the 2019 Final SEIS/SOEIS and previous versions, and NAEMO are similar in many ways (both models represent each marine species as independent virtual animals called "animats"). Differences between the models are described in Section 2.2.1.

2 IMPACTS TO MARINE MAMMALS FROM ACOUSTIC STRESSORS

This analysis is presented as follows:

- The impacts that would be expected due to sonar used in the Proposed Action are described in Section 2.1 (Impacts due to SURTASS LFA Training).
- The approach to modeling and quantifying impacts for stressors that may cause injury, auditory effects, or significant behavioral responses is summarized in Section 2.2 (Quantifying Impacts to Marine Mammals from Acoustic Stressors).
- The approach to assessing the significance of responses for both individuals and populations is described in Section 2.3 (Assessing Impacts to Individuals and Populations).
- Impacts to individual species (or stocks) in the Study Area under the Preferred Alternative (Alternative 1), including predicted instances of harm or harassment, are presented in Section 2.4 (Species Impact Assessments). Tables summarizing quantified impacts that correspond to each Action Alternative are presented at the end of Section 2.4 (Species Impact Assessments).
- Ranges to effects are shown in Section 2.5 (Ranges to Effects).

2.1 IMPACTS FROM SURTASS LFA TRAINING

Assessing whether a sound may disturb or injure a marine mammal involves understanding the characteristics of the acoustic sources, the marine mammals that may be present in the vicinity of the sources, and the effects that sound may have on the physiology and behavior of those marine mammals. Although it is known that sound is important for marine mammal communication, navigation, and foraging (National Research Council 2003, 2005), there are many unknowns in assessing impacts, 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. 2007a; Southall et al. 2021b). Many other factors besides just the received level of sound may affect an animal's reaction, such as the duration of the sound-producing activity, the animal's physical condition, prior experience with the sound, activity at the time of exposure (e.g., feeding, traveling, resting), the context of the exposure (e.g., in a semi-enclosed bay vs. open ocean), and proximity of the animal to the source of the sound.

In this analysis, impacts are categorized as auditory injury (AINJ, including permanent threshold shift [PTS] and auditory neural injury), temporary hearing loss (temporary threshold shift [TTS]), other physiological response (including stress), masking (occurs when a noise interferes with the detection, discrimination, or recognition of other sounds), and behavioral responses. An "exposure" occurs when the received sound level is above the background ambient noise level within a similar frequency band; not all exposures are perceivable or result in impacts.

There are two active acoustic sources that would be used during the Proposed Action: LFA and high frequency marine mammal monitoring (HF/M3) sonars. Sonars emit sound waves into the water to detect objects, safely navigate, and communicate. Sonars are considered non-impulsive and vary in source level, frequency, duration (the total time that a source emits sound including any silent periods between pings), duty cycle (the portion of time a sonar emits sound when active, from infrequent to continuous), beam characteristics (narrow to wide, directional to omnidirectional, downward or forward facing), and movement (stationary or on a moving platform). Sonar use could occur throughout the entirety of the Study Area. Source characteristics for these sources are distinctly different, which in turn influences the potential for impacts to exposed marine mammals.

LFA sonar consists of a vertical source array of sound-producing elements that are suspended by cable under a Tactical-Auxiliary General Ocean Surveillance (T-AGOS) vessel. These elements, called projectors, are devices that produce the active sonar sound pulses or pings. To produce a ping, the projectors transform electrical energy to mechanical energy (i.e., vibrations), which travel as pressure disturbances in water. The LFA sonar source is a vertical line array consisting of up to 18 source projectors. Each LFA source projector transmits sonar beams that are omnidirectional (360 degrees) in the horizontal, with a narrow vertical beamwidth that can be steered above or below the horizontal. The operating features of the active component of the SURTASS LFA sonar system, are:

- The source level of an individual source projector on the LFA sonar array is approximately 215 decibels (dB) referenced to 1 microPascal (re 1 µPa) at 1 meter (m; root mean square [rms]) or less.
- Frequency range of 100 to 500 hertz (Hz).
- The typical LFA sonar signal is not a constant tone but consists of various waveforms that vary in frequency and duration. A complete sequence of sound transmissions (waveforms) is referred to as a wavetrain (also known as a ping). These wavetrains last between 6 and 100 seconds (sec), with an average length of 60 sec. Within each wavetrain, a variety of signal types can be used, including continuous wave and frequency-modulated signals. The duration of each continuous-frequency sound transmission within the wavetrain is no longer than 10 sec.
- The maximum duty cycle (ratio of sound “on” time to total time) is 20 percent. The typical duty cycle, based on historical SURTASS LFA sonar operational parameters (2003 to 2017), is 7.5 to 10 percent.
- The time between wavetrain transmissions typically ranges from six to 15 minutes.

The HF/M3 sonar is a Navy-developed, enhanced high-frequency (HF) commercial sonar used as a mitigation and monitoring asset to detect, locate, and track marine mammals and sea turtles that may pass close enough to the SURTASS LFA sonar’s transmit array to enter the LFA mitigation zone (2,000 yard [yd; 1.8 kilometer (Joyce et al.)]). This source sits at the top of the vertical line array containing the LFA projectors. This source would operate at a source level of 220 dB re 1 µPa at 1 m (rms) and source frequencies between 30 and 40 kilohertz (kHz), with maximum pulse length of 40 milliseconds and a variable duty cycle that is nominally 3 to 4 percent.

Sonars have the potential to affect marine mammals by causing hearing loss, masking, non-injurious physiological responses (such as stress), or behavioral reactions. Low- (less than 1 kHz), mid- (1–10 kHz), and some high (10–100 kHz) frequency sonars are within the hearing range of all marine mammals, though odontocetes hear poorly at low frequencies.

<u>Hearing Loss</u>: Hearing loss, or threshold shift, is related to the received level of sound and the duration of the exposure. Proposed activities with more sound sources, louder sound sources, or that transmit sonar for longer durations increase the likelihood of auditory effects in marine mammals. Research has shown that marine mammals are more susceptible to hearing loss within frequencies of best hearing. Hearing loss is most likely to occur at or above the dominant frequency of the sound source, not below. The recovery of hearing thresholds begins after an exposure. Any hearing loss that is recovered is called TTS, whereas any remaining threshold shift after recovery is considered AINJ. TTS and AINJ due to sonars

are estimated using criteria developed for marine mammal hearing groups and modeling methods described below in Section 2.2 (Quantifying Impacts on Marine Mammals from Acoustic Stressors).

Masking: Masking can reduce the ranges over which marine mammals can detect biologically relevant sounds in the presence of high-duty cycle sources. Lower-duty cycle sonars have less of a masking effect, as the listener can detect signals of interest during the quiet periods between cycles. The reduction in range over which marine mammals communicate is highly dependent on the frequencies of the sonar and biological signal of interest, as well as the source levels of the sonar. High-frequency (10–100 kHz) sonars, including the HF/M3 source, fall within the best hearing and vocalization ranges of most odontocetes. High frequencies attenuate more rapidly in the water due to absorption than do lower frequency sounds, thus producing a smaller zone of potential masking than mid and low frequencies. While high-frequency sonar has the potential to mask marine mammal vocalizations under certain conditions, reduction in available communication space or ability to locate prey is unlikely because of the small zone of effect.

Masking effects of sonar associated with the Proposed Action are expected to be typically transient and temporary, as the sound sources are mobile, and masking is reduced as the spatial separation between the masker and signal of interest increases. In some cases, mammals can compensate for masking by changing their calls or moving away from the source.

For large mysticetes, the range of best hearing is estimated between 0.1 and 10 kHz, which overlaps with SURTASS LFA sonar sources; additionally, their vocalizations are below 1 kHz, which overlaps with low-frequency sources. Any auditory impacts (TTS and AINJ) or masking may affect communication due to low-frequency sonars. For the other mysticetes, the range of best hearing and vocalizations is between 1 and 30 kHz, which overlaps with mid- and high-frequency sonar sources. Masking from high-frequency sonar sources would be less likely to affect communication for these mysticetes than impacts due to low-frequency sonars.

Odontocetes that use echolocation to hunt may experience masking of the echoes needed to find their prey when foraging near low-frequency and mid-frequency sonar sources. Communication sounds could also be masked by these sources. This effect is likely to be temporary in offshore areas where these sources would operate. Odontocetes with very high frequency hearing, such as harbor porpoises, may experience masking of echolocation and communication calls from close-proximity very-high-frequency sources, but these effects are likely to be transient and temporary.

Pinnipeds may also experience masking due to low- and mid- frequency sources because their communication calls range from approximately 0.1 – 30 kHz. Some species of pinnipeds communicate primarily in air and would not experience masking due to sonar.

Physiological response (stress): Physiological stress is an adaptive process that helps an animal cope with changing conditions. Marine mammals could experience a physiological change in heart rate, stress hormones, or immune system due to sound exposure. Currently, the sound characteristics that correlate with physiological responses in marine mammals are poorly understood, as are the ultimate consequences of these changes. Because there are many unknowns regarding the occurrence of acoustically induced stress responses in marine mammals, any physiological response (e.g., hearing loss or injury) or significant behavioral response is assumed to be associated with a stress response.

Behavioral response: Marine mammals only behaviorally respond to sounds they can hear or otherwise perceive. Marine mammals may react in several ways depending on the sound's characteristics, their experience with the sound source, and whether they are traveling, breeding, or feeding. Behavioral responses may include alerting, terminating feeding dives and surfacing, diving, or swimming away. Marine mammals' reaction to sonar can vary based on the individual, species, and context. Behavioral responses to sonars are estimated using criteria developed for marine mammal behavioral groups and modeling methods described below in Section 2.2 (Quantifying Impacts on Marine Mammals from Acoustic Stressors). The sensitivity to behavioral disturbance due to sonars differs among marine mammal groups as follows:

- Mysticetes are the least behaviorally sensitive group. Behavioral reactions in mysticetes are much more likely within a few kilometers of a sound source. Mysticetes have been observed to route around sound sources placed in their migration path.
- Large odontocetes, such as killer whales and pilot whales, have been observed to temporarily cease natural behaviors such as feeding, avoid the sonar source, or even move towards the sound source, as seen in pilot whales. These same behavioral responses have been observed in delphinids, both in captivity and in the field; however, this group appears to be less sensitive to sound and anthropogenic disturbance than other cetacean species.
- Responses of beaked whales have been carefully studied on Navy ranges, including the Southern California Anti-Submarine Warfare Range west of San Clemente Island in the Southern California (SOCAL) Range Complex and the Pacific Missile Range Facility west of Kauai, Hawaii. Beaked whales exposed to sonar or other active acoustic sources may discontinue feeding dives and avoid the area during anti-submarine warfare activities. In areas where anti-submarine warfare training exercises occur with some regularity, beaked whales leave the area but return within a few days after the event ends (e.g., Henderson et al. 2015; Henderson et al. 2016; Jacobson et al. 2022; Manzano-Roth et al. 2016; Tyack et al. 2011). Population levels of beaked whales and other odontocetes on Navy fixed ranges that have been operating for decades appear to be stable. In areas where beaked whales are unlikely to regularly encounter naval sonar activity, beaked whales may be more likely to be displaced for longer periods of time (e.g.,(Stanistreet et al. 2022)). Significant behavioral reactions to sonar are likely when beaked whales are exposed to anti-submarine sonar within a few tens of kilometers, especially for prolonged periods (a few hours or more). Avoidance likely decreases the potential for hearing loss for these species.
- Porpoises are small odontocetes that are sensitive to anthropogenic activity and avoid anthropogenic sound sources at low received levels. Behavioral reactions are more likely than with most other odontocetes.
- Pinnipeds in the water are generally tolerant of anthropogenic sound and activity. They may not react at all until the sound source is approaching within a few hundred meters and then may alert, ignore the stimulus, change their behaviors, or avoid the immediate area by swimming away, diving, or hauling out.

For the Proposed Action, trained Lookouts observe defined mitigation zones for marine mammals and indicators that marine mammals may be present. The mitigation zones encompass the ranges to auditory injury for all marine mammals for all sonars shown in Section 2.5 (Ranges to Effects).

Because sonars may result in the incidental take of marine mammals (auditory impacts and significant behavioral responses), sonar impacts are modeled per the methods presented in Section 2.2 (Quantifying Impacts on Marine Mammals from Acoustic Stressors). Impacts on each marine mammal stock are discussed and quantified below in Section 2.4 (Species Impact Assessments).

2.2 QUANTIFYING IMPACTS ON MARINE MAMMALS FROM ACOUSTIC STRESSORS

The following section provides an overview of key components of the modeling methods used in this analysis to estimate the number and types of acoustic and explosive impacts to marine mammals. The *Quantitative Analysis TR, Criteria and Thresholds TR, Density TR,* and *Dive Profile TR* detail the quantitative process and show specific data inputs to the models.

2.2.1 THE NAVY ACOUSTIC EFFECTS MODEL

NAEMO was developed to conduct a comprehensive acoustic impact analysis for use of sonars, air guns, and explosives[1] in the marine environment. This model considers the physical environment, including bathymetry, seafloor composition/sediment type, wind speed, and sound speed profiles, to estimate propagation loss. The propagation information combined with data on the locations, numbers, and types of military readiness activities and marine resource densities provides estimated numbers of effects to each stock.

Individual animals are represented as "animats," which function as dosimeters and record acoustic energy from all active underwater sources during a simulation of a training or testing event. Each animat's depth changes during the simulation according to the typical depth pattern observed for each species. During any individual modeled event, impacts on individual animats are considered over 24-hour periods.

The model estimates the number of instances in which an effect threshold was exceeded over the course of a year, it does not estimate the number of times an individual in a population may be impacted over a year. Some individuals could be impacted multiple times, while others may not experience any impact.

All previous quantitative modeling for SURTASS LFA was completed using the AIM model. NAEMO has been used for SURTASS LFA modeling for the first time to support this Draft SEIS/OEIS. The largest differences include:

- Different statistical analysis is used for each model. NAEMO uses the range-independent Comprehensive Acoustic Simulation System/Gaussian Ray Bundle for propagation modeling while AIM uses the range-dependent Navy standard parabolic equation.
- NAEMO models propagation at 5° bearing resolution, AIM uses a 90° resolution.
- Cutoff distances for potential impacts was done differently in each model. NAEMO models to a 500 km distance cutoff, while AIM modeled to a 100 dB transmission loss cutoff regardless of how far from the sound source that transmission loss occurred.
- NAEMO distributes animats and runs simulations for all species-stock density layers, while AIM used three representative densities for modeling and scaled simulation output based on species-stock density for final results. Animats are horizontally stationary in NAEMO but movement through the water column is captured. AIM simulates animate movement.
- NAEMO has the ability to mathematically approximate animal avoidance to sound, while AIM's animal movement did not factor avoidance.

[1] No air gun or explosive use is associated with the Proposed Action.

- NAEMO calculates behavioral effect using the maximum sound pressure level (SPL) an animat is exposed to, while AIM uses a single ping equivalent metric.

A complete summary of how AIM was used to model SURTASS LFA sonar can be found in Appendix B in the 2019 Final SEIS/SOEIS.

2.2.2 Quantifying Impacts on Hearing

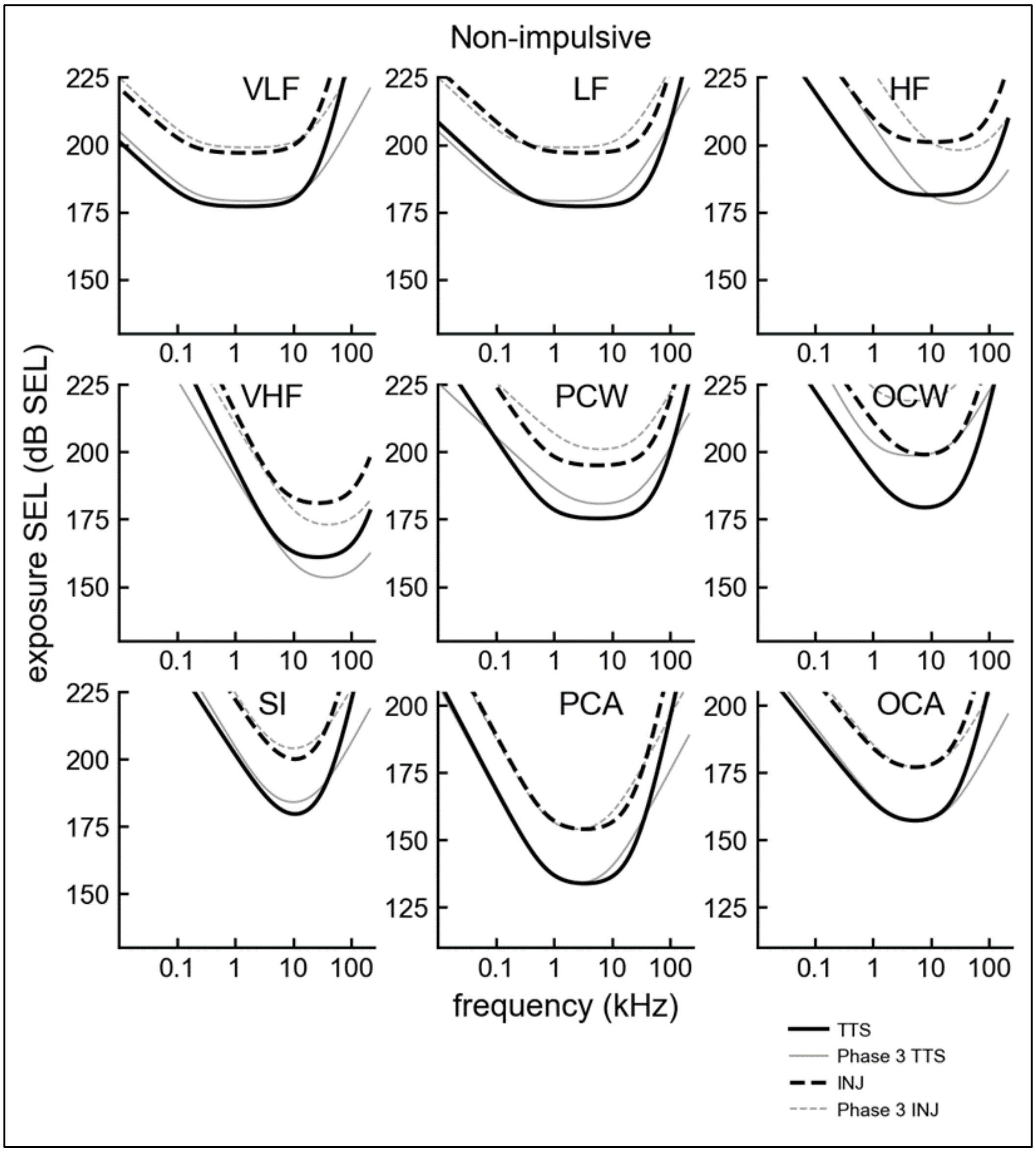
The auditory criteria and thresholds used in this analysis have been updated since the 2019 Final SEIS/SOEIS. They incorporate new best available science since the release of National Marine Fisheries Service (NMFS) guidance for assessing the effects of sound on marine mammal hearing (National Marine Fisheries Service 2024) and since the publication of recommendations by the expert panel on marine mammal auditory criteria (Southall et al. 2019b).

The best way to illustrate frequency-dependent susceptibility to auditory effects is an exposure function. For each marine mammal auditory group, exposure functions for TTS and AINJ (previously called PTS, but now called AINJ to clarify that this is inclusive of neural injury) incorporate both the shape of the group's auditory weighting function and its weighted threshold value for either TTS or AINJ. The updated exposure functions and the exposure functions used in the prior analysis of impacts (Phase III) are shown together in Figure 2-1.

The auditory criteria and thresholds (described in the *Criteria and Thresholds TR*) underwent several notable changes from the prior analysis that influence estimates of the number of marine mammals that could be impacted in each training or testing event.

- The mysticetes have been split from one auditory group (the low frequency cetaceans, LF) into two auditory groups: the LF (including minke, humpback, gray, Bryde's, and sei whales), and the very low frequency cetaceans (VLF; blue, fin, and right whales). While the VLF auditory group retains similar susceptibility to auditory effects as the prior analysis, the new LF auditory group is predicted to be more susceptible to effects at higher frequencies and less susceptible to effects at lower frequencies. Consequently, for LF species, estimated auditory effects due to sources at frequencies above 10 kHz are substantially higher than in prior analysis of the same activities.
- The auditory group previously called the mid-frequency cetaceans (MF) is now called the high frequency cetaceans (HF). All species previously in the MF cetacean auditory group (most odontocetes) are now in the HF cetacean auditory group, and there is no MF cetacean exposure function. In the future, there may be sufficient data to support splitting the current HF cetacean auditory group into MF and HF auditory groups, with certain larger odontocetes (sperm, beaked, and killer whales) in the MF auditory group.
- The HF cetaceans are predicted to be much more susceptible to auditory effects at low- and mid-frequencies than previously analyzed. Consequently, the estimated auditory effects due to sources under 10 kHz are substantially higher for this auditory group than in prior analyses of the same activities.
- The auditory group previously called the high frequency cetaceans (HF) is now called the very high frequency cetaceans (VHF). This auditory group, which includes harbor porpoises and Kogia whales, is predicted to be less susceptible to auditory effects at high frequencies (above 10 kHz) than previously analyzed. Consequently, estimated impacts to this group from high frequency sources is slightly lower than prior analyses of the same activities.

- The phocid carnivores (PCW) are predicted to be slightly more susceptible and otariids and other marine carnivores (OCW) are predicted to be substantially more susceptible to auditory effects across their hearing range than previously analyzed. Consequently, estimated auditory effects for PCW and OCW are higher than in prior analyses of the same activities.



Note: Auditory groups are very low frequency cetaceans (VLF), low frequency cetaceans (LF), high frequency cetaceans (HF), very high frequency cetaceans (VHF), phocid carnivores in water and air (PCW and PCA), otariids and other marine carnivores in water and in air (OCW and OCA), and sirenians (SI). SI are not in HCTT Study Area. Heavy solid lines —Phase 4 TTS exposure functions. Thin solid lines —Phase 3 TTS exposure functions. Heavy dashed lines —Phase 4 AINJ exposure functions. Thin dashed lines —Phase 3 AINJ exposure functions. Figure taken from U.S. Department of the Navy (2025).

Figure 2-1: Marine Mammal TTS and AINJ Exposure Functions for Sonars and Other Non-Impulsive Sources

The thresholds to auditory impacts (AINJ and TTS) are presented in Table 2-1. Derivation of these thresholds is detailed further in the *Criteria and Thresholds TR*.

Table 2-1. Thresholds for Auditory Impacts to Marine Mammals from Non-Impulsive Sources

Hearing Group	*TTS threshold SEL (weighted)*[1]	*AINJ threshold SEL (weighted)*[1]
VLF & LF	177	197
HF	181	201
VHF	161	181
OCW	179	199
PCW	175	195

Note: VLF = very low frequency cetacean, LF = low frequency cetacean, HF = high frequency cetacean, VHF = very high frequency cetacean, OCW = otariid in water, PCW = phocid in water.
[1] SEL thresholds are in dB re 1 $\mu Pa^2 s$

The instances of AINJ and TTS predicted by NAEMO are not reduced to account for visual observation mitigation in this analysis. Still, it is possible that some model-predicted instances of AINJ and TTS would not occur during actual events using platforms and acoustic sources with applicable mitigation. Whenever transmitting during training and testing activities, three types of monitoring measures would be employed simultaneously: visual monitoring by trained personnel, passive acoustic monitoring using the passive SURTASS towed array to listen for sounds generated by marine mammals, and active acoustic monitoring using the HF/M3 sonar to detect, locate, and track marine mammals. If a marine mammal is observed within or entering a 2,000 yd. mitigation zone, the use of sonar would be delayed or ceased, as appropriate for the source as described in the *Mitigation* section of the Draft SEIS/OEIS. This would reduce an animal's sound exposure level or prevent an exposure that could cause hearing loss altogether.

NAEMO estimates the reduction in cumulative sound exposure level due to marine mammal avoidance of high-level sonar exposures. Initiation of aversive behavior is based on the applicable behavioral response function for a species. Avoidance speeds and durations are estimated from baseline species data and actual sonar exposure data, when available. The estimated cumulative exposure level, including any reductions due to avoidance (if initiated), is compared to the thresholds for AINJ and TTS to assess auditory impacts. If the thresholds for AINJ or TTS are not exceeded, the potential for behavioral response is assessed based on the highest exposure in the simulation. This analysis assumes that a small portion (5 percent) of delphinids in the odontocete behavioral group would not avoid most events but would stay in the vicinity to engage in bow-riding or other behaviors near platforms (i.e., the cumulative sound exposure level is not reduced through avoidance). A detailed explanation of the new avoidance model and the species avoidance factors are in the *Quantitative Analysis TR* (U.S. Department of the Navy 2024).

The ability to reduce cumulative sound exposure level depends on susceptibility to auditory effects, sensitivity to behavioral disturbance, and characteristics of the sonar source, including duty cycle, source level, and frequency. Table 2-2 shows the percentage reduction of AINJ across the modeled activities in this analysis due to avoidance. The reduction in AINJ due to avoidance differs across the Proposed Action and between auditory and behavioral groups. Groups that are relatively less sensitive to behavioral disturbance compared to susceptibility to auditory effects are less likely to avoid AINJ; these include the Mysticete and Odontocete behavioral groups. Groups that are relatively more sensitive to behavioral disturbance compared to susceptibility to auditory effects are more likely to avoid AINJ; these include the Sensitive Species and Pinniped behavioral groups. The reduction in AINJ for most groups is less than assumed in prior analyses[2]. As is shown in Table 2-2, avoidance was only able to be applied for pinnipeds. It is likely that no reduction of AINJ could be applied to any other hearing group due to the high source level and low frequency of the SURTASS LFA.

Table 2-2: Reduction in AINJ due to Avoiding Sonars in the Navy Acoustic Effects Model

FHG	MYST	ODONT	SENS	PINN
VLF	0 - 0 %	-	-	-
LF	0 - 0 %	-	-	-
HF	-	0 - 0 %	0 - 0 %	-
VHF	-	0 - 0 %	-	-
PW	-	-	-	0 - 75 %
OT	-	-	-	0 - 0 %

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Recovery from TTS after a sound exposure is not quantified in this analysis. Small amounts of TTS (a few dB) typically begin to recover immediately after the sound exposure and may fully recover in minutes, while larger amounts of TTS require longer to recover. Most TTS fully recovers within 24 hours, but larger shifts could take days to fully recover. In general, TTS quantified based on SEL for intermittent sound exposures is likely over-estimated because some recovery from TTS may occur in the quiet periods between sounds, especially when the duty cycle is low. Lower duty cycles allow for more time between sounds and therefore more of an opportunity for hearing to recover. Modeled effects using the SEL-based criteria are therefore likely to accurately predict impacts from higher duty cycle sources and certainly overestimate impacts from lower duty cycle sources.

See Section 2.5 (Ranges to Effects) for information on the ranges to TTS and AINJ with distance based on the type of sound sources and hearing group, as well as several other factors.

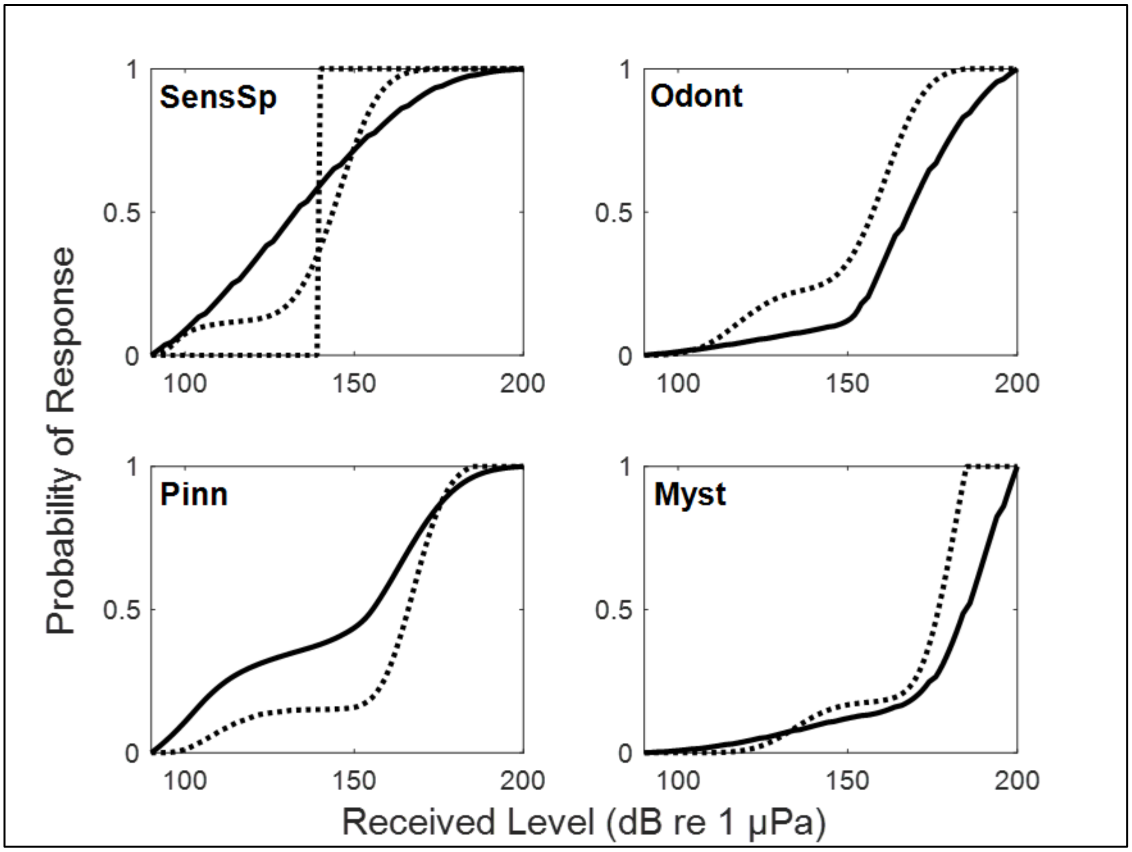
2.2.3 Quantifying Behavioral Responses to Sonars

Criteria and thresholds for behavioral responses have been updated since the prior analysis (see *Criteria and Thresholds TR*). Notable differences between the prior and updated criteria and thresholds for behavioral responses to sonars are as follows:

- Beaked whales and harbor porpoise are in a combined Sensitive Species behavioral group (previously, these groups had unique response functions). Other behavioral groupings remain the same: Mysticetes (all baleen whales), Odontocetes (most toothed whales, dolphins, and porpoises), and Pinnipeds (true seals, sea lions, walruses, polar bears).
- This analysis applies a dual cut-off condition based on both distance and received level. The cut-off distances have also been revised. These updates are described at the end of this section.

For each group, a biphasic behavioral response function was developed using best available data and Bayesian dose response models. The behavioral response functions are shown in Figure 2-2.

[2] The 2019 SEIS/SOEIS determined that, based on the mitigation procedures used during SURTASS LFA sonar activities, the chances of PTS were negligible. Therefore, no PTS (MMPA Level A harassment) is expected with the implementation of mitigation measures.



Notes: Revised behavioral response functions (solid lines) and prior behavioral response functions (Phase 3, dotted lines). SensSp = Sensitive Species, Odont = Odontocetes, Pinn = Pinnipeds, Myst = Mysticetes. Both the Phase 3 beaked whale behavioral response function and the Phase 3 harbor porpoise step function are plotted against the new Sensitive Species curve. Figure taken from U.S. Department of the Navy (2025).

Figure 2-2: Behavioral Response Functions

Due to the addition of new data and the separation of some species groups, the most significant differences from prior analyses include the following:

- The Sensitive Species behavioral response function is more sensitive at lower received levels but less sensitive at higher received levels than the prior beaked whale and harbor porpoise functions.
- The Odontocete behavioral response function is less sensitive across all received levels due to including additional behavioral response research. This will result in a lower number of behavioral responses than in the prior analysis for the same event, but also reduces the avoidance of auditory effects.
- The Pinniped in-water behavioral response function is more sensitive due to including additional captive pinniped data. Only three behavioral studies using captive pinnipeds were available for the derivation of the behavioral response function. Behavioral studies of captive animals can be difficult to extrapolate to wild animals due to several factors (e.g., use of trained subjects). This means the pinniped behavioral response function likely overestimates effects compared to observed reactions of wild pinnipeds to sound and anthropogenic activity.
- The Mysticete behavioral response function is less sensitive across most received levels due to including additional behavioral response research. This will result in a lower number of behavioral

responses than in the prior analysis for the same event, but also reduces the avoidance of auditory effects.

The behavioral response functions only relate the highest received level of sound during an event to the probability that an animal will have a behavioral response. Currently, there are insufficient data to develop criteria that include the context of an exposure, characteristics of individual animals, behavioral state, duration of an exposure, sound source duty cycle, the number of individual sources in an activity, or how loud the animal may perceive the sonar signal to be based on the frequency of the sonar versus the animal's hearing range, although these factors certainly influence the severity of a behavioral response.

The behavioral response functions also do not account for distance. At moderate to low received levels the correlation between probability of reaction and received level is very poor and it appears that other variables mediate behavioral reactions (e.g., Ellison et al. 2011) such as the distance between the animal and the sound source. Data suggest that beyond a certain distance, significant behavioral responses are unlikely. At shorter ranges (less than 10 km) some behavioral responses have been observed at received levels below 140 dB re 1 µPa. Thus, proximity may mediate behavioral responses at lower received levels. Since most data used to derive the behavioral response functions is within 10 km of the source, probability of reaction at farther ranges is not well-represented. Therefore, the source-receiver range must be considered separately to estimate likely significant behavioral reactions.

This analysis applies behavioral cut-off conditions to responses predicted using the behavioral response functions. Animals within a specified distance and above a minimum probability of response are assumed to have a significant behavioral response. The cut-off distance is based on the farthest source-animal distance across all known scientific studies where animals exhibited a significant behavioral response. Animals beyond the cut-off distance but with received levels above the SPL associated with a probability of response of 0.50 on the behavioral response function are also assumed to have a significant behavioral response. The actual likelihood of significant behavioral reactions occurring beyond the distance cut-off is unknown.

As opposed to defining a specific cut-off distance, previous modeling using AIM propagated SURTASS LFA sonar to wherever there was 100 dB of transmission loss. NAEMO uses the maximum unweighted SPL value of exposures received by an animat to determine the behavioral effects. Cutoff conditions are applied in both distance and received level in NAEMO to determine which exposures are included in the behavioral effects calculation. Due to the nature of SURTASS LFA sonar (i.e., low frequency, high source level), the cut-off distances used during modeling are higher than those used for other Navy Phase IV At-Sea efforts.

See Section 2.5 (Ranges to Effects) for information on the probability of behavioral response with distance based on the type of sonar and behavioral group, as well as several other factors.

2.3 ASSESSING IMPACTS ON INDIVIDUALS AND POPULATIONS

2.3.1 SEVERITY OF BEHAVIORAL RESPONSES TO MILITARY READINESS ACTIVITIES

The statutory definition of Level B harassment of marine mammals for military readiness activities is the "disruption of natural behavioral patterns, including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering, to a point where such behavioral patterns are abandoned or significantly altered" (Section 3(18)(B) of the Marine Mammal Protection Act [MMPA]). The terms "significant response" or "significant behavioral response" are used to describe behavioral reactions that may lead to an abandonment or significant alteration of a natural behavior pattern. Defining when a behavioral response becomes significant, as well as setting corresponding predictive exposure threshold values, is challenging. Whether an animal discernably responds, and the severity of that response are likely influenced by the animal's life experience, motivation, and conditioning; the physical condition of the animal; and the context of the exposure (Ellison et al. 2012; Southall et al. 2007b; Southall et al. 2019a).

Behavioral responses can be generally categorized as low, moderate, or high severity. These are derived from the Southall et al. (2021c) severity scale. Low severity responses are within an animal's range of typical (baseline) behaviors and would not be considered significant. High severity responses are those with a higher likelihood of consequences to growth, survival, or reproduction, such as behaviors that increase the risk of injury, prolonged separation of a female and dependent offspring, prolonged displacement from foraging areas, or prolonged disruption of breeding behavior. High severity reactions would always be considered significant, even if no direct negative outcome is observed. For example, separation of a killer whale mother-calf pair was observed when they were approached by a vessel with an active sonar source during a behavioral response study (Miller et al. 2014), but the animals rejoined once the ship passed.

Stranding is a very high severity response. Use of mid-frequency sonar has been associated with atypical mass strandings of beaked whales (Bernaldo de Quirós et al. 2019; D'Amico et al. 2009). Five stranding events, mostly involving beaked whales, have been attributed to U.S. Navy active sonar use. The confluence of factors that contributed to those strandings is now better understood, and U.S. Navy sonar has not been identified as a causal factor in an atypical mass stranding since 2006. The Navy does not anticipate that marine mammal strandings or mortality will result from the operation of sonar during SURTASS LFA training and testing in the Study Area. Through adaptive management under the MMPA, NMFS, and the Navy will determine the appropriate way to proceed if a causal relationship were to be found between Navy activities and a future stranding. There are no reported strandings associated with SURTASS LFA.

The behavioral responses predicted in this analysis are likely moderate severity within the scale presented in Southall et al. (2021b). Examples of moderate severity responses include avoidance, changes in vocalization, reduced foraging, reduced surfacing, and changes in courtship behavior. If moderate behaviors are sustained long enough to be outside of normal daily variations in feeding, reproduction, resting, migration/movement, or social cohesion, they are considered significant.

Given the available data on marine mammal behavioral responses, this analysis errs toward overestimating the number of significant behavioral responses. It is not possible to ascertain the true significance of most observed reactions that underlie the behavioral response functions used in this analysis. The behavioral criteria assume that most reactions that lasted for the duration of a sound exposure or longer were significant, regardless of exposure duration. It is possible that some short duration responses would not rise to the level of harassment as defined above. In addition, the experimental designs used during some behavioral response studies with non-captive animals were unlike military readiness activities in important ways. These differences include closely approaching and tagging subject animals; following subjects before the exposure; vectoring towards avoiding animals; or multiple close passes by focal animal groups. In contrast, military platforms would not purposely undertake such close approaches nor make directed movements toward animals. As researchers have improved experimental designs in subsequent behavioral response studies, more recent data better reflects responses in contexts more closely matching exposures during military readiness activities. Interpreting studies with captive animals presents other challenges, as captive animals may have different behavioral motivations than non-captive animals, and the context of exposure (confined environment, distance from source) differs from non-captive exposures. Thus, some behavioral reactions associated with acoustic received levels then used to develop behavioral risk functions may have been influenced by other aspects of the experimental exposures.

2.3.2 Potential Opportunities to Mitigate Auditory and Non-Auditory Injury

Visual observation of mitigation zone is prescribed in the *Mitigation* chapter of the Draft SEIS/OEIS. In summary, trained Lookouts would be positioned on surface vessels to observe the designated mitigation zone prior to and during the use of SURTASS LFA sonar. The specified mitigation zone is the largest area Lookouts can reasonably be expected to observe during typical activity conditions, while being practical to implement from an operational standpoint. When a marine mammal (and in some instances, indicators of marine mammal presence like floating concentrations of vegetation) is sighted within or entering a mitigation zone, sound-producing activities are delayed, powered down, or ceased. These actions either reduce an acoustic dose (in the case of an ongoing acoustic stressor) or prevent an injurious exposure altogether.

Ranges to auditory effects (AINJ and TTS) for marine mammals exposed to sonars are in Section 2.5.1 (Ranges to Effects to Marine Mammals). The median ranges to AINJ for all hearing groups due to SURTASS LFA sonars are encompassed by the applicable mitigation zone (2,000 yd. shut down). However, due to the acoustic characteristics of SURTASS LFA, animals could be repeatedly exposed to noise below the AINJ and TTS thresholds and could in turn be exposed to enough noise as to trigger an auditory effect outside of the mitigation zone.

Although the mitigation zone covers the range to AINJ for most sonar sources in most conditions, this analysis does not reduce model-predicted impacts to account for visual observations. Instead, NAEMO identified the number of instances that animats with doses exceeding thresholds for AINJ (sonar) also had their closest points of approach within applicable mitigation zones. These instances are considered potential mitigation opportunities, which would be further influenced by other factors such as the sightability of the species and viewing conditions, as discussed in the *Mitigation* chapter of the Draft SEIS/OEIS. The closest point of approach considers any predicted animal avoidance of a sound source in the activity. Only mysticetes in the VLF and LF hearing groups have at least one model-predicted AINJ. The potential mitigation opportunities for VLF and LF hearing groups during SURTASS LFA training and testing activities is 5% and 8%, respectively.

2.3.3 Behavioral Responses by Distance and Sound Pressure Level

Figure 2-3 and Figure 2-4 provide the total number of predicted behavioral responses under a maximum year of SURTASS LFA sonar use for each behavioral response group (i.e., Odontocetes, Mysticetes, Pinnipeds, and Sensitive Species) without applying TTS or AINJ thresholds. In other words, in these plots, behavioral response functions were applied to all animats in the Navy's acoustic effects model, assuming animals that did receive TTS or AINJ would also be likely to exhibit a behavioral response. For these two figures, the total bar height represents the total number of behavioral responses as indicated on the vertical axis, whereas the dark gray bars indicate the number of *significant* behavioral responses as defined for military readiness activities using the distance and probability of response cut-off conditions described at the end of Section 2.2.3 (Quantifying Behavioral Responses to Sonars) and presented in Figure 2-3 shows the total number of behavioral responses in 6-dB SPL bins representing the highest received SPL. All exposures equal to or above the received level associated with p(0.50) on the applicable behavioral response function are assumed to be significant in this analysis. A portion of behavioral responses predicted at lower received levels (as low as 100 dB SPL) are also assumed to be significant. Overall, there are few exposures to sonar above 200 dB SPL.

Figure 2-4 shows the total number of behavioral responses in 25-km bins to 500 km. For odontocetes and mysticetes, significant behavioral responses are estimated to all occur within 50 km of the sound source. For pinnipeds, significant behavioral responses are estimated out to 150 km. Some significant behavioral responses for sensitive species are predicted out to and beyond 500 km. This explains the spike in predicted behavioral responses at these distances in this Study Area.

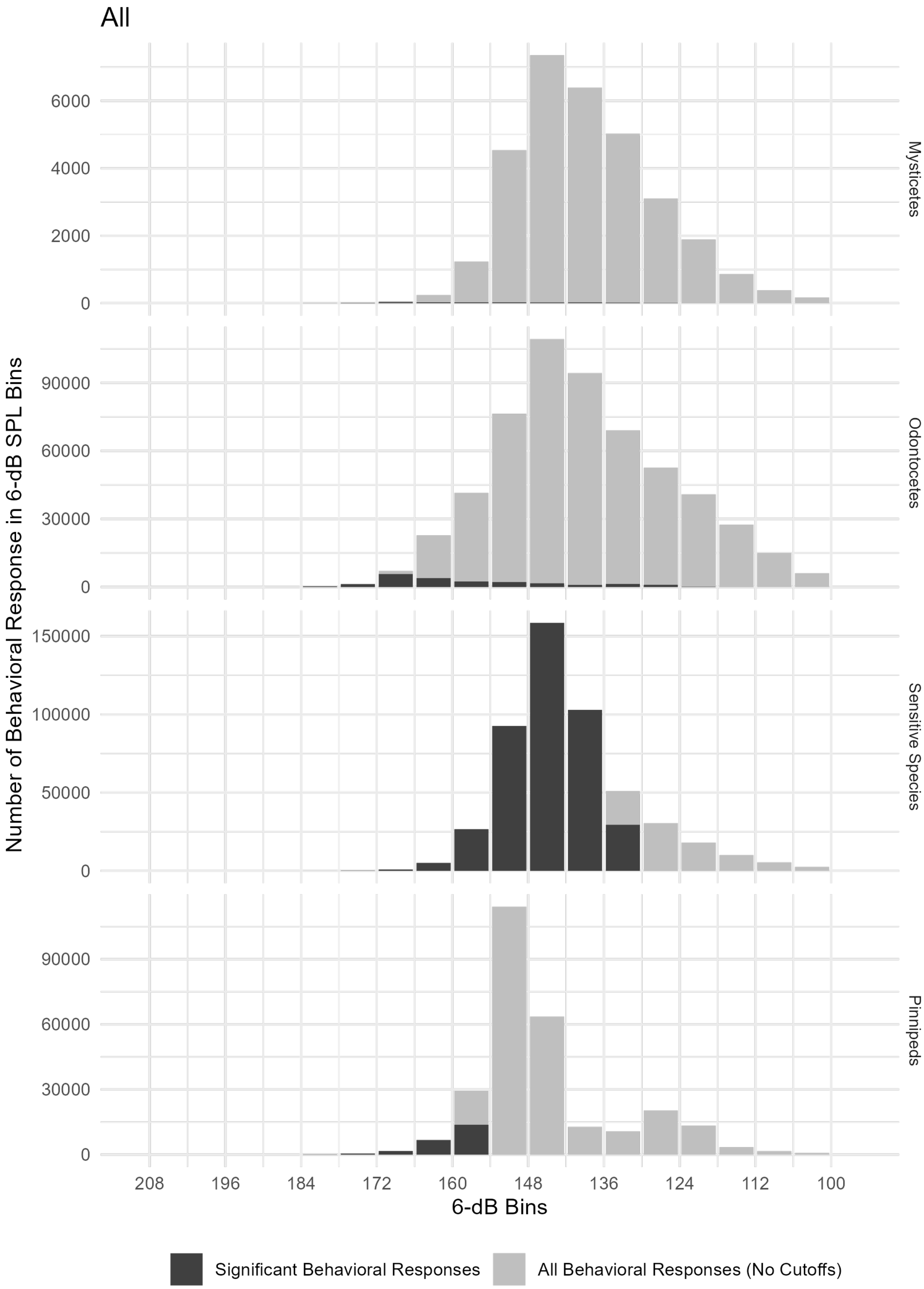


Figure 2-3: Total predicted Instances of Marine Mammal Behavioral Responses in the Study Area by Received Level

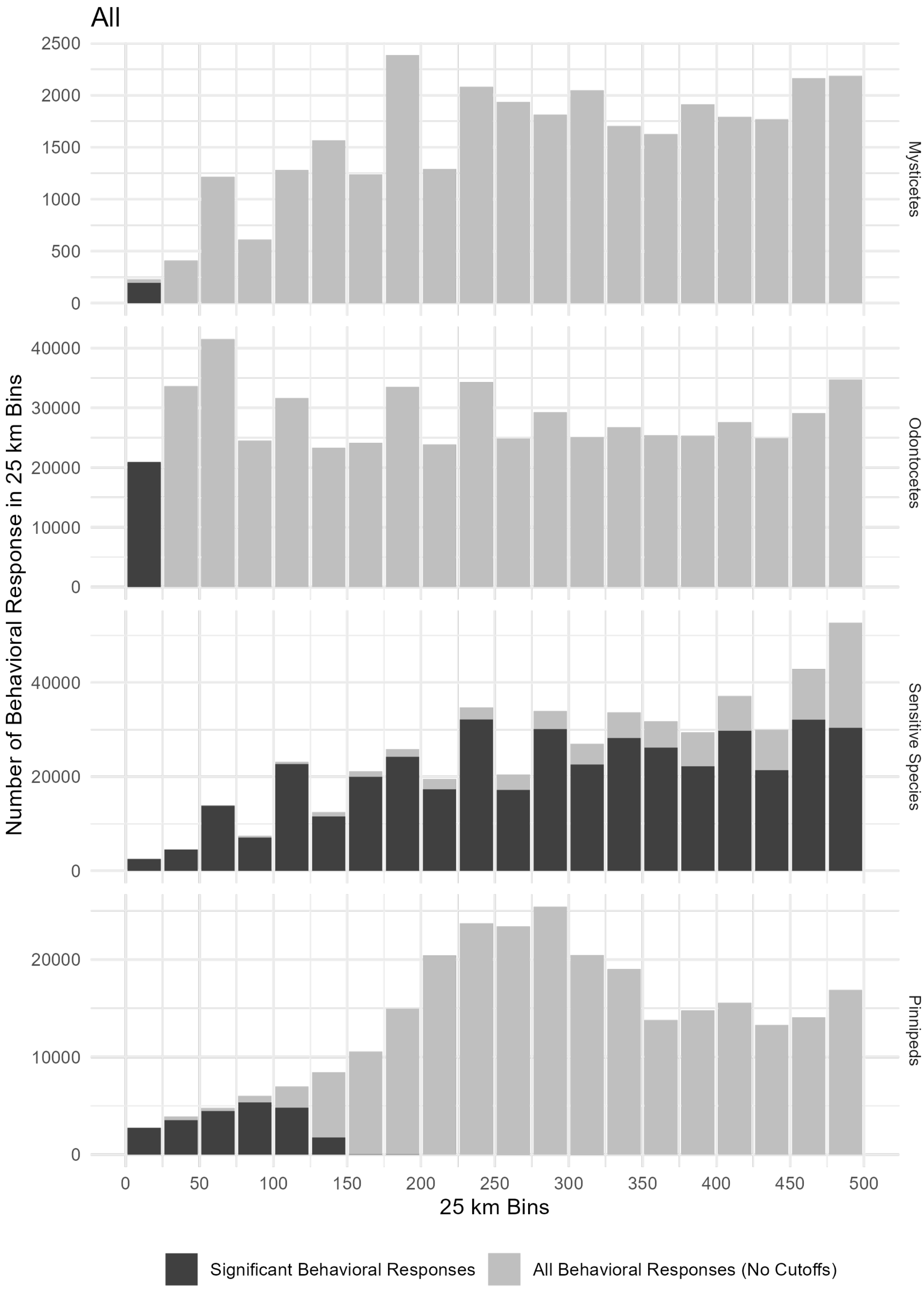


Figure 2-4: Total Predicted Instances of Marine Mammal Behavioral Responses in the Study Area by Distance

2.3.4 RISKS TO MARINE MAMMAL POPULATIONS

To issue an LOA under the MMPA, NMFS must determine that an impact "cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival." Assessing the consequences to a marine mammal population due to individual, short-term responses can be difficult and has been the subject of many studies.

Given the scope of the Proposed Action and the current state of the science regarding marine mammals, there is no known method to determine or predict the age, sex, or reproductive condition of the various species of marine mammals predicted to be impacted because of the proposed training and testing.

This analysis adapts the assessment of species vulnerability described in Southall et al. (2023). The relativistic risk assessment approach in Southall et al. (2023) was designed to compare risk to populations from specific industry impact scenarios at different locations or times of year. This approach may not be suitable for many military readiness activities, for which alternate spatial or seasonal scenarios are not usually feasible. However, the concepts considered in that framework's population vulnerability assessment are useful in this analysis, including population status (endangered or threatened), population trend (decreasing, stable, or increasing), population size, and chronic exposure to other anthropogenic or environmental stressors. These stock vulnerability factors are provided for every stock in the Study Area in Table 2-5 for Endangered Species Act (ESA)-listed species and in Table 2-6 for non ESA-listed species.

This analysis also relies on the population consequences of disturbance themes identified in Keen et al. (2021). These themes fall into three categories: *life history traits, environmental conditions, and disturbance source characteristics*.

Life history trait definitions used in this analysis are shown in Table 2-3. Life history traits include:

- Movement ecology (resident/nomadic/migratory): Resident animals that have small home ranges relative to the size and duration of an impact zone would have a higher risk of repeated exposures to an ongoing activity. Animals that are nomadic over a larger range may have less predictable risk of repeated exposure. For resident and nomadic populations, overlap of a stressor with feeding or reproduction depend more on time of year rather than location in their habitat range. In contrast, migratory animals may have higher or reduced potential for exposure during feeding and reproduction based on both location, time of the year, and duration of an activity. The risk of repeated exposure during individual events may be lower during migration as animals maintain directed transit through an area. Pinniped species designated as "Resident-nomadic" are those that seasonally migrate following sea ice over relatively small distances, but typically return to the same rookeries and haul-out sites.
- Reproductive strategy (capital/income/mixed): Reproduction is energetically expensive for female marine mammals. Mysticetes and phocids are capital breeders. Capital breeders rely on their capital, or energy stores, to migrate, maintain pregnancy, and nurse a calf. Capital breeders would be more resilient to short-term foraging disruption due to their reliance on built-up energy reserves. Otariids and most odontocetes are income breeders, which rely on some level of income, or regular foraging, to give birth and nurse a calf. Income breeders would be more sensitive to the consequences of disturbances that impact foraging during lactation. Some species exhibit traits of both, such as beaked whales.

- Body size (small/medium/large): Smaller animals require more food intake per unit body mass than large animals. They must consume food on a regular basis and are likely to be non-migratory and income breeders. The smallest odontocetes, the porpoises, must maintain high metabolisms to maintain thermoregulation and cannot rely on blubber stores for long periods of time, whereas larger odontocetes can more easily thermoregulate. The larger size of other odontocetes is an adaptation for deep diving that allows them to access high quality mesopelagic and bathypelagic prey. Both small and large odontocetes have lower foraging efficiency than the large whales. The filter-feeding large whales (mysticetes) consume most of their food within several months of the year and rely on extensive lipid reserves for the remainder of the year. The metabolism of mysticetes allows for fasting while seeking prey patches during foraging season and prolonged periods of fasting outside of foraging season (Goldbogen et al. 2023). Their energy stores support capital breeding and long migrations. The effect of a temporary feeding disturbance is likely to have inconsequential impacts to a mysticete but may be consequential for small cetaceans. Despite their relatively smaller size, amphibious pinnipeds have lower thermoregulatory requirements because they spend a portion of time on land. For purposes of this assessment, marine mammals were generally categorized as small (less than 10 feet [ft]), medium (10-30 ft), or large (more than 30 ft) based on length.
- Pace of life (slow/medium/fast): Populations with a fast pace of life are characterized by early age of maturity, high birth rates, and short life spans, whereas populations with a slow pace of life are characterized by later age of maturity, low birth rates, and long life spans. The consequences of disturbance in these populations differ. Although reproduction in populations with a fast pace of life are more sensitive to foraging disruption, these populations are quick to recover. Reproduction in populations with a slow pace of life is resilient to foraging disruption, but late maturity and low birth rates mean that long-term impacts to breeding adults have a longer-term effect on population growth rates. The discussion of “generation times” in the species impact analyses below are referring to that species’ age of maturity. Pace of life was categorized for each species in this analysis by comparing age at sexual maturity, birth rate interval, life span, body size, and feeding and reproductive strategy. Pace of life attribute definitions are shown in Table 2-4.

Table 2-3: Life History Characteristic Definitions

Life History Characteristic	*Body Size*	*Feeding/ Breeding Strategy*	*Pace of Life*	*Chronic Anthropogenic Risk Factors*	*Chronic Biological Risk Factors*
Categories/ Definitions	[Small, Medium, Large]	[Capital, Income, Intermediate/ Mixed]	[Fast, Medium, Slow]	Risk from anthropogenic stressors (e.g., acoustic, fisheries interactions, vessel strike)	Presence of disease, parasites, prey limitations, or high predation
Source of Information	Keen et al. (2021)	Keen et al. (2021)	Keen et al. (2021)	SAR, Best Available Science, NMFS Species Profiles	SAR, Best Available Science, NMFS Species Profiles
Definitions	Small: < 3 m Medium: 3 - 9 m Large: > 9 m	Capitol breeder: stores energy prior to parturition for lactation Income Breeder: feeds during lactation	See Table 2-4	Environmental factors outside of Action Proponent's SURTASS LFA sonar activities. Increased prevalence of third-party stressors may increase species-specific vulnerability to the potential disturbance (Southall et al. 2021a).	

Notes: < = less than; > = more than; NMFS = National Marine Fisheries Service; SAR = stock assessment report

Table 2-4: Pace of Life Attribute Definitions

Attribute[1]	*Definitions*		
	Fast	*Medium*	*Slow*
Body Size	Small	Medium	Large
Birth Rate Interval	1 to 2 years	2 to 3 years	3+ years
Sexual Maturity[2]	Up to 3.75 years on average	3.75 to 7 years on average	7+ years on average
Lifespan	Up to 29 years	29 to 50 years	50+ years
Pace of Life Overall	Majority (3+) fast attributes	Majority medium[3]	Majority (3+) slow attributes

[1] Attribute citations (Keen et al. 2021)
[2] If sexual maturity was reported as a range for a particular species, an average value was used.
[3] If there was not an equal number of attributes, justification based on body size and birth rate interval was used to make final category decision. For example, most pinniped species were an even mix of small, medium, and fast attributes. However, with their overall small body size and birth rate interval of one year, it was determined that they fall in the "Fast" Pace of Life category overall.
Note: + = or more

Environmental conditions include external anthropogenic and biological risk factors (not associated with the Proposed Action) that can stress individuals and populations, making them more susceptible to long-term consequences. These factors include fisheries interactions, pollution, climate change, vessel strike, and other anthropogenic noise sources. These additional stressors are also considered when assessing the overall vulnerability of a stock to repeated effects from acoustic stressors.

Disturbance source characteristics include overlap with biologically important habitats, the duration and frequency (how often it occurs) of disturbance, and the nature and context of the exposure. In this analysis, disturbance source characteristics are considered as follows:

- The numbers and types of effects are estimated in areas that are identified as biologically important for certain species and in designated critical habitats for ESA-listed species.
- Information about the context of exposures can be obtained through the current exposure modeling process, including season, location of the activity, the distance from an acoustic source where an exposure threshold is exceeded, and the type of activity that resulted in modeled impacts.
- To obtain an estimate of the average number of times individual marine mammals within each stock may be affected annually, the total number of non-injurious (i.e., behavioral response, TTS) and injurious effects (i.e., AINJ) are considered versus the population abundance.
- Activities that occur on instrumented ranges and within homeports, and long duration activities, such as major training exercises, require special consideration due to the potential for more frequent repeated impacts to individuals as compared to individuals living outside areas where military readiness activities may be concentrated.

The above life history traits are identified for each NMFS-designated stock in the Study Area in Table 2-5 for ESA-listed species and in Table 2-6 for all other stocks in the Study Area. If a species or stock has life history trait characteristics that span two classifications, both are shown (e.g., if a species exhibits both resident and nomadic behavior, it is described as resident-nomadic in the table).

Table 2-5: Stock Vulnerability Factors and Life History Traits for ESA-listed Marine Mammal Stocks within the Study Area

Species	*Stock*[1]	*Movement Ecology*	*Body Size*	*Feeding/ Breeding Strategy*	*Pace of Life*	*Population Trend*	*Chronic Risk Factors*[2]
Bearded seal	Beringia[3]	Nomadic	Small	Capital	Fast	Unk	Habitat degradation, contaminants, pollution
Blue whale	Central North Pacific Worldwide	Migratory	Large	Capital	Slow	Unk	Vessel strikes, fisheries interactions, habitat degradation, pollution, vessel disturbance, ocean noise
False killer whale	Main Hawaiian Islands Insular	Resident-nomadic	Med	Income	Med	Appears to be decreasing	Fisheries interactions, contaminants
Fin whale	Hawaiian Worldwide	Migratory	Large	Capital	Slow	Unk	Vessel strikes, fisheries interactions, habitat degradation, pollution, vessel disturbance, ocean noise
Hawaiian Monk Seal	Hawaiian	Resident	Small	Capital	Fast	Stable/ increasing	Fisheries interactions, illegal harassment, habitat degradation, disease
Humpback whale	Western North Pacific	Migratory	Large	Capital	Slow	Unk	Vessel strikes, fisheries interactions, habitat degradation, pollution, vessel disturbance, ocean noise
North Pacific right whale	Worldwide	Migratory	Large	Capital	Slow	Unk	Vessel strikes, fisheries interactions, ocean noise
Ringed seal	Worldwide	Resident-nomadic	Small	Capital	Fast	Unk, but likely stable	Fisheries interactions, habitat degradation
Northern sea otter	Southern Alaska	Resident	Small	Income	Fast	Appears to be stable or increasing	Fisheries interactions, vessel strike, pollution, contaminants, illegal killing, disease, predation
Sei whale	Hawaii Worldwide	Migratory	Large	Capital	Slow	Unk	Vessel strikes, fisheries interactions, ocean noise
Sperm whale	Hawaii North Pacific Worldwide	Resident-migratory	Large	Income	Slow	Unk Unk, but possibly stable Unk,	Vessel strikes, fisheries interactions, ocean noise, marine debris, disease
Spotted seal	Southern DPS	Resident-nomadic	Small	Capital	Fast	Unk	Habitat degradation, contaminants, subsistence hunting
Steller sea lion	Western	Resident-nomadic	Small	Income	Fast	Regionally dependent	Fisheries interactions, contaminants, disease

Notes: Unk = unknown, Med = medium

[1] Stock designations are from Pacific and Alaska Stock Assessment Reports prepared by NMFS (Carretta et al. 2023; Young 2023).

[2] Fisheries interactions represents entanglement in fishing gear, including derelict fishing gear, and bycatch.

[3] Foreign ESA-listed species. NMFS does not include information on this stock in their Stock Assessment Reports.

Table 2-6: Stock Vulnerability Factors and Life History Traits for non-ESA-listed Marine Mammal Stocks within the Study Area

Species	*Stock[1]*	*Movement Ecology*	*Body Size*	*Feeding/ Breeding Strategy*	*Pace of Life*	*Population Trend*	*Chronic Anthropogenic Risk Factors[2]*
Antarctic minke whale	Worldwide	Migratory, resident	Med-Large	Capital	Slow	Unk, possibly decreasing	Vessel strikes, fisheries interactions, pollution, ocean noise, whaling
Baird's beaked whale	Worldwide	Nomadic, resident	Large	Mixed	Slow	Stable, possibly increasing	Fisheries interactions, ocean noise
Blainville's beaked whale[3]	Hawaii	Nomadic, resident	Med	Mixed	Med	Unk	Fisheries interactions, ocean noise, disease
	Worldwide						
Bryde's whale	Hawaii	Unknown, likely migratory	Large	Capital	Slow	Unk	Vessel strikes, fisheries interactions, habitat degradation, pollution, vessel disturbance, ocean noise
	Worldwide						
Common bottlenose dolphin	Hawaiian Pelagic	Nomadic	Small-Med	Income	Med	Unk	Entanglement, Fisheries interactions, disease
	Worldwide	Nomadic					
Common dolphin	Worldwide	Nomadic	Small-Med	Income	Med	Unk	Entanglements, fisheries interactions, hunting
Dall's porpoise	Worldwide	Nomadic	Small	Income	Fast	Unk but likely stable	Fisheries interactions
Deraniyagala beaked whale	Worldwide	Unk	Small-Med	Mixed	Med	Unk	Fisheries interactions, contaminants, pollution, ocean noise
Dwarf sperm whale	Hawaii	Migratory, resident, nomadic	Small	Income	Fast	Unk	Vessel strike, entanglements, fisheries interactions, ocean noise, disease
	Worldwide						
False killer whale	Hawaii Pelagic	Nomadic	Med	Income	Med	Unk	Fisheries interactions, contaminants
	Worldwide	Resident, nomadic					
Fraser's dolphin	Hawaii	Nomadic	Small	Income	Fast	Unk	Fisheries interactions
	Worldwide						
Goose-beaked whale	Hawaii	Nomadic, resident	Med	Mixed	Med	Unk	Fisheries interactions, ocean noise
	Worldwide						
Ginkgo-toothed beaked whale[3]	Worldwide	Unk	Small-Med	Mixed	Med	Unk	Fisheries interactions, contaminants, pollution, ocean noise

Species	*Stock[1]*	*Movement Ecology*	*Body Size*	*Feeding/ Breeding Strategy*	*Pace of Life*	*Population Trend*	*Chronic Anthropogenic Risk Factors[2]*
Harbor seal	California	Resident-nomadic	Small	Capital	Fast	Increasing	Vessel strike, entanglement, illegal harassment, habitat degradation, contaminants
Hubbs' beaked whale[3]	Worldwide	Unk	Small-Med	Mixed	Med	Unk	Fisheries interactions, contaminants, pollution, ocean noise
Humpback whale	CNP Stock and Hawai'i DPS	Migratory	Large	Capital	Slow	Unk	Vessel strikes, fisheries interactions, habitat degradation, pollution, vessel disturbance, ocean noise
	Worldwide						
Killer whale	Hawaii	Nomadic	Large	Income	Slow	Unk	Fisheries interactions
	Worldwide						
Longman's beaked whale	Hawaii	Nomadic- resident	Med	Mixed	Med	Unk	Fisheries interactions, ocean noise, disease
	Worldwide						
Melon-headed whale	Hawaiian Islands	Resident-nomadic	Small	Income	Med	Unk	Fisheries interactions, ocean noise
	Worldwide	Nomadic					
Minke whale	Hawaii	Migratory	Med-Large	Capital	Slow	Unk	Vessel strikes, fisheries interactions, habitat degradation, pollution, disease
	Worldwide						
Northern fur seal	Worldwide	Migratory	Small	Income	Fast	Decreasing	Fisheries interactions, intentional killing/harassment, chemical contaminants, disease
Northern right whale dolphin	Worldwide	Nomadic	Small	Income	Med	Unk	Fisheries interactions
Omura's whale	Worldwide	Resident- nomadic	Large	Capital	Slow	Unk	Vessel strikes, fisheries interactions, habitat degradation
Pacific white-sided dolphin	North Pacific	Nomadic	Small	Income	Med	Unk	Fisheries interactions, ocean noise
Pantropical spotted dolphin	Hawaii Pelagic	Nomadic	Small	Income	Med	Unk	Fisheries interactions
	Worldwide	Resident- nomadic					
Pygmy killer whale	Hawaii	Migratory, nomadic, resident	Small-Med	Income	Fast	Unk	Fisheries interactions, marine debris, ocean noise
	Worldwide						
Ribbon seal	Worldwide	Resident-nomadic	Small	Capital	Fast	Unk	Habitat degradation, contaminants, subsistence hunting
Risso's dolphin	Hawaii	Nomadic	Med	Income	Med	Unk	

Species	*Stock*[1]	*Movement Ecology*	*Body Size*	*Feeding/ Breeding Strategy*	*Pace of Life*	*Population Trend*	*Chronic Anthropogenic Risk Factors*[2]
	Worldwide						Fisheries interactions, entanglement, contaminants, ocean noise, hunting
Rough-toothed dolphin	Hawaii Worldwide	Nomadic	Med	Income	Med	Unk	Entanglement, hunting, ocean noise, disease
Short-finned pilot whale	Hawaii Worldwide	Nomadic- resident	Med	Income	Med	Unk	Vessel strikes, fisheries interactions, entanglement, hunting
Spinner dolphin	Hawaii Pelagic Worldwide	Nomadic	Small	Income	Fast	Unk	Swim with the dolphin programs, ocean noise, fisheries interactions, disease
Spotted seal	Southern DPS	Resident-nomadic	Small	Capital	Fast	Unk	Habitat degradation, contaminants, subsistence hunting
Stejneger's beaked whale[3]	Worldwide	Unk	Small-Med	Mixed	Med	Unk	Fisheries interactions, contaminants, pollution, ocean noise
Striped dolphin	Hawaii Pelagic Worldwide	Nomadic	Small	Income	Med	Unk	Fisheries interactions

Notes: DPS = distinct population segment; Unk = unknown; Med = medium; NMFS = National Marine Fisheries Service
[1] NMFS-managed stock and information designations are from Pacific and Alaska Stock Assessment Reports prepared by NMFS (Carretta et al. 2023; Young 2023).
[2] Fisheries interactions represents entanglement in fishing gear, including derelict fishing gear, and bycatch.
[3] Mesoplodont beaked whales off the U.S. west coast are managed as a single California/Oregon/Washington stock. This stock includes Blainville's, Hubbs', gingko-toothed, Perrin's, lesser (pygmy), and Stejneger's beaked whales. Only Blainville's, Hubbs', ginkgo-toothed, and Stejneger's beaked whales are found within the Study Area and are classified as non-NMFS managed stocks.

The costs to marine mammals affected by acoustic stressors vary based on the type and magnitude of the effect.

- Marine mammals that experience masking may have their ability to communicate with conspecifics reduced, especially at farther ranges. However, larger mysticetes (e.g., blue whale, fin whale, sei whale) communicate at frequencies below those of mid-frequency sonar and even most low-frequency sonars. Other marine mammals that communicate at higher frequencies (e.g., minke whale, dolphins) may be affected by some short-term and intermittent masking. Odontocetes use echolocation to find prey and navigate. The echolocation clicks of odontocetes are above the frequencies of most sonar systems, especially those used during anti-submarine warfare. Therefore, echolocation associated with feeding and navigation in odontocetes is unlikely to be masked by sounds from sonars. Sounds from mid-frequency sonar could mask killer whale vocalizations, making them more difficult to detect, especially at farther ranges. A single or even a few short periods of masking, if it were to occur, to an individual marine mammal per year are unlikely to have any long-term consequences for that individual.
- Threshold shifts do not necessarily affect all hearing frequencies equally, and typically occur at the exposure frequency or within an octave above the exposure frequency. Recovery from threshold shift begins almost immediately after the noise exposure ceases and can take a few minutes to a few days, depending on the severity of the initial shift, to recover. Most TTS, if it does occur, would likely be minor to moderate (i.e., less than 20 dB of TTS directly after the exposure) and would recover within a matter of minutes to hours. During the period that a marine mammal had hearing loss, social calls from conspecifics could be more difficult to detect or interpret. Killer whales are a primary predator of most other marine mammals. Some hearing loss could make killer whale calls more difficult to detect at farther ranges until hearing recovers. Odontocete echolocation clicks and vocalizations are at frequencies above a few tens of kHz for delphinids, beaked whales, and sperm whales, and above 100 kHz for harbor porpoises and Kogia whales. Echolocation associated with feeding and navigation in odontocetes could be affected by higher-frequency hearing loss but is unlikely to be affected by threshold shift at lower frequencies. It is unclear how or if mysticetes use sound for finding prey or feeding; therefore, it is unknown whether hearing loss would affect a mysticetes' ability to locate prey or rate of feeding. A single or even a few TTS in an individual marine mammal per year are unlikely to have any long-term consequences for that individual.
- Auditory injury includes but is not limited to permanent hearing loss. AINJ that did occur would likely be of a small amount (single digit permanent threshold shift) or could cause other physiological changes without any permanent hearing loss (see the *Criteria and Thresholds TR*). In cases where AINJ results in permanent hearing loss, this could reduce an animal's ability to detect sounds that are important for survival (including sounds that facilitate breeding, signal feeding opportunities, and allow avoidance of predators, vessels, and other threats), which could have long-term consequences for individuals. However, permanent loss of some degree of hearing is a normal occurrence as mammals age (see the *Marine Mammal Background Section*). While a small decrease in hearing sensitivity may include some degree of energetic costs, it would be unlikely to impact behaviors, opportunities, or detection capabilities to a degree that would interfere with reproductive success or survival. However, individuals that are already in a compromised state at the time of exposure may be more likely to be impacted as compared to relatively healthy individuals.

- Exposures that result in non-auditory injuries may limit an animal's ability to find food, communicate with other animals, or interpret the surrounding environment. Impairment of these abilities can decrease an individual's chance of survival or impact its ability to successfully reproduce. The death of an animal would eliminate future reproductive potential, which is considered in the analysis of potential long-term consequences to the population.

Assessments of likely long-term consequences to populations of marine mammals are provided by empirical data gathered from areas where military readiness activities routinely occur. Substantial Navy-funded marine mammal survey data, monitoring data, and scientific research have been collected since 2006. These empirical data are beginning to provide insight on the qualitative analysis of the actual (as opposed to model-predicted numerical) impact on marine mammals resulting from training and testing activities based on observations of marine mammals generally in and around range complexes.

2.4 SPECIES IMPACT ASSESSMENTS

The following sections analyze impacts to each marine mammal stock under the Proposed Action and show model-predicted estimates of take for a maximum year of the proposed action. A star (*) is added to the species header if a species or a distinct population segment (DPS) is listed as endangered or threatened under the ESA. The analyses rely on information on species presence and behavior in the Study Area presented in Appendix C of the Draft SEIS/OEIS. That information is briefly summarized in each species impact analysis. The reader is referred to Appendix C of the Draft SEIS/OEIS application for additional detail and supporting references. Some populations, such as gray whales, were only qualitatively analyzed within the Draft SEIS/OEIS, as density data throughout the Study Area was unavailable to use within NAEMO. Gray whale impacts are not further discussed in this quantitative analysis.

The methods used to quantify impacts for SURTASS LFA sonar are described in the *Quantitative TR*. The methods used to assess significance of individual impacts and risks to marine mammal populations are described above in Section 2.2.2 (Quantifying Impacts on Hearing). There is no expected physical/non-auditory injury or mortality to any of the marine mammal species due to the Proposed Action; therefore, it is not further discussed.

For each species, a table quantifies impacts. Each row shows the number of instances of each effect type that could occur due to SURTASS LFA use associated with the Proposed Action over a maximum year of activity, broken down by stock. Stocks are designated as being either NMFS-managed or not for this analysis; due to the complexity of interpreting international stock designations, any animals not included in a NMFS stock assessment report (SAR) would be lumped into a "Worldwide [Nsd]" stock for the species as they have no stock designation (Nsd).

The number of instances of effect is not the same as the number of individuals that could be affected, as some individuals in a stock could be affected multiple times, whereas others may not be affected at all. The instances of effect are those predicted by NAEMO and are not further reduced to account for visual observation mitigation that may reduce effects near the sound source.

In the modeling, instances of effect are calculated within 24-hour periods of each individually modeled event. Impacts are assigned to the highest order threshold exceeded at the animat, which is a dosimeter in the model that represents an animal of a particular species or stock. Any auditory effect is assumed to outrank significant behavioral responses. In all instances any auditory effects are assumed to represent a concurrent significant behavioral response. For example, if a significant behavioral response and TTS are predicted for the same animat in a modeled event, the effect is counted as a TTS in the table.

Total impacts are based on multiplying the average expected impacts at a location by the number of times that activity is expected to occur. This is a reasonable method to estimate impacts for activities that occur every year and multiple times per year.

The summation of instances of effect includes all fractional values caused by averaging multiple modeled iterations of individual events. Impacts are eventually rounded into whole numbers. Rounding follows standard rounding rules, in which values less than 0.5 round down to the lower whole number, and values equal to or greater than 0.5 round up to the higher whole number.

- A zero value (0) indicates that the sum of impacts is greater than true zero but less than 0.5. These impacts are described in the species analysis as "negligible."

- A dash (-) indicates that no impacts are predicted (i.e., a "true" zero). This would occur when there is no overlap of an animat in the modeling with a level of acoustic exposure that would result in any possibility of impacts.
- If there are comparatively few instances of modeled impacts from SURTASS LFA sonar, this result will be described in the species analysis as "limited."

The summation of impacts across seven years is shown in Section 2.4.4 (Impact Summary Tables). The seven-year sum accounts for any variation in the annual levels of activities. The seven-year sum includes any fractional impact values predicted in any year, which is then rounded following standard rounding rules. That is, the seven-year impacts are not the result of summing the rounded annual impacts.

If a seven-year sum is larger than the annual modeled impacts multiplied by seven, the annual maximum impacts shown in the stock impact tables were increased by dividing the seven-year sum of impacts by seven then rounding up to the nearest integer. For example, this could happen if maximum annual modeled impacts are 1.34 (rounds to 1 annually) and seven-year modeled impacts are 8.60 (rounds to 9), where 9 divided by 7 years (9 ÷ 7 = 1.29) is greater than the rounded annual impact of 1. In this instance, the maximum annual impacts would be adjusted from 1 to 2 based on rounding up 1.29 to 2. In multiple instances, this approach resulted in increasing the maximum annual impacts predicted by NAEMO.

Each row in the tables include an estimate of the average number of times an individual in the stock would be affected in a maximum year of activity. The annual impacts per individual is the sum of all instances of effect divided by the population abundance estimate. The annual injurious impacts per individual is only the sum of auditory injuries divided by the population abundance estimate. For some stocks, if there is not a reliable population abundance estimate available, then this is noted and the annual impacts and annual injurious impacts were not calculated.

This analysis does not estimate the distribution of instances of effect across a population (i.e., whether some animals in a population would be affected more times than others). The Navy's Acoustic Effects Model does not currently model animat movements within, into, and out of the Study Area over a year. Additionally, while knowledge of stock movements and residencies is improving, significant data gaps remain. Impact assessment is not broken out by region, but it is assumed that take could occur anywhere in the Study Area.

2.4.1 Impacts on Mysticetes

The mysticetes have been split from the previous inclusive LF cetacean auditory group into two auditory groups: the VLF and LF cetaceans. The predicted hearing range of the VLF cetaceans resembles the previous combined auditory group for all mysticetes, whereas the predicted hearing range for the revised LF cetacean group is shifted to slightly higher frequencies.

For sonar exposures, the behavioral response function indicates less sensitivity to behavioral disturbance than predicted in the prior analysis. As described in Section 2.2.2 (Quantifying Impacts on Hearing), the methods to model avoidance of sonars have been revised to base a species' probability of an avoidance responses on the behavioral response function. Because the probability of behavioral response has decreased for the Mysticete behavioral group while the estimated susceptibility to auditory effects has increased (primarily for the LF hearing group), this analysis predicts more auditory impacts than the prior SURTASS analysis. In addition, the cut-off conditions for predicting significant behavioral responses have been revised as shown in Section 2.2.3 (Quantifying Behavioral Responses to

Sonars). These factors interact in complex ways that the results of this analysis challenging to compare to prior analyses.

2.4.1.1 Antarctic Minke Whale (*Balaenoptera bonaerensis*)

Antarctic minke whales (AMWs) are in the LF cetacean auditory group and the Mysticete behavioral group. Only one stock exists in the Study Area – a combination of those that are not managed under NMFS, classified as a "Worldwide" stock. Model-predicted impacts are presented in Table 2-7. They are an oceanic species occurring in waters beyond the continental shelf break.

AMWs range from the waters of the Southern Ocean in Antarctica (south of 60 °S) to the ice edge during austral summer. In the austral winter, some whales overwinter in Antarctic waters. They have been spotted as far north as northern Australia during the austral winter.

Without a population abundance, it is not possible to estimate the annual effects per individual to the Worldwide stock. There is no predicted risk of auditory injury. There is predicted risk of some temporary auditory effects. However, most of the impacts to AMWs would be behavioral responses. Most impacts would be behavioral responses in an open ocean basin that are unlikely to contribute to any long-term impacts on individuals.

The risk of repeated impacts on individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. AMWs are medium to large capital breeders with a slow pace of life. Migratory AMWs are likely to sustain fewer impacts during the cold season when their local abundance is lower. Although some impacts are likely to occur when AMWs are engaged in feeding behavior, they are expected to be resilient to short-term foraging disruptions due to their reliance on built-up energy reserves. Population trends for AMWs are unknown. This is a not a NMFS-managed species and, therefore, not endangered. Their slow pace of life means that long-term impacts on breeding adults could have a longer-term effect on population growth rates.

The limited instances of predicted behavioral, non-injurious auditory impacts are unlikely to result in any long-term impacts to individuals. Most predicted impacts are temporary auditory effects that are unlikely to contribute to any long-term impacts to individuals. Long-term consequences to the species are unlikely.

Table 2-7: Estimated Effects to Antarctic Minke Whale Stocks over a Maximum Year of Proposed Activities

Stock	*BEH*	*TTS*	*AINJ*	*Population Abundance*	*Annual Effects per Individual*	*Annual Injurious Effects per Individual*
Worldwide [Nsd]	4	44	-	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Asterisk (*) indicates no reliable abundance estimate is available.

2.4.1.2 Blue Whale (*Balaenoptera musculus*)*

Blue whales are in the VLF cetacean auditory group and the Mysticete behavioral group. The Central North Pacific (CNP) stock is found with the Study Area, as well as a combination of those that are not managed under NMFS, classified as a "Worldwide" stock. Blue whales are ESA-listed as endangered throughout their range with no designated DPSs. Model-predicted impacts are presented in Table 2-8. Blue whales are migratory and can occur near the coast, over the continental shelf, or in oceanic waters.

Blue whales occur in lower numbers in the central and western North Pacific than in the eastern North Pacific, but sightings have been reported in Hawaiian waters, in Kamchatka and the Kuril Islands, and in offshore Japan. The CNP stock of blue whales migrate from their feeding grounds in the Gulf of Alaska to Hawaii in winter. While they are found in the Hawaii region, they are not sighted frequently or year-round. Most impacts during the cold season (winter to spring) would occur in the eastern portion of the Study Area, around Hawaii. Whereas, in the rest of the Study Area, impacts are more likely to occur in the warm season.

On average, individuals in the CNP stock would be impacted less than once per year. Without a population abundance, it is not possible to estimate the annual effects per individual to the Worldwide stock. There is no predicted risk of auditory injury to the CNP stock. The risk of auditory injury in the Worldwide stock is low. The risk of auditory injury may be reduced through visual observation mitigation because blue whales are moderately sightable. Most impacts would be temporary auditory effects. Additionally, there would be some behavioral responses. Several instances of behavioral disturbance over a year are unlikely to have any long-term consequences for individuals.

The risk of repeated impacts on individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. Blue whales are large capital breeders with a slow pace of life. They are expected to be resilient to short-term foraging disruptions due to their reliance on built-up energy reserves. Population trends for blue whales are unknown. The species as a whole is endangered. Their slow pace of life means that long-term impacts to breeding adults could have a longer-term effect on population growth rates.

A case study examined long-term effects of changing environmental conditions and exposure to military sonar for Eastern North Pacific blue whales on the SOCAL Range Complex based on the description of sonar use in the previous action (2018 Hawaii-Southern California Training and Testing EIS/OEIS). According to the model, only a ten-fold increase in sonar activity combined with a shift in geographical location to overlap with main feeding areas of blue whales would result in a moderate decrease in lifetime reproductive success. Even in such extreme instances, there was still no effect on survival (Pirotta et al. 2022).

The limited instances of predicted behavioral, non-injurious auditory impacts are unlikely to result in any long-term impacts to individuals, although individuals who suffer an auditory injury may experience minor energetic costs. Most predicted impacts are temporary auditory effects that are unlikely to contribute to any long-term impacts to individuals. Long-term consequences to either of the stocks are unlikely.

The use of SURTASS LFA sound source during training activities <u>may affect, and are likely to adversely affect</u>, blue whales.

Table 2-8: Estimated Effects to Blue Whale Stocks over a Maximum Year of Proposed Activities

Stock	BEH	TTS	AINJ	Population Abundance[1]	Annual Effects per Individual	Annual Injurious Effects per Individual
Central North Pacific	(1)	12	-	133	0.10	0.00
Worldwide [Nsd]	1	1,061	3	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Values in parentheses are rounded up from less than 0.5 based on the 7-year rounding rules discussed in Section 2.4.
Asterisk (*) indicates no reliable abundance estimate is available.
[1] Population abundance values come from most recent NMFS Pacific Ocean Stock Assessment Reports (Carretta et al. 2023), where available.

2.4.1.3 Bryde's Whale (*Balaenoptera brydei/edeni*)

Bryde's whales are in the LF cetacean auditory group and the Mysticete behavioral group. Two stocks are in the Study Area – the Hawaii stock and a combination of those that are not managed under NMFS, classified as a "Worldwide" stock. Model-predicted impacts are presented in Table 2-9.

Little is known about the movements of Bryde's whales in the Study Area, but seasonal shifts in their distribution occur toward and away from the equator in winter and summer. Therefore, both stocks of Bryde's whales are at least somewhat migratory populations that travel within their tropical and subtropical ranges year-round. Bryde's whales found within the Study Area from the Worldwide stock are distributed in the subarctic-subtropical transition area—the frontal boundary where subarctic waters intersect the warmer waters of the Kuroshio Current—of the Western North Pacific Ocean throughout summer. Within the Hawaii stock, Bryde's whales are the only baleen whale found in Hawaiian waters year-round, and the only mysticete in Hawaii that does not undergo predictable north-south seasonal migrations. However, Bryde's whales occur mostly in offshore waters of the North Pacific. A population of Bryde's whales congregates near the Main Hawaiian Islands, and they occur there at a consistently lower density.

On average, individuals in the Hawaii stock would be impacted less than once per year. Without a population abundance, it is not possible to estimate the annual effects per individual to the Worldwide stock. There is no predicted risk of auditory injury to the Hawaii stock and the risk in the Worldwide stock is low. Most impacts to both stocks would be temporary auditory effects. Additionally, there is some potential risk of behavioral responses, especially for the Worldwide stock. Several instances of behavioral disturbance over a year are unlikely to have any long-term consequences for individuals.

The risk of repeated impacts on individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. Being large capital breeders, Bryde's whales have a slow pace of life and may be less susceptible to impacts from foraging disruption. Even somewhat migratory movement ecology combined with the overall low number of predicted impacts for this stock means the risk of consequences to any individual is low. Long-term consequences to either stock is unlikely.

The limited instances of predicted behavioral or temporary auditory impacts are unlikely to result in any long-term impacts to individuals, although individuals who suffer an auditory injury may experience minor energetic costs. Most predicted impacts are temporary auditory effects that are unlikely to contribute to any long-term impacts to individuals. Long-term consequences to either of the stocks are unlikely.

Table 2-9: Estimated Effects to Bryde's Whale Stocks over a Maximum Year of Proposed Activities

Stock	*BEH*	*TTS*	*AINJ*	*Population Abundance[1]*	*Annual Effects per Individual*	*Annual Injurious Effects per Individual*
Hawaii	1	6	-	791	0.01	0.00
Worldwide [Nsd]	17	799	1	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Asterisk (*) indicates no reliable abundance estimate is available.
[1] Population abundance values come from most recent NMFS Pacific Ocean Stock Assessment Reports (Carretta et al. 2023), where available.

2.4.1.4 Fin Whale (*Balaenoptera physalus*)*

Fin whales are in the VLF cetacean auditory group and the Mysticete behavioral group. Two stocks are in the Study Area – the Hawaiian stock and a combination of those that are not managed under NMFS, classified as a “Worldwide” stock. Fin whales are ESA-listed as endangered throughout their range with no designated DPSs. Model-predicted impacts are presented in Table 2-10.

Fin whales are generally found in higher densities farther offshore in the summer and fall, and closer to shore in winter and spring. They have higher abundances in temperate and polar waters and are not frequently seen in warm tropical waters. While fin whales are found in Hawaii, they are not sighted frequently or year-round. The Hawaii stock only migrates to this area during fall and winter, which is when they are most likely to experience impacts in this region. Because fewer fin whales are present in this region, there are comparatively fewer impacts to this stock.

On average, individuals in the Hawaii stock would be impacted less than once per year. Without a population abundance, it is not possible to estimate the annual effects per individual to the Worldwide stock. There is no predicted risk of auditory injury to the Hawaii stock. There is potential risk of auditory injury to the Worldwide stock. Most impacts to both stocks would be temporary auditory effects. The risk of these impacts may be reduced through visual observation mitigation. There are some impacts to behavioral responses from the Worldwide stock, however these impacts over a year are unlikely to have any long-term consequences for individuals.

The risk of repeated impacts on individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. Fin whales are large capital breeders with a slow pace of life. They are expected to be resilient to short-term foraging disruptions due to their reliance on built-up energy reserves. Population trends for fin whales are unknown, however, the species is endangered. Their slow pace of life means that long-term impacts to breeding adults could have a longer-term effect on population growth rates.

The limited instances of predicted behavioral and non-injurious auditory impacts are unlikely to result in any long-term impacts to individuals, although individuals who suffer an auditory injury may experience minor energetic costs. Most predicted impacts are temporary auditory effects that are unlikely to contribute to any long-term impacts to individuals. Long-term consequences to the stocks of fin whales are unlikely.

The use of SURTASS LFA sound source during training activities may affect, and are likely to adversely affect, fin whales.

Table 2-10: Estimated Effects to Fin Whale Stocks over a Maximum Year of Proposed Activities

Stock	*BEH*	*TTS*	*AINJ*	*Population Abundance[1]*	*Annual Effects per Individual*	*Annual Injurious Effects per Individual*
Hawaii	0	16	-	203	0.08	0.00
Worldwide [Nsd]	2	5,736	32	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Asterisk (*) indicates no reliable abundance estimate is available.
[1] Population abundance values come from most recent NMFS Pacific Ocean Stock Assessment Reports (Carretta et al. 2023), where available.

2.4.1.5 Humpback Whale (*Megaptera novaeangliae*)*

Humpback whales are in the LF cetacean auditory group and the Mysticete behavioral group. Three stocks are in the Study Area – the Western North Pacific (WNP) stock (WNP DPS – ESA-listed); the CNP stock (Hawaii DPS – not ESA-listed); and a combination of those that are not managed under NMFS, classified as a "Worldwide" stock (not ESA-listed). Humpbacks occur in neritic and pelagic waters, with neritic occurrences happening on foraging grounds in the summer and in waters close to islands and reef systems in the winter. They occupy cold, high latitude waters in the spring to feed, and then in winter, they move to warmer, low latitude waters to calve and breed.

2.4.1.5.1 ESA-listed Humpback Whales (Western North Pacific Stock and DPS)*

Model-predicted impacts for the ESA-listed WNP stock and DPS are presented in Table 2-11. The WNP Stock and DPS winter off Japan and migrate to the Bering Sea and Aleutian Islands in the summer and fall. They also mix with humpback whales from the CNP stock in the central Gulf of Alaska.

Without a population abundance, it is not possible to estimate the annual effects per individual to the WNP stock. Impacts to WNP humpbacks are most likely to occur in cold months off the northeastern and eastern coasts of Japan. There is a risk of auditory injury to some individuals. The risk of auditory injury may be reduced through visual observation mitigation because humpback whales are moderately sightable. The majority of impacts would be from temporary auditory effects. Additionally, there would be some impacts resulting in behavioral responses. Several instances of behavioral disturbance over a year are unlikely to have any long-term consequences for individuals.

The risk of repeated exposures to individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. Humpback whales are large capital breeders with a slow pace of life. Although some impacts are likely to occur when humpbacks are engaged in feeding behavior, they are expected to be resilient to short-term foraging disruptions due to their reliance on built-up energy reserves. Although the WNP stock and DPS population trend is unknown, they are endangered. Humpback whales' slow pace of life means that long-term impacts to breeding adults could have a longer-term effect on population growth rates.

The instances of predicted behavioral and non-injurious auditory impacts are unlikely to result in any long-term impacts to individuals, although individuals who suffer an auditory injury may experience minor energetic costs. Most predicted impacts are temporary auditory effects that are unlikely to contribute to any long-term impacts to individuals. Long-term consequences to the stock are unlikely.

The use of SURTASS LFA sound source during training activities may affect, and are likely to adversely affect, the WNP stock (WNP DPS) of humpback whales.

Table 2-11: Estimated Effects to ESA-listed Humpback Whale Stocks over a Maximum Year of Proposed Activities

Stock	*BEH*	*TTS*	*AINJ*	*Population Abundance*	*Annual Effects per Individual*	*Annual Injurious Effects per Individual*
WNP Stock/DPS	5	1,128	4	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Asterisk (*) indicates no reliable abundance estimate is available.

2.4.1.5.2 Non-ESA-listed Humpback Whales (Central North Pacific Stock and Hawaii DPS; Worldwide Stock)

Model-predicted impacts for non-ESA listed humpback whales are presented in Table 2-12. The CNP stock (also known as the Hawaii DPS) of humpback whales have particularly strong site fidelity on the Hawaii breeding grounds from February to March, although they may be present December through June. Since humpback whales are found in Hawaii seasonally, most impacts would only occur during the cold season. Outside of the WNP and CNP stock, the remaining Worldwide stock is found predominantly in the Southern Hemisphere, off the west coast of Australia in the warm season.

Without a population abundance, it is not possible to estimate the annual effects per individual for either stock. There are no auditory injuries predicted for either stock. There are very limited temporary auditory effects and limited behavioral responses predicted. Several instances of behavioral disturbance over a year are unlikely to have any long-term consequences for individuals.

The risk of repeated exposures to individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. Humpback whales are large capital breeders with a slow pace of life. Although some impacts are likely to occur when humpbacks are engaged in feeding behavior, they are expected to be resilient to short-term foraging disruptions due to their reliance on built-up energy reserves. The Hawaii and Worldwide stocks of humpback whales are not endangered, but they have unknown population trends. Humpback whales' slow pace of life means that long-term impacts to breeding adults could have a longer-term effect on population growth rates.

The limited instances of predicted behavioral and non-injurious auditory impacts are unlikely to result in any long-term impacts to individuals. Most predicted impacts are temporary auditory effects that are unlikely to contribute to any long-term impacts to individuals. Long-term consequences to either of the stocks are unlikely.

Table 2-12: Estimated Effects to Non-ESA Listed Humpback Whale Stocks over a Maximum Year of Proposed Activities

Stock	*BEH*	*TTS*	*AINJ*	*Population Abundance*	*Annual Effects per Individual*	*Annual Injurious Effects per Individual*
CNP Stock/HI DPS	2	11	-	*	*	*
Worldwide Nsd	(1)	2	-	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Values in parentheses are rounded up from less than 0.5 based on the 7-year rounding rules discussed in Section 2.4.
Asterisk (*) indicates no reliable abundance estimate is available.

2.4.1.6 Minke Whale (*Balaenoptera acutorostrata*)

Minke whales are in the LF cetacean auditory group and the Mysticete behavioral group. Two stocks are in the Study Area – the Hawaii stock and a combination of those that are not managed under NMFS, classified as a “Worldwide” stock. Model-predicted impacts are presented in Table 2-13.

The Hawaii stock generally congregates in Hawaiian waters in the colder months (fall to spring). The Worldwide stock generally occurs mostly in tropical to polar coastal/neritic and inshore waters, as well as more infrequently in pelagic waters. Although migration pathways are not well known, they generally move to higher latitudes to feed in the summer and return to lower latitudes to breed and calve in the winter.

On average, individuals in the Hawaii stock would be impacted less than once per year. Without a population abundance, it is not possible to estimate the annual effects per individual to the Worldwide stock. There is no predicted risk of auditory injury to the Hawaii stock. The risk of auditory injury in the Worldwide stock is low. The risk of auditory injury may be reduced through visual observation mitigation, although minke whales have a relatively low sightability. In the Hawaii and Worldwide stocks most impacts are from temporary auditory effects. For behavioral responses, there are almost no impacts to the Hawaii stock, but several impacts to the Worldwide stock. Several instances of behavioral disturbance over a year are unlikely to have any long-term consequences for individuals.

The risk of repeated exposures to individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. Although they are the smallest mysticete, minke whales are large capital breeders with a slow pace of life. Migratory minke whales in both stocks are likely to sustain fewer impacts during the warm season when their abundances are lower throughout. Although some impacts are likely to occur when minke whales are engaged in feeding behavior, they are expected to be resilient to short-term foraging disruptions due to their reliance on built-up energy reserves. While population trends for minke whales are unknown, both stocks of minke whales are not endangered. Their slow pace of life means that long-term impacts to breeding adults could have a longer-term effect on population growth rates.

The limited instances of predicted behavioral and non-injurious auditory impacts are unlikely to result in any long-term impacts to individuals, although individuals who suffer an auditory injury may experience minor energetic costs. Most predicted impacts are temporary auditory effects that are unlikely to contribute to any long-term impacts to individuals. Long-term consequences to the stock are unlikely.

Table 2-13: Estimated Effects to Minke Whale Stocks over a Maximum Year of Proposed Activities

Stock	*BEH*	*TTS*	*AINJ*	*Population Abundance*[1]	*Annual Effects per Individual*	*Annual Injurious Effects per Individual*
Hawaii	(1)	2	-	438	0.01	0.00
Worldwide [Nsd]	53	2,967	6	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Values in parentheses are rounded up from less than 0.5 based on the 7-year rounding rules discussed in Section 2.4.
Asterisk (*) indicates no reliable abundance estimate is available.
[1] Population abundance values come from most recent NMFS Pacific Ocean Stock Assessment Reports (Carretta et al. 2023), where available.

2.4.1.7 North Pacific Right Whale (*Eubalaena japonica*)*

North Pacific right whales are in the VLF cetacean auditory group and the Mysticete behavioral group. Only one stock exists in the Study Area –a combination of those that are not managed under NMFS, classified as a “Worldwide” stock. North Pacific right whales are ESA-listed as endangered throughout their range with no designated DPSs. Model-predicted impacts are presented in Table 2-14.

Little is known about the movements of North Pacific right whales in the Study Area, but it is thought the whales spend the summer in far northern feeding grounds and migrate south to warmer waters. Therefore, North Pacific whales are at least somewhat migratory as they travel throughout the Study Area. They regularly occur in the Sea of Okhotsk and the southeastern Bering Sea, with rare occurrences documented in the waters of the Gulf of Alaska, the Sea of Japan (off the Republic of Korea), and North Pacific waters.

Without a population abundance, it is not possible to estimate the annual effects per individual to the Worldwide stock. There is a small risk of auditory injury to some individuals, however this may be reduced through visual observation mitigation. Most impacts are temporary auditory effects. No behavioral responses are expected. Long-term consequences from any of these effects are unlikely.

Consequences to individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. Being large capital breeders, North Pacific right whales have a slow pace of life and may be less susceptible to impacts from foraging disruption. Population trends are unknown; however, the species as a whole is endangered. Their slow pace of life means that long-term impacts to breeding adults could have a longer-term effect on population growth rates.

The instances of predicted non-injurious auditory impacts are unlikely to result in any long-term impacts to individuals, although individuals who suffer an auditory injury may experience minor energetic costs. Most predicted impacts are temporary auditory effects that are unlikely to contribute to any long-term impacts to individuals. Long-term consequences to the stock are unlikely.

The use of SURTASS LFA sound source during training activities may affect, and are likely to adversely affect, North Pacific right whales.

Table 2-14: Estimated Effects to North Pacific Right Whale Stocks over a Maximum Year of Proposed Activities

Stock	BEH	TTS	AINJ	Population Abundance	Annual Effects per Individual	Annual Injurious Effects per Individual
Worldwide ^{Nsd}	0	325	2	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Asterisk (*) indicates no reliable abundance estimate is available.

2.4.1.8 Omura's Whale (*Balaenoptera omurai*)

Omura's whales are in the LF cetacean auditory group and the Mysticete behavioral group. Only one stock exists in the Study Area –a combination of those that are not managed under NMFS, classified as a "Worldwide" stock. Model-predicted impacts are presented in Table 2-15.

Little is known about the movements of Omura's whales in the Study Area, but seasonal shifts in their distribution occur toward and away from the equator in winter and summer. Omura's whales are often observed in coastal and neritic waters, but these whales have also been observed in deep waters off the shelf. They primarily inhabit warm-temperate and tropical locations in the western Pacific. The majority of impacts to Omura's whales throughout the Study Area occur during the cold season.

Without a population abundance, it is not possible to estimate the annual effects per individual to the Worldwide stock. There is no predicted risk of non-auditory injury. The predicted risk of auditory injury is low. Most impacts are temporary auditory effects. Little behavioral responses are expected. Long-term consequences are unlikely.

Consequences to individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. Being large capital breeders, Omura's whales have a slow pace of life and may be less susceptible to impacts from foraging disruption. Even somewhat migratory movement ecology combined with the overall low number of predicted impacts for this stock means the risk of consequences to any individual is low.

The instances of predicted non-injurious auditory impacts are unlikely to result in any long-term impacts to individuals, although individuals who suffer an auditory injury may experience minor energetic costs. Most predicted impacts are temporary auditory effects that are unlikely to contribute to any long-term impacts to individuals. Long-term consequences to the stocks are unlikely.

Table 2-15: Estimated Effects to Omura's Whale Stocks over a Maximum Year of Proposed Activities

Stock	BEH	TTS	AINJ	Population Abundance	Annual Effects per Individual	Annual Injurious Effects per Individual
Worldwide ^{Nsd}	1	216	1	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Asterisk (*) indicates no reliable abundance estimate is available.

2.4.1.9 Sei Whale (*Balaenoptera borealis*)*

Sei whales are in the LF cetacean auditory group and the Mysticete behavioral group. Two stocks are in the Study Area – the Hawaii stock and a combination of those that are not managed under NMFS, classified as a "Worldwide" stock. Sei whales are listed as endangered throughout their range with no designated DPSs. Model-predicted impacts are presented in Table 2-16.

Sei whales generally have higher abundances in the cold deep waters of the open ocean. The Hawaii stock of sei whales is migratory, traveling from their cold subpolar latitudes to Hawaii in the winter. While they are not frequently detected in Hawaii, they are more likely to be in the area in the cold season. The Worldwide stock has some seasonal migrations that are less extensive compared to other mysticetes. This stock of sei whales is most frequently found in the offshore waters of the far eastern portion of the Study Area, near Japan and Guam.

On average, individuals from the Hawaii stock would be impacted less than once per year. Without a population abundance, it is not possible to estimate the annual effects per individual to the Worldwide stock. While minimal, there is risk of auditory injury to both stocks. The majority of impacts to both stocks are temporary auditory effects. The risk of these impacts may be reduced through visual observation mitigation. There are a few behavioral response impacts to both stocks, however these impacts over a year are unlikely to have any long-term consequences for individuals.

The risk of repeated impacts on individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. Sei whales are large capital breeders with a slow pace of life. Migratory sei whales in the Worldwide stock are likely to sustain fewer impacts during the warm season when their abundance in the western portion of the Study Area is lower, whereas impacts to the Hawaii stock are more likely to occur year-round. Sei whales are expected to be resilient to short-term foraging disruptions due to their reliance on built-up energy reserves. Population trends for sei whales are unknown; however, both stocks are endangered. Their slow pace of life means that long-term impacts to breeding adults could have a longer-term effect on population growth rates.

Limited instances of predicted behavioral and non-injurious auditory impacts are unlikely to result in any long-term impacts to individuals, although individuals who suffer an auditory injury may experience minor energetic costs. Most predicted impacts are temporary auditory effects that are unlikely to contribute to any long-term impacts to individuals. Long-term consequences to the stocks of sei whales are unlikely.

The use of SURTASS LFA sound source during training activities <u>may affect, and are likely to adversely affect</u>, sei whales.

Table 2-16: Estimated Effects to Sei Whale Stocks over a Maximum Year of Proposed Activities

Stock	BEH	TTS	AINJ	Population Abundance[1]	Annual Effects per Individual	Annual Injurious Effects per Individual
Hawaii	(1)	4	1	391	0.02	0.00
Worldwide [Nsd]	5	2,016	9	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Values in parentheses are rounded up from less than 0.5 based on the 7-year rounding rules discussed in Section 2.4.
Asterisk (*) indicates no reliable abundance estimate is available.
[1] Population abundance values come from most recent NMFS Pacific Ocean Stock Assessment Reports (Carretta et al. 2023), where available.

2.4.2 Impacts on Odontocetes

The odontocetes are divided into the HF and VHF cetacean hearing groups. The updated HF cetacean criteria reflect greater susceptibility to auditory effects at low-frequencies than previously analyzed. Consequently, the predicted auditory effects due to sources under 10 kHz, including SURTASS LFA sonar systems, are substantially higher for this auditory group than in prior analyses of the same activities. For VHF cetaceans, susceptibility to auditory effects has not changed substantially since the prior analysis. However, differences between NAEMO and AIM, the model used in previous analyses, have generally led to a decrease estimated takes of odontocetes.

The methods to model sonar avoidance have also been revised to base a species' probability of an avoidance responses on the behavioral response functions as described in 2.2.2 (Quantifying Impacts on Hearing). The combined behavioral response function for Sensitive Species replaces the two prior distinct behavioral response functions for beaked whales and porpoises. Due to their greater susceptibility to disturbance, HF and VHF cetaceans in the Sensitive behavioral group are predicted to avoid many auditory injuries. All other odontocetes remain in the Odontocete behavioral group, including VHF cetaceans that are not behaviorally sensitive (e.g., Dall's porpoise and Kogia whales). Because the probability of behavioral response has decreased for the Odontocete behavioral group while the estimated susceptibility to behavioral responses has increased for the HF hearing group (including the VHF hearing group, which was formerly included in the HF hearing group in the 2019 Final SEIS/SOEIS), this analysis predicts more behavioral impacts than the prior analysis for these species.

2.4.2.1 Baird's Beaked Whale (*Berardius bairdii)*

Baird's beaked whales are in the HF cetacean auditory group and the Sensitive behavioral group. Only one stock exists in the Study Area –a combination of those that are not managed under NMFS, classified as a "Worldwide" stock. Model-predicted impacts are presented in Table 2-17.

Baird's beaked whales occur in the North Pacific and are typically found in deep waters over the continental slope, near oceanic seamounts, and in areas with submarine escarpments, although they may be seen close to shore where deep water approaches the coast. The lack of quantitative seasonal information on this species resulted in these density estimates being applied year-round.

Without a population abundance, it is not possible to estimate the annual effects per individual to the Worldwide stock. There is no predicted risk of auditory injury or temporary auditory effects to Baird's beaked whales. Most impacts are behavioral responses because beaked whales are in the Sensitive behavioral group and are likely to avoid noise sources.

The risk of repeated impacts to individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. While beaked whales are mixed breeders (i.e., behaviorally income breeders), they demonstrate capital breeding strategies during gestation and lactation (Keen et al. 2021), so they may be more vulnerable to prolonged loss of foraging opportunities during gestation. However, as large odontocetes with a slow pace of life, Baird's beaked whales are more resilient to missed foraging opportunities due to acoustic disturbance compared to other beaked whale species. Because Baird's beaked whales have a nomadic-resident movement ecology, the risk of repeated impacts to individuals is likely similar within the population as animals move throughout their range. However, since this species has longer generation times, this population would require more time to recover if significantly impacted.

Several instances of behavioral disturbance over a year are unlikely to have any long-term consequences for individuals. Based on the above analysis, long-term consequences for Baird's beaked whales are unlikely. Most predicted impacts are behavioral responses in an open ocean basin that are unlikely to contribute to any long-term impacts to individuals. Long-term consequences to these stocks are unlikely.

Table 2-17: Estimated Effects to Baird's Beaked Whales Stocks over a Maximum Year of Proposed Activities

Stock	*BEH*	*TTS*	*AINJ*	*Population Abundance*	*Annual Effects per Individual*	*Annual Injurious Effects per Individual*
Worldwide [Nsd]	64,875	0	-	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Asterisk (*) indicates no reliable abundance estimate is available.

2.4.2.2 Blainville's Beaked Whale (*Mesoplodon densirostris*)

Blainville's beaked whales are in the HF cetacean auditory group and the Sensitive behavioral group. Two Blainville's beaked whale stocks are found within the Study Area – the Hawaii stock and a combination of those that are not managed under NMFS, classified as a "Worldwide" stock. Model-predicted impacts to both stocks are presented in Table 2-18.

Blainville's beaked whales are cosmopolitan and can be found in the Pacific and Indian Oceans in warm temperate and tropical waters. Additionally, in regions where long-term tagging and photo-ID studies occur, it is believed that Blainville's beaked whales exhibit strong site fidelity, with limited migrations and movements (Baird 2019; Claridge 2013; Joyce et al. 2020; Reyes Suárez 2018).

On average, individuals in the Hawaii stock of Blainville's beaked whales could be impacted a couple of times per year. Without a population abundance, it is not possible to estimate the annual effects per individual to the Worldwide stock. There is no predicted risk of auditory injury or temporary auditory effects to Blainville's beaked whales. Most impacts are behavioral responses because beaked whales are in the Sensitive behavioral group and are likely to avoid noise sources.

The risk of repeated impacts to individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. As medium-sized odontocetes with a medium pace of life, Blainville's beaked whales are likely moderately resilient to missed foraging opportunities due to acoustic disturbance. While beaked whales are mixed breeders (i.e., behaviorally income breeders), they demonstrate capital breeding strategies during gestation and lactation (Keen et al. 2021), so they may be more vulnerable to prolonged loss of foraging opportunities during gestation.

Because Blainville's beaked whales have a nomadic-resident movement ecology, the risk of repeated impacts to individuals is likely similar within the population as animals move throughout their range. However, since this species has longer generation times, this population would require more time to recover if significantly impacted.

Limited instances of behavioral disturbance over a year are unlikely to have any long-term consequences for individuals. Based on the above analysis, long-term consequences for the Hawaii and Worldwide stocks of Blainville's beaked whales are unlikely.

Table 2-18: Estimated Effects to Blainville's Beaked Whales Stocks over a Maximum Year of Proposed Activities

Stock	*BEH*	*TTS*	*AINJ*	*Population Abundance[1]*	*Annual Effects per Individual*	*Annual Injurious Effects per Individual*
Hawaii	2,073	-	-	1,132	1.83	0.00
Worldwide [Nsd]	61,964	-	-	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Asterisk (*) indicates no reliable abundance estimate is available.
[1] Population abundance values come from most recent NMFS Pacific Ocean Stock Assessment Reports (Carretta et al. 2023), where available.

2.4.2.3 Common Bottlenose Dolphin (*Tursiops truncatus*)

Bottlenose dolphins are in the HF cetacean auditory group and the Odontocete behavioral group. There are five NMFS-managed stocks in the Study Area – the Hawaii Pelagic stock, the Kauai Niihau stock, the Oahu stock, the 4-Islands stock, and the Hawaii Island stock – and a combination of those that are not managed under NMFS, classified as a "Worldwide" stock. Model-predicted impacts are presented in Table 2-19.

Bottlenose dolphins occur in coastal and continental shelf waters of tropical and temperate regions of the Pacific Ocean. Five common bottlenose dolphin stocks occur in both shallow coastal waters and deep offshore waters throughout the Hawaiian Islands, especially throughout the main islands and from the Island of Hawaii to Kure Atoll. The Hawaii Pelagic stock of bottlenose dolphins is residential to the warm tropical waters around Hawaii. However, this stock has the largest range out of the other NMFS-managed bottlenose dolphin stocks in the Hawaii portion of the Study Area. It is the only NMFS-managed stock that has any estimated takes associated with the Proposed Action.

Individuals in the Hawaii Pelagic stock could be impacted less than once per year, and impacts would likely be behavioral in nature. Without a population abundance, it is not possible to estimate the annual effects per individual to the Worldwide stock. There would be no predicted risk of auditory injury and only a few occurrences of temporary auditory effects to either of the stocks. The risk of impacts may be reduced through visual observation mitigation, as bottlenose dolphins are relatively sightable. Most impacts to both stocks would be from behavioral responses.

The risk of repeated exposures to individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. Bottlenose dolphins are income breeders with a small-medium body size and a medium pace of life, suggesting they are moderately resilient to foraging disruption due to acoustic disturbance, except for during lactation. Because these stocks are nomadic, the risk of repeated exposures to individuals is likely similar within these populations as animals move throughout their range. Risk of impacts would also be similar across seasons and critical life functions. Bottlenose dolphins generally have unknown population trends. Since this species has longer generation times, they would require more time to recover if significantly impacted.

Limited instances of predicted behavioral and non-injurious auditory impacts are unlikely to result in any long-term consequences for individuals. Most predicted impacts are temporary auditory effects that are unlikely to contribute to any long-term impacts to individuals. Because bottlenose dolphins are resilient to limited instances of disturbance, long-term consequences are unlikely for any stock in the Study Area.

Table 2-19: Estimated Effects to Bottlenose Dolphins Stocks over a Maximum Year of Proposed Activities

Stock	*BEH*	*TTS*	*AINJ*	*Population Abundance*[1]	*Annual Effects per Individual*	*Annual Injurious Effects per Individual*
Hawaii Pelagic	31	(1)	-	24,669	0.00	0.00
Worldwide [Nsd]	1,897	4	-	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Values in parentheses are rounded up from less than 0.5 based on the 7-year rounding rules discussed in Section 2.4.
Asterisk (*) indicates no reliable abundance estimate is available.
[1] Population abundance values come from most recent NMFS Pacific Ocean Stock Assessment Reports (Carretta et al. 2023), where available.

2.4.2.4 Common Dolphin (*Delphinus delphis*)

Common dolphins are in the HF cetacean auditory group and the Odontocete behavioral group. Only one stock exists in the Study Area –a combination of those that are not managed under NMFS, classified as a “Worldwide” stock. Model predicted impacts are presented in Table 2-20. The SMM (2023) has resolved and revised the complex taxonomy of the common dolphin, which had formerly been divided into the short-beaked common dolphin and the long-beaked common dolphin. Although the Indo-Pacific common dolphin is retained as a subspecies, the SMM no longer distinguishes between the two, short-beaked and long-beaked, subspecies of common dolphins; both species are now simply the common dolphin. NMFS still distinguishes between the two species.

Common dolphins are widely distributed worldwide in temperate, tropical, and subtropical oceans, primarily in neritic waters of the continental shelf and steep bank regions where upwelling occurs. These dolphins seem to be most common in the coastal waters of the Pacific Ocean, often occurring within 180 km of land (Jefferson et al. 2015).

Without a population abundance, it is not possible to estimate the annual effects per individual to the Worldwide stock. There are no auditory injuries are predicted. There is less than one instance of temporary auditory impacts predicted. The majority of impacts to common dolphins would be behavioral responses.

The risk of repeated exposures to individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. As income breeders with a small body and a medium pace of life, common dolphins have some resilience to missed foraging opportunities due to acoustic disturbance, except for during lactation. Because they are nomadic, the risk of repeated exposures to individuals is likely similar within the population as animals move throughout their range. Risk of impacts would also be similar across seasons and critical life functions.

Due to this species' longer generation times, this population would require more time to recover if significantly impacted.

A few instances of predicted behavioral disturbance and temporary auditory effects are unlikely to result in any long-term impacts on individuals. Long-term consequences to the stock are unlikely.

Table 2-20: Estimated Effects to Common Dolphins Stocks over a Maximum Year of Proposed Activities

Stock	*BEH*	*TTS*	*AINJ*	*Population Abundance*	*Annual Effects per Individual*	*Annual Injurious Effects per Individual*
Worldwide Nsd	1,712	(1)	-	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Values in parentheses are rounded up from less than 0.5 based on the 7-year rounding rules discussed in Section 2.4.
Asterisk (*) indicates no reliable abundance estimate is available.

2.4.2.5 Dall's Porpoise (*Phocoenoides dalli*)

Dall's porpoises are in the VHF cetacean auditory group and the Odontocete behavioral group. Two distinct subspecies are currently recognized: *P.d. dalli* and *P.d. truei*; both subspecies are found in the Study Area. Only one stock exists in the Study Area –a combination of those that are not managed under NMFS, classified as a "Worldwide" stock. Model-predicted impacts are presented in Table 2-21.

Dall's porpoises can be found in the North Pacific Ocean and adjacent seas, including the Gulf of Alaska, Bering Sea, Okhotsk Sea, and Sea of Japan. They shift their distribution southward during cooler-water periods on both interannual and seasonal time scales. They primarily congregate in shelf and slope waters and decrease substantially in warmer waters.

Without a population abundance, it is not possible to estimate the annual effects per individual to the Worldwide stock. As VHF cetaceans, Dall's porpoises are more susceptible to auditory impacts in mid- to high frequencies than other species. Therefore, no auditory injuries are predicted for this LF sound source. There is less than one instance of temporary auditory impacts predicted. The majority of impacts to Dall's porpoises would be behavioral responses.

The risk of repeated exposures to individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. As small odontocetes and income breeders with a fast pace of life, Dall's porpoises are less resilient to missed foraging opportunities than larger odontocetes. Because Dall's porpoises are nomadic, the risk of repeated exposures to individuals is likely similar within the population as animals move throughout their range. Risk of impacts would also be similar across seasons and critical life functions. Although reproduction in populations with a fast pace of life are more sensitive to foraging disruption, these populations are quick to recover. However, population trends and status of Dall's porpoise are unknown.

Severa instances of behavioral disturbance over a year are unlikely to have any long-term consequences for individuals. Based on the above analysis, long-term consequences for Dall's porpoises are unlikely.

Table 2-21: Estimated Effects to Dall's Porpoise Stocks over a Maximum Year of Proposed Activities

Stock	*BEH*	*TTS*	*AINJ*	*Population Abundance*	*Annual Effects per Individual*	*Annual Injurious Effects per Individual*
Worldwide Nsd	3,019	(1)	-	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Values in parentheses are rounded up from less than 0.5 based on the 7-year rounding rules discussed in Section 2.4.
Asterisk (*) indicates no reliable abundance estimate is available.

2.4.2.6 Deraniyagala Beaked Whale (*Mesoplodon hotaula*)

Deraniyagala beaked whales dolphins are in the HF cetacean auditory group and the Sensitive behavioral group. Only one stock exists in the Study Area –a combination of those that are not managed under NMFS, classified as a "Worldwide" stock. Model-predicted impacts are presented in Table 2-22. Deraniyagala beaked whale are a part of the *Mesoplodon* genus. Most *Mesoplodon* spp. are not well known due to difficulty in identifying individual species at-sea; therefore, most information presented about their behavior has been documented to genus level only.

Most *Mesoplodon* species have a wide distribution and are not residential to any location within the Study Area. *Mesoplodon* beaked whales are distributed in all of the world's oceans in deep (greater than 200 m) pelagic waters and are occasionally sighted in waters over the continental shelf. Deraniyagala beaked whale ranges throughout the tropical waters of the equatorial Indo-Pacific.

Without a population abundance, it is not possible to estimate the annual effects per individual to the Worldwide stock. There is no predicted risk of auditory injury or temporary auditory effects to Deraniyagala beaked whales. Most impacts would be behavioral responses because beaked whales are in the Sensitive behavioral group and are likely to avoid noise sources.

The risk of repeated impacts on individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. As medium-sized odontocetes with a medium pace of life, Deraniyagala beaked whales are likely moderately resilient to missed foraging opportunities due to acoustic disturbance. While beaked whales are mixed breeders (i.e., behaviorally income breeders), they demonstrate capital breeding strategies during gestation and lactation (Keen et al. 2021), so they may be more vulnerable to prolonged loss of foraging opportunities during gestation. Because Mesoplodont beaked whales have a nomadic movement ecology, the risk of repeated impacts on individuals is likely similar within the population as animals move throughout their range.

Several instances of predicted behavioral disturbance over a year are unlikely to result in any long-term impacts on individuals. Based on the above analysis, long-term consequences for Deraniyagala beaked whales are unlikely.

Table 2-22: Estimated Effects to Deraniyagala Beaked Whale Stocks over a Maximum Year of Proposed Activities

Stock	*BEH*	*TTS*	*AINJ*	*Population Abundance*	*Annual Effects per Individual*	*Annual Injurious Effects per Individual*
Worldwide Nsd	9,448	-	-	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Asterisk (*) indicates no reliable abundance estimate is available.

2.4.2.7 Dwarf and Pygmy Sperm Whale (*Kogia sima* and *Kogia breviceps*)

Dwarf and pygmy sperm whales are analyzed together, as these species are difficult to distinguish during at-sea surveys and as a result are frequently classified together as Kogia species. Kogia species are in the VHF cetacean auditory group and the Odontocete behavioral group. One NMFS-managed stock occurs in the Study Area –the Hawaii stock – and a combination of those that are not managed under NMFS, classified as a “Worldwide” stock. Model-predicted impacts are presented in Table 2-23 for dwarf sperm whales, and Table 2-24 for pygmy sperm whales.

Dwarf and pygmy sperm whales are distributed worldwide, primarily in temperate to tropical deep waters, and they are especially common in waters along continental shelf breaks. Dwarf sperm whales appear to prefer tropical waters more than pygmy sperm whales, which are rarely reported. This may contribute to the higher impacts to dwarf sperm whales rather than pygmy sperm whales in Hawaii.

Little evidence for seasonal movements exists in either species. Kogia density values for the Study Area are presented differently for the Hawaii and the Worldwide stocks. In Hawaii there is enough data on dwarf and pygmy sperm whales to provide density estimates for each species separately, but fewer live sightings have occurred elsewhere, so density values are provided for Kogia as a genus. Additionally, density data are insufficient to identify any seasonal patterns in the distribution of Kogia, so these estimates are considered to represent year-round densities.

On average, individuals in the Hawaii stock of dwarf sperm whales could be impacted less than once per year. Without a population abundance, it is not possible to estimate the annual effects per individual to either of the Worldwide stocks or to the Hawaii stock of pygmy sperm whales. No auditory injuries are predicted for any of the Kogia species’ stocks. There is a very slight chance of temporary auditory effects for both stocks of the pygmy sperm whale and the worldwide stock of the dwarf sperm whale. The majority of responses for all Kogia species’ stocks are behavioral responses. The risk of impacts may be reduced through visual observation mitigation, although Kogia are cryptic and have low sightability.

The risk of repeated exposures to individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. As small-medium odontocetes that are income breeders with a fast pace of life, dwarf and pygmy sperm whales are likely less resilient to missed foraging opportunities, especially during lactation. Little is known about the movement ecology of these stocks, other than a small resident population of dwarf sperm whales off the west coast of the Island of Hawaii, which will likely increase the risk of repeated impacts on individual dwarf sperm whales in that portion of the Study Area. Although reproduction in populations with a fast pace of life are more sensitive to foraging disruption, these populations would be quick to recover.

The limited instances of predicted behavioral responses and temporary auditory effects are unlikely to result in any long-term impacts to individuals. Most predicted impacts would be behavioral responses that are unlikely to contribute to any long-term impacts to individuals. Long-term consequences to either of the Kogia spp. stocks are unlikely.

Table 2-23: Estimated Effects to Dwarf Sperm Whale Stocks over a Maximum Year of Proposed Activities

Stock	*BEH*	*TTS*	*AINJ*	*Population Abundance*	*Annual Effects per Individual*	*Annual Injurious Effects per Individual*
Hawaii	151	-	-	*	*	*
Worldwide Nsd	718	(1)	-	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Values in parentheses are rounded up from less than 0.5 based on the 7-year rounding rules discussed in Section 2.4.
Asterisk (*) indicates no reliable abundance estimate is available.

Table 2-24: Estimated Effects to Pygmy Sperm Whale Stocks over a Maximum Year of Proposed Activities

Stock	*BEH*	*TTS*	*AINJ*	*Population Abundance[1]*	*Annual Effects per Individual*	*Annual Injurious Effects per Individual*
Hawaii	151	(1)	-	42,083	0.00	0.00
Worldwide Nsd	863	(1)	-	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Values in parentheses are rounded up from less than 0.5 based on the 7-year rounding rules discussed in Section 2.4.
Asterisk (*) indicates no reliable abundance estimate is available.
[1] Population abundance values come from most recent NMFS Pacific Ocean Stock Assessment Reports (Carretta et al. 2023), where available.

2.4.2.8 False Killer Whale (*Pseudorca crassidens*)*

False killer whales are in the HF cetacean auditory group and the Odontocete behavioral group. Three false killer whale populations are in the Study Area –the Main Hawaiian Islands (MHI) Insular stock (MHI Insular DPS – ESA-listed); the Hawaii Pelagic stock (not ESA-listed); and a combination of those that are not managed under NMFS, classified as a “Worldwide” stock (not ESA-listed). False killer whales are found worldwide in tropical to warm temperate zones in deep waters. Although a pelagic species, they approach close to shores of oceanic islands. Breeding grounds and seasonal movements are unknown. Additionally, these whales do not have specific feeding grounds and are considered opportunistic foragers.

2.4.2.8.1 ESA-listed False Killer Whales (Main Hawaiian Islands Insular DPS)*

Model-predicted impacts for ESA-listed false killer whales are presented in Table 2-25. The MHI insular stock (MHI Insular DPS) of false killer whales is resident to the main Hawaiian Islands consisting of Kauai, Oahu, Molokai, Lanai, Kahoolawe, Maui, and Hawaii. Although they have been tracked up to 115 km from the Hawaiian Islands, they generally stay within 72 km from shore.

On average, individuals in this stock would be impacted less than once per year. There is no predicted risk of auditory injury or temporary auditory effects to the MHI Insular stock (MHI Insular DPS). Additionally, effects from behavioral responses to this stock would be negligible, occurring less than once per year.

The risk of repeated exposures to individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. As medium-sized odontocetes that are income breeders, false killer whales are likely somewhat resilient to missed foraging opportunities due to acoustic disturbance but may be vulnerable to impacts during lactation. In addition, because of their longer generation times, false killer whales would require more time to recover if significantly impacted. Since the MHI Insular stock of false killer whales are resident-nomadic, the risk of repeated exposures to individuals in this stock is likely similar within the population as animals move throughout their range.

The limited instances of predicted behavioral responses are unlikely to result in any long-term impacts to individuals. Long-term consequences to the MHI Insular stock of false killer whales are unlikely.

The use of SURTASS LFA sound source during training activities may affect, and are likely to adversely affect, the MHI Insular stock (MHI Insular DPS) of false killer whales.

Table 2-25: Estimated Effects to ESA-listed False Killer Whale Stocks over a Maximum Year of Proposed Activities

Stock	*BEH*	*TTS*	*AINJ*	*Population Abundance[1]*	*Annual Effects per Individual*	*Annual Injurious Effects per Individual*
MHI Insular	(1)	-	-	167	0.01	0.00

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury, MHI = Main Hawaiian Islands
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Values in parentheses are rounded up from less than 0.5 based on the 7-year rounding rules discussed in Section 2.4.
Asterisk (*) indicates no reliable abundance estimate is available.
[1] Population abundance values come from most recent NMFS Pacific Ocean Stock Assessment Reports (Caretta et al. 2024), where available.

2.4.2.8.2 Non-ESA-listed False Killer Whales (Worldwide; Hawaii Pelagic)

Model-predicted impacts are presented in Table 2-26. The Hawaii Pelagic stock is inclusive of those whales found in the Northwestern Hawaiian Islands stock; both of which are managed by NMFS. The Worldwide stock is inclusive of those found outside of Hawaii, in the northern and western portions of the Study Area.

False killer whales outside of Hawaii are found in all Pacific Remote Island Areas, the Mariana Archipelago, and in American Samoa. Whales from the Worldwide stock are common closer to coastlines of the eastern Pacific portion of the Study Area. The Northwestern Hawaiian Islands stock of false killer whales have been seen as far as 93 km from Kauai, Niihau, and the Northwestern Hawaiian Islands.

On average, individuals in the Hawaii Pelagic stock would be impacted less than once per year. Without a population abundance, it is not possible to estimate the annual effects per individual to the Worldwide stock. There is no predicted risk of auditory injury or temporary auditory effects to either the Hawaii Pelagic or Worldwide stock. There are a few predicted effects from behavioral responses for both stocks.

The risk of repeated exposures to individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. As medium-sized odontocetes that are income breeders, false killer whales are likely somewhat resilient to missed foraging opportunities due to acoustic disturbance but may be vulnerable to impacts during lactation. In addition, because of their longer generation times, false killer whales would require more time to recover if significantly impacted. Since the Hawaii and Worldwide stocks of false killer whales are resident-nomadic, the risk of repeated exposures to individuals is likely similar within the population as animals move throughout their range.

A couple instances of behavioral disturbance over a year are unlikely to have any long-term consequences for individuals. Based on the above analysis, long-term consequences for the Hawaii Pelagic and Worldwide stocks of false killer whales are unlikely.

Table 2-26: Estimated Effects to Non-ESA Listed False Killer Whale Stocks over a Maximum Year of Proposed Activities

Stock	*BEH*	*TTS*	*AINJ*	*Population Abundance[1]*	*Annual Effects per Individual*	*Annual Injurious Effects per Individual*
Hawaii Pelagic	7	-	-	5,528	0.00	0.00
Worldwide [Nsd]	60	-	-	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Asterisk (*) indicates no reliable abundance estimate is available.
[1] Population abundance values come from most recent NMFS Pacific Ocean Stock Assessment Reports (Carretta et al. 2023), where available.

2.4.2.9 Fraser's Dolphin (*Lagenodelphis hosei*)

Fraser's dolphins are in the HF cetacean auditory group and the Odontocete behavioral group. Two Fraser's dolphin stocks are in the Study Area – the Hawaii stock and a combination of those that are not managed under NMFS, classified as a "Worldwide" stock. Model-predicted impacts are presented in Table 2-27.

Fraser's dolphins occur primarily in tropical and subtropical waters of the Pacific and Indian Oceans. They are an oceanic species commonly found in deep waters and in areas where deep water approaches the coast, such as in the Philippines, Taiwan, and the Indonesian-Malay Archipelago. The Hawaii stock of Fraser's dolphins generally congregate in deep tropical waters with occurrence likely related to upwelling modified waters in the eastern tropical Pacific. Breeding areas and calving seasonality have not been confirmed.

On average, individuals in the Hawaii stock would be impacted less than once per year, primarily due to behavioral responses. Without a population abundance, it is not possible to estimate the annual effects per individual to the Worldwide stock. There is no predicted risk of auditory injury to either stock. There is a slight chance—at most once per year—of temporary auditory effects to both stock populations. The majority of effects to both stocks would be from behavioral responses. Several instances of behavioral disturbance over a year are unlikely to have any long-term consequences for individuals. The risk of impacts may be reduced through visual observation mitigation, especially since Fraser's dolphins tend to travel in large groups and have high sightability.

The risk of repeated exposures to individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. Fraser's dolphins are income breeders with a small body and fast pace of life, suggesting they are less resilient to missed foraging opportunities due to acoustic disturbance, especially during lactation. This nomadic population moves within its range year-round. Therefore, the risk of repeated exposures to individuals is likely similar within the population as animals move throughout their Pacific range. Although reproduction in populations with a fast pace of life are more sensitive to foraging disruption, these populations would be quick to recover.

The limited instances of predicted behavioral disturbances and temporary auditory effects are unlikely to result in any long-term consequences for individuals. Based on the above analysis, long-term consequences for the Hawaii and Worldwide stocks of Fraser's dolphins are unlikely.

Table 2-27: Estimated Effects to Fraser's Dolphin Stocks over a Maximum Year of Proposed Activities

Stock	*BEH*	*TTS*	*AINJ*	*Population Abundance[1]*	*Annual Effects per Individual*	*Annual Injurious Effects per Individual*
Hawaii	151	(1)	-	40,960	0.00	0.00
Worldwide [Nsd]	464	(1)	-	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Values in parentheses are rounded up from less than 0.5 based on the 7-year rounding rules discussed in Section 2.4.
Asterisk (*) indicates no reliable abundance estimate is available.
[1] Population abundance values come from most recent NMFS Pacific Ocean Stock Assessment Reports (Carretta et al. 2023), where available.

2.4.2.10 Ginkgo-Toothed Beaked Whale (*Mesoplodon ginkgodens*)

Ginkgo-toothed beaked whales are in the HF cetacean auditory group and the Sensitive behavioral group. Only one stock exists in the Study Area –a combination of those that are not managed under NMFS, classified as a "Worldwide" stock. Model-predicted impacts are presented in Table 2-28. Ginkgo-toothed beaked whales are a part of the *Mesoplodon* genus. Most *Mesoplodon* spp. are not well known due to difficulty in identifying individual species at-sea; therefore, most information presented about their behavior has been documented to genus level only.

Most *Mesoplodon* species have a wide distribution and are not residential to any location within the Study Area. *Mesoplodon* beaked whales are distributed in all of the world's oceans in deep pelagic waters and are occasionally sighted in waters over the continental shelf. The distribution of ginkgo-toothed beaked whales is thought to be restricted to the tropical and warm-temperate waters of the North Pacific; however, this assumption is based on the location of stranded individuals (MacLeod et al. 2006).

Without a population abundance, it is not possible to estimate the annual effects per individual to the Worldwide stock. There is no predicted risk of auditory injury and less than one single instance of a temporary auditory effect to ginkgo-toothed beaked whales. Most impacts are behavioral responses because beaked whales are in the Sensitive behavioral group and are likely to avoid noise sources.

The risk of repeated impacts on individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. As medium-sized odontocetes with a medium pace of life, ginkgo-toothed beaked whales are likely moderately resilient to missed foraging opportunities due to acoustic disturbance. While beaked whales are mixed breeders (i.e., behaviorally income breeders), they demonstrate capital breeding strategies during gestation and lactation (Keen et al. 2021), so they may be more vulnerable to prolonged loss of foraging opportunities during gestation. Little is known about the specific movements of ginkgo-toothed beaked whales; however, in general Mesoplodont beaked whales tend to have nomadic movement ecology. Therefore, the risk of repeated impacts on individuals is likely similar within the population as animals move throughout their range.

Several instances of predicted behavioral impacts are unlikely to result in any long-term impacts on individuals. Based on the above analysis, long-term consequences for ginkgo-toothed beaked whales are unlikely.

Table 2-28: Estimated Effects to Ginkgo-Toothed Beaked Whale Stocks over a Maximum Year of Proposed Activities

Stock	*BEH*	*TTS*	*AINJ*	*Population Abundance*	*Annual Effects per Individual*	*Annual Injurious Effects per Individual*
Worldwide Nsd	30,341	(1)	-	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Values in parentheses are rounded up from less than 0.5 based on the 7-year rounding rules discussed in Section 2.4.
Asterisk (*) indicates no reliable abundance estimate is available.

2.4.2.1 Goose-beaked Whale (*Ziphius cavirostris*)

Goose-beaked whales (also known as Cuvier's beaked whales) are in the HF cetacean auditory group and the Sensitive behavioral group. Two goose-beaked whale stocks are in the Study Area – the Hawaii stock and a combination of those that are not managed under NMFS, classified as a "Worldwide" stock. Model-predicted impacts are presented in Table 2-29.

This species is the most cosmopolitan of all beaked whale species. The Hawaii stock of goose-beaked whales is relatively common off the Hawaiian Islands of Lanai, Maui, Hawaii, Niihau, and Kauai, which provide strong evidence for both insular and offshore populations of goose-beaked whales in waters of the Hawaiian Islands EEZ. They are widely distributed in tropical to polar oceanic waters of all oceans and major seas, including the Sea of Japan and Sea of Okhotsk. No data on breeding and calving grounds has been published.

On average, individuals in the Hawaii stock could be impacted a little more than twice per year, due to behavioral responses. The revised cut-off conditions for significant behavioral responses result in predicting significant responses farther than observed in studies of beaked whale responses to sonar (see Section 2.3.3 [Behavioral Responses by Distance and Sound Pressure Level]). Without a population abundance, it is not possible to estimate the annual effects per individual to the Worldwide stock. There is no predicted risk of auditory injury to either stock population. There is less than one temporary auditory effect to the Worldwide stock and no predicted temporary auditory effects for the Hawaii stock. The vast majority of effects to both stocks are a result of behavioral responses. Several instances of behavioral disturbance over a year are unlikely to have any long-term consequences for individuals.

The risk of repeated exposures to individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. As medium-sized odontocetes with a medium pace of life, goose-beaked whales are likely moderately resilient to missed foraging opportunities due to acoustic disturbance. While beaked whales are mixed breeders (i.e., behaviorally income breeders), they demonstrate capital breeding strategies during gestation and lactation (Keen et al. 2021), so they may be more vulnerable to prolonged loss of foraging opportunities during gestation. Because goose-beaked whales have a nomadic-resident movement ecology, the risk of repeated impacts to individuals is likely similar within the population as animals move throughout their range. The individuals within the Hawaii stock that are more residential to areas on around Hawaii may be at higher risk for repeated exposure and long-term consequences from repeated displacement (Hin et al. 2023).

Since this species has longer generation times, this population would require more time to recover if significantly impacted.

Several instances of predicted behavioral responses or temporary auditory effects are unlikely to result in any long-term consequences on individuals. Most predicted impacts are behavioral responses in an open ocean basin that are unlikely to contribute to any long-term impacts to individuals. Long-term consequences to the Hawaii and Worldwide stocks are unlikely.

Table 2-29: Estimated Effects to Goose-Beaked Whale Stocks over a Maximum Year of Proposed Activities

Stock	*BEH*	*TTS*	*AINJ*	*Population Abundance[1]*	*Annual Effects per Individual*	*Annual Injurious Effects per Individual*
Hawaii	9,185	-	-	4,431	2.07	0.00
Worldwide [Nsd]	111,484	(1)	-	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Values in parentheses are rounded up from less than 0.5 based on the 7-year rounding rules discussed in Section 2.4.
Asterisk (*) indicates no reliable abundance estimate is available.
[1] Population abundance values come from most recent NMFS Pacific Ocean Stock Assessment Reports (Carretta et al. 2023), where available.

2.4.2.2 Hubbs' Beaked Whale (*Mesoplodon carlshubbi*)

Hubbs' beaked whales are in the HF cetacean auditory group and the Sensitive behavioral group. Only one stock exists in the Study Area –a combination of those that are not managed under NMFS, classified as a "Worldwide" stock. Model-predicted impacts are presented in Table 2-30. Hubbs' beaked whale are a part of the Mesoplodon genus. Most Mesoplodon spp. are not well known due to difficulty in identifying individual species at-sea; therefore, most information presented about their behavior has been documented to genus level only.

Most *Mesoplodon* species have a wide distribution and are not residential to any location within the Study Area. *Mesoplodon* beaked whales are distributed in all of the world's oceans in deep pelagic waters and are occasionally sighted in waters over the continental shelf. Hubbs' beaked whales are endemic to North Pacific waters, potentially with separate eastern and western populations (MacLeod et al. 2006).

Without a population abundance, it is not possible to estimate the annual effects per individual to the Worldwide stock. There is no predicted risk of auditory injury or temporary auditory effects to Hubbs' beaked whales. Most impacts are behavioral responses because beaked whales are in the Sensitive behavioral group and are likely to avoid noise sources.

The risk of repeated impacts on individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. As medium-sized odontocetes with a medium pace of life, Hubbs' beaked whales are likely moderately resilient to missed foraging opportunities due to acoustic disturbance. While beaked whales are mixed breeders (i.e., behaviorally income breeders), they demonstrate capital breeding strategies during gestation and lactation (Keen et al. 2021), so they may be more vulnerable to prolonged loss of foraging opportunities during gestation. Little is known about the specific movements of Hubbs' beaked whales, however, in general Mesoplodont beaked whales tend to have a nomadic movement ecology. Therefore, the risk of repeated impacts on individuals is likely similar within the population as animals move throughout their range.

Several instances of predicted behavioral impacts are unlikely to result in any long-term impacts on individuals. Based on the above analysis, long-term consequences for Hubbs' beaked whales are unlikely.

Table 2-30: Estimated Effects to Hubbs' Beaked Whale Stocks over a Maximum Year of Proposed Activities

Stock	*BEH*	*TTS*	*AINJ*	*Population Abundance*	*Annual Effects per Individual*	*Annual Injurious Effects per Individual*
Worldwide [Nsd]	25,289	-	-	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Asterisk (*) indicates no reliable abundance estimate is available.

2.4.2.3 Killer Whale (*Orcinus orca*)

Killer whales are in the HF cetacean auditory group and the Odontocete behavioral group. Two killer whale stocks are in the Study Area – the Hawaii stock and a combination of those that are not managed under NMFS, classified as a "Worldwide" stock. Model-predicted impacts are presented in Table 2-31.

Killer whales can occur in coastal zones or deep ocean basins but are most numerous in coastal water at higher latitudes. Killer whales are not frequently seen in Hawaiian waters. The Hawaii stock of killer whales is typically only seen during the winter, suggesting those sighted in Hawaii are seasonal migrants to Hawaii. Killer whales have higher density around the Hawaiian Islands compared to the high seas, which is where they are most likely to experience impacts. In the northwestern Pacific Ocean, along the southeastern coast of Kamchatka, fish-eating, coastal killer whales forage in Avachinskaya Bay (i.e., Avacha Bay), although some transient killer whales have been detected in these waters acoustically (Burdin et al. 2007).

On average, individuals in the Hawaii stock would be impacted less than once per year. Without a population abundance, it is not possible to estimate the annual effects per individual to the Worldwide stock. There is no predicted risk of auditory injury to either stock population. While there is a chance of temporary auditory effects to the Worldwide stock, there is a likelihood of only a single occurrence. Additionally, there are some impacts to behavioral responses across both stocks—mostly the Worldwide stock. Several instances of behavioral disturbance over a year are unlikely to have any long-term consequences for individuals.

The risk of repeated exposures to individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. Killer whales are large, income-breeding odontocetes with a slow pace of life, suggesting they are more resilient to missed foraging opportunities due to acoustic disturbance, except during lactation. Both stocks of killer whales move within their range year-round and are considered nomadic. Therefore, the risk of repeated exposures to individuals is likely similar within the population as animals move throughout their range. These two stocks of killer whales in the Study Area are not endangered and have unknown population trends. Overall, killer whales would be resilient to missed foraging opportunities but would require more time to recover if significantly impacted.

A few instances of predicted behavioral responses or temporary auditory effects over a year are unlikely to have any long-term consequences for individuals. Based on the above analysis, long-term consequences for the Hawaii and Worldwide stocks of killer whales are unlikely.

Table 2-31: Estimated Effects to Killer Whales Stocks over a Maximum Year of Proposed Activities

Stock	*BEH*	*TTS*	*AINJ*	*Population Abundance[1]*	*Annual Effects per Individual*	*Annual Injurious Effects per Individual*
Hawaii	1	-	-	161	0.01	0.00
Worldwide [Nsd]	172	1	-	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Asterisk (*) indicates no reliable abundance estimate is available.
[1] Population abundance values come from most recent NMFS Pacific Ocean Stock Assessment Reports (Carretta et al. 2023), where available.

2.4.2.4 Longman's Beaked Whale (*Indopacetus pacificus)*

Longman's beaked whales are in the HF cetacean auditory group and the Sensitive behavioral group. Two Longman's beaked whale stocks are in the Study Area – the Hawaii stock and a combination of those that are not managed under NMFS, classified as a "Worldwide" stock. Model-predicted impacts are presented in Table 2-32.

While the full extent of the Longman's beaked whale distribution is not fully understood, there have been many sightings in tropical waters throughout the Pacific and Indian Oceans in waters over deep bathymetric slopes from 200 to 2,000 m. They appear to be rare in the eastern Pacific and Indian Oceans, but they are more common in the western Pacific and western Indian Oceans, suggesting that this species prefers warmer waters found in western ocean basins (Pitman 2018). The Hawaii stock generally congregates in warm deep waters. Seasonal movements are unknown.

On average, individuals in the Hawaii stock could be impacted a little less than twice per year, due to behavioral responses. The revised cut-off conditions for significant behavioral responses result in predicting significant responses farther than observed in studies of beaked whale responses to sonar (see Section 2.3.3 [Behavioral Responses by Distance and Sound Pressure Level]). Without a population abundance, it is not possible to estimate the annual effects per individual to the Worldwide stock. There is no predicted risk of auditory injury to either stock population. There is less than one temporary auditory effect to the Worldwide stock and no predicted temporary auditory effects for the Hawaii stock. The vast majority of effects are behavioral responses. Several instances of behavioral disturbance over a year are unlikely to have any long-term consequences for individuals.

The risk of repeated exposures to individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. As medium-sized odontocetes with a medium pace of life, Longman's beaked whales are likely moderately resilient to missed foraging opportunities due to acoustic disturbance. While beaked whales are mixed breeders (i.e., behaviorally income breeders), they demonstrate capital breeding strategies during gestation and lactation (Keen et al. 2021), so they may be more vulnerable to prolonged loss of foraging opportunities during gestation. Because Longman's beaked whales have a nomadic-resident movement ecology, the risk of repeated impacts to individuals is likely similar within the population as animals move throughout their range.

Several instances of predicted behavioral responses or temporary auditory effects are unlikely to result in any long-term consequences for individuals. Most predicted impacts are behavioral responses in an open ocean basin that are unlikely to contribute to any long-term impacts to individuals. Long-term consequences to the Hawaii and Worldwide stocks are unlikely.

Table 2-32: Estimated Effects to Longman's Beaked Whale Stocks over a Maximum Year of Proposed Activities

Stock	*BEH*	*TTS*	*AINJ*	*Population Abundance[1]*	*Annual Effects per Individual*	*Annual Injurious Effects per Individual*
Hawaii	5,017	-	-	2,550	1.97	0.00
Worldwide Nsd	69,987	(1)	-	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Values in parentheses are rounded up from less than 0.5 based on the 7-year rounding rules discussed in Section 2.4.
Asterisk (*) indicates no reliable abundance estimate is available.
[1] Population abundance values come from most recent NMFS Pacific Ocean Stock Assessment Reports (Carretta et al. 2023), where available.

2.4.2.5 Melon-Headed Whale (*Peponocephala electra*)

Melon-headed whales are in the HF cetacean auditory group and the Odontocete behavioral group. Two melon-headed whale stocks are found within the Study Area – the Hawaiian Islands stock and a combination of those that are not managed under NMFS, classified as a "Worldwide" stock. Model-predicted impacts are presented in Table 2-33.

Melon-headed whales occur in pelagic tropical and subtropical waters worldwide and are frequently associated with oceanic islands and archipelagoes. They tend to congregate in deep tropical and subtropical waters, especially when they forage at night. They have been known to rest nearshore around oceanic islands during the day. Melon-headed whales are regularly found within Hawaiian waters. The Hawaiian Islands stock includes melon-headed whales inhabiting waters throughout the Hawaiian Islands. Breeding areas and seasonal movements of this species have not been confirmed.

On average, individuals in the Hawaiian Islands stock would be impacted less than once per year. Without a population abundance, it is not possible to estimate the annual effects per individual to the Worldwide stock. There is no predicted risk of auditory injury to either stock. There would be a small chance of temporary auditory effects to the Worldwide stock and no predicted temporary auditory effects for the Hawaiian Islands stock. The risk of effects may be reduced through visual observation mitigation especially since melon-headed whales tend to travel in large groups. The vast majority of effects to both stocks are behavioral responses. Several instances of behavioral disturbance over a year are unlikely to have any long-term consequences for individuals.

The risk of repeated exposures to individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. As small odontocetes that are income breeders with a medium pace of life, melon-headed whales are likely somewhat resilient to missed foraging opportunities due to acoustic disturbance but could be vulnerable during lactation. Because the Hawaiian Islands stock is nomadic-resident, the risk of repeated exposures to individuals is likely similar within the populations as animals move throughout their range. However, because of their longer generation times, these populations would require more time to recover if significantly impacted.

A few instances of behavioral disturbance over a year are unlikely to have any long-term consequences for individuals. Based on the above analysis, long-term consequences for the Hawaiian Islands and Worldwide stocks of melon-headed whales are unlikely.

Table 2-33: Estimated Effects to Melon-headed Whale Stocks over a Maximum Year of Proposed Activities

Stock	*BEH*	*TTS*	*AINJ*	*Population Abundance*[1]	*Annual Effects per Individual*	*Annual Injurious Effects per Individual*
Hawaiian Islands	107	-	-	40,647	0.00	0.00
Worldwide [Nsd]	536	(1)	-	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Values in parentheses are rounded up from less than 0.5 based on the 7-year rounding rules discussed in Section 2.4.
Asterisk (*) indicates no reliable abundance estimate is available.
[1] Population abundance values come from most recent NMFS Pacific Ocean Stock Assessment Reports (Caretta et al. 2024), where available.

2.4.2.6 Northern Right Whale Dolphin (*Steno bredanensis*)

Northern right whale dolphins are in the HF cetacean auditory group and the Odontocete behavioral group. Only one stock exists in the Study Area –a combination of those that are not managed under NMFS, classified as a "Worldwide" stock. Model-predicted impacts are presented in Table 2-34.

Northern right whale dolphins generally have higher abundances in cold waters along the outer continental shelf and slope. They move nearshore only in areas where the continental shelf is narrow or where productivity on the shelf is especially high. Their range extends from the Kuril Islands south to Japan and from the Gulf of Alaska to southern California. They exhibit inshore-offshore movements seasonally in some areas.

Without a population abundance, it is not possible to estimate the annual effects per individual to the Worldwide stock. There is no predicted risk of auditory injury or temporary auditory effects to northern right whale dolphins. There would be only a few limited instances of behavioral responses. Several instances of behavioral disturbance over a year are unlikely to have any long-term consequences for individuals.

The risk of repeated exposures to individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. As income breeders with a small body and a medium pace of life, northern right whale dolphins have some resilience to missed foraging opportunities due to acoustic disturbance, except for during lactation. Because they are a nomadic species, the risk of repeated exposures to individuals is likely similar within the population as animals move throughout their range. Risk of impacts would also be similar across critical life functions. The population trend for this stock is unknown, and because of their longer generation times, this population would require more time to recover if it was further significantly impacted.

A few instances of behavioral disturbance over a year are unlikely to have any long-term consequences for individuals. Based on the above analysis, long-term consequences for northern right whale dolphins are unlikely.

Table 2-34: Estimated Effects to Northen Right Whale Dolphin Stocks over a Maximum Year of Proposed Activities

Stock	BEH	TTS	AINJ	Population Abundance	Annual Effects per Individual	Annual Injurious Effects per Individual
Worldwide Nsd	10	-	-	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Asterisk (*) indicates no reliable abundance estimate is available.

2.4.2.7 Pacific White-Sided Dolphin (*Lagenorhynchus acutus*)

Pacific white-sided dolphins are in the HF cetacean auditory group and the Odontocete behavioral group. One stock of Pacific white-sided dolphin is in the Study Area – the North Pacific stock. Model-predicted impacts are presented in Table 2-35.

Pacific white-sided dolphins are mostly pelagic and have a primarily cold temperate distribution across the North Pacific. In the western North Pacific, this species occurs from Taiwan north to the Commander and Kuril Islands. They are distributed within continental shelf and slope waters generally within 185 km of shore, often moving into coastal and inshore waters. No breeding grounds are known for this species, but their distribution changes seasonally, linked to water temperatures and prey abundance (Rechsteiner 2012).

Without a population abundance, it is not possible to estimate the annual effects per individual to the North Pacific stock. There is no predicted risk of auditory injury or temporary auditory effects to Pacific white-sided dolphins. The vast majority of effects are behavioral responses. Several instances of behavioral disturbance over a year are unlikely to have any long-term consequences for individuals.

The risk of repeated exposures to individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. As small odontocetes that are income breeders with a medium pace of life, Pacific white-sided dolphins are likely somewhat resilient to missed foraging opportunities due to acoustic disturbance but could be vulnerable during lactation. This nomadic population moves within their range year-round, so the risk of repeated exposures to individuals within the population is likely similar year-round. However, because of their longer generation times, this species would require more time to recover if significantly impacted.

A few instances of behavioral disturbance over a year are unlikely to have any long-term consequences for individuals. Based on the above analysis, long-term consequences for the North Pacific stock of Pacific white-sided dolphins are unlikely.

Table 2-35: Estimated Effects to Pacific White-Sided Dolphin Stocks over a Maximum Year of Proposed Activities

Stock	BEH	TTS	AINJ	Population Abundance	Annual Effects per Individual	Annual Injurious Effects per Individual
North Pacific	49	-	-	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Asterisk (*) indicates no reliable abundance estimate is available.

2.4.2.8 Pantropical Spotted Dolphin (*Stenella attenuata*)

Pantropical spotted dolphins are in the HF cetacean auditory group and the Odontocete behavioral group. Five pantropical spotted dolphin stocks are in the Study Area – the Hawaiian Islands Stock Complex (including the Maui Nui stock [formerly the 4-Islands stock], the Hawaii Island stock, the Hawaii Pelagic stock, and the Oahu stock) and a combination of those that are not managed under NMFS, classified as a "Worldwide" stock. Model-predicted impacts are presented in Table 2-36. Effects were estimated for the Hawaii Pelagic and the Worldwide stocks only.

Pantropical spotted dolphins can be found mostly in deep offshore tropical and subtropical waters of the Pacific and Indian Oceans, but they do approach the coast in some areas like Hawaii and Taiwan. They are one of the most abundant species of cetaceans in Hawaiian waters.

The Maui Nui stock of pantropical spotted dolphins generally congregate in shallow coastal waters with depths from 1,500 to 3,500 m. The Hawaii Island stock generally congregate in shallow coastal waters with depths from 1,500 to 3,500 m. The Hawaii Pelagic stock can be found in tropical offshore waters of the Hawaiian Islands EEZ, with highest densities near all the islands, but particularly around the Main Hawaiian Islands. The Oahu stock generally congregate in shallow coastal waters with depths from 1,500 to 3,500 m.

On average, individuals in the Hawaii Pelagic stock would be impacted less than once per year. Without a population abundance, it is not possible to estimate the annual effects per individual to the Worldwide stock. There is no predicted risk of auditory injury to either stock. There is a slight chance—at most once per year—of temporary auditory effects to the Worldwide stock population. Temporary auditory effects are not expected to occur in the Hawaii Pelagic stock. The vast majority of effects to both stocks would be behavioral responses. Several instances of behavioral disturbance over a year are unlikely to have any long-term consequences for individuals. The risk of impacts may be reduced through visual observation mitigation, especially since Pantropical spotted dolphins tend to travel in large groups.

The risk of repeated exposures to individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. As small odontocete income breeders with a medium pace of life, Pantropical spotted dolphins are likely somewhat resilient to missed foraging opportunities due to acoustic disturbance. Because nomadic and offshore populations of pantropical spotted dolphins like the Hawaii Pelagic stock have a larger range farther from shore, they have a lower risk of repeated exposure compared to the other three nearshore residential stocks in the Hawaii portion of the Study Area. The Oahu stock of pantropical spotted dolphins has the smallest range out of the three residential stocks.

Several instances of predicted behavioral impacts are unlikely to result in any long-term impacts on individuals. Based on the above analysis, long-term consequences for pantropical spotted dolphins are unlikely. Based on the above analysis, long-term consequences for the Hawaii Pelagic or Worldwide stocks of pantropical spotted dolphins are unlikely.

Table 2-36: Estimated Effects to Pantropical Spotted Dolphin Stocks over a Maximum Year of Proposed Activities

Stock	*BEH*	*TTS*	*AINJ*	*Population Abundance[1]*	*Annual Effects per Individual*	*Annual Injurious Effects per Individual*
Hawaii Pelagic	233	-	-	67,313	0.00	0.00
Worldwide [Nsd]	2,784	1	-	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Asterisk (*) indicates no reliable abundance estimate is available.
[1] Population abundance values come from most recent NMFS Pacific Ocean Stock Assessment Reports (Caretta et al. 2024), where available.

2.4.2.9 Pygmy Killer Whale (*Feresa attenuata*)

Pygmy killer whales are in the HF cetacean auditory group and the Odontocete behavioral group. Two pygmy killer whale populations are in the Study Area – the Hawaii stock and a combination of those that are not managed under NMFS, classified as a “Worldwide” stock. Model-predicted impacts are presented in Table 2-37.

Pygmy killer whales have been sighted in oceanic tropical and subtropical waters of all oceans. The population in Hawaiian waters shows high site fidelity and is considered to be a resident population. No data are available to confirm seasonal migration patterns or the locations of breeding or calving grounds.

On average, individuals in the Hawaii stock would be impacted less than once per year. Without a population abundance, it is not possible to estimate the annual effects per individual to the Worldwide stock. There is no predicted risk of auditory injury for either stock. There is a slight chance—at most once per year—of temporary auditory effects to the Worldwide stock population. Temporary auditory effects are not expected to occur in the Hawaii stock. The vast majority of effects to both stocks would be behavioral responses. Several instances of behavioral disturbance over a year are unlikely to have any long-term consequences for individuals.

The risk of repeated exposures to individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. Little is known about pygmy killer whale demographics, but they are income breeders with a small body and medium pace of life, suggesting they are less resilient to missed foraging opportunities due to acoustic disturbance, especially during lactation. Since they have a nomadic-resident movement ecology, both stocks of pygmy killer whales move within their range year-round.

Several instances of predicted behavioral impacts are unlikely to result in any long-term impacts on individuals. Based on the above analysis, long-term consequences for the Hawaii or Worldwide stocks of pygmy killer whales are unlikely.

Table 2-37: Estimated Effects to Pygmy Killer Whale Stocks over a Maximum Year of Proposed Activities

Stock	BEH	TTS	AINJ	Population Abundance[1]	Annual Effects per Individual	Annual Injurious Effects per Individual
Hawaii	32	-	-	10,328	0.00	0.00
Worldwide [Nsd]	317	(1)	-	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Values in parentheses are rounded up from less than 0.5 based on the 7-year rounding rules discussed in Section 2.4.
Asterisk (*) indicates no reliable abundance estimate is available.
[1] Population abundance values come from most recent NMFS Pacific Ocean Stock Assessment Reports (Caretta et al. 2024), where available.

2.4.2.10 Risso's Dolphin (*Grampus griseus*)

Risso's dolphins are in the HF cetacean auditory group and the Odontocete behavioral group. Two Risso's dolphin stocks are in the Study Area – the Hawaii stock, and a combination of those that are not managed under NMFS, classified as a "Worldwide" stock. Model-predicted impacts are presented in Table 2-38.

Risso's dolphins inhabit deep oceanic and continental slope waters from the tropics through the temperate regions, predominantly around steep shelf-edge habitats. Dolphins have exhibited seasonal migrations in Japan; however, seasonal variations in movements have not been studied elsewhere. The Hawaii stock of Risso's dolphins have the highest densities offshore of the Hawaiian Islands in waters approximately 2,500 m to 4,500 m depth, and mid-range densities farther offshore. Dolphins have been known to calve year-round, but peak timing differs by habitat.

On average, individuals in the Hawaii stock would be impacted less than once per year. Without a population abundance, it is not possible to estimate the annual effects per individual to the Worldwide stock. There is no predicted risk of auditory injury to either stock. The risk of any temporary auditory effect is low (less than one) in any year for the Worldwide stock. There are no predicted temporary auditory effects for the Hawaii stock. The vast majority of effects would be from behavioral responses. Several instances of behavioral disturbance over a year are unlikely to have any long-term consequences for individuals.

The risk of repeated exposures to individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. As income breeders with a small-medium body and a medium pace of life, Risso's dolphins are moderately resilient to foraging disruption due to acoustic disturbance, except for during lactation. Because both stocks in the Study Area are nomadic, the risk of repeated exposures to individuals is likely similar within the population as animals move throughout their range. Risk of impacts would also be similar across seasons and critical life functions. Both stocks have unknown population trends. Due to this species' longer generation times, this population would require more time to recover if significantly impacted.

Several instances of predicted behavioral responses or temporary auditory effects are unlikely to result in any long-term on individuals. Based on the above analysis, long-term consequences for the Hawaii stock and Worldwide stock of Risso's dolphins are unlikely.

Table 2-38: Estimated Effects to Risso's Dolphin Stocks over a Maximum Year of Proposed Activities

Stock	*BEH*	*TTS*	*AINJ*	*Population Abundance[1]*	*Annual Effects per Individual*	*Annual Injurious Effects per Individual*
Hawaii	38	-	-	6,979	0.01	0.00
Worldwide [Nsd]	1,574	(1)	-	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Values in parentheses are rounded up from less than 0.5 based on the 7-year rounding rules discussed in Section 2.4.
Asterisk (*) indicates no reliable abundance estimate is available.
[1] Population abundance values come from most recent NMFS Pacific Ocean Stock Assessment Reports (Caretta et al. 2024), where available.

2.4.2.11 Rough-Toothed Dolphin (*Steno bredanensis*)

Rough-toothed dolphins are in the HF cetacean auditory group and the Odontocete behavioral group. Two rough-toothed dolphin stocks are in the Study Area – the Hawaii stock and a combination of those that are not managed under NMFS, classified as a "Worldwide" stock. Model-predicted impacts are presented in Table 2-39.

Rough-toothed dolphins occur in oceanic tropical and warm-temperate waters around the world. These dolphins are found in deep, offshore waters that lack major upwelling. In the western Pacific, they inhabit waters from central Japan to northern Australia. Rough-toothed dolphins are also found in the Indian Ocean, from the southern tip of Africa across to Australia. Seasonal movements and breeding areas for this species have not been confirmed; however, high site-fidelity is hypothesized. For example, in Hawaii they have been documented to have limited movement between islands (Baird et al. 2008).

On average, individuals in the Hawaii stock would be impacted less than once per year. Without a population abundance, it is not possible to estimate the annual effects per individual to the Worldwide stock. There is no predicted risk of auditory injury to either stock. There is a slight chance—at most once per year—of temporary auditory effects to the Worldwide stock population. Temporary auditory effects are not expected to occur in the Hawaii stock. The vast majority of effects to both stocks would be from behavioral responses. Several instances of behavioral disturbance over a year are unlikely to have any long-term consequences for individuals.

The risk of repeated exposures to individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. As income breeders with a small body and a medium pace of life, rough-toothed dolphins have some resilience to missed foraging opportunities due to acoustic disturbance, except for during lactation. Because the Hawaii stock is nomadic, the risk of repeated exposures to individuals is likely similar within the population as animals move throughout their range. Risk of impacts would also be similar across seasons and critical life functions. The population trend for both of these stocks is unknown, and because of their longer generation times, these populations would require more time to recover if it was further significantly impacted.

Several instances of predicted behavioral impacts are unlikely to result in any long-term impacts on individuals. Based on the above analysis, long-term consequences for the Hawaii or Worldwide stocks of rough-toothed dolphins are unlikely.

Table 2-39: Estimated Effects to Rough-toothed Dolphin Stocks over a Maximum Year of Proposed Activities

Stock	*BEH*	*TTS*	*AINJ*	*Population Abundance[1]*	*Annual Effects per Individual*	*Annual Injurious Effects per Individual*
Hawaii	299	-	-	83,915	0.00	0.00
Worldwide [Nsd]	508	-	-	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Asterisk (*) indicates no reliable abundance estimate is available.
[1] Population abundance values come from most recent NMFS Pacific Ocean Stock Assessment Reports (Caretta et al. 2024), where available.

2.4.2.12 Short-Finned Pilot Whale (*Globicephala macrorhynchus*)

Short-finned pilot whales are in the HF cetacean auditory group and the Odontocete behavioral group. Two short-finned pilot whale stocks are in the Study Area – the Hawaii stock and a combination of those that are not managed under NMFS, classified as a “Worldwide” stock. Model-predicted impacts to the Hawaii and Worldwide stocks are presented in Table 2-40.

Short-finned pilot whales occur from nearshore to pelagic and tropical to warm-temperate waters of the Pacific and Indian Oceans. Short-finned pilot whales are considered nomadic, although resident populations are known to occur in the Hawaiian Islands (Olson 2018). This is a nomadic species which follows the movements of their prey (e.g., squid) rather than a migration path. Short-finned pilot whales are found close to shore near oceanic islands like Hawaii, where the shelf is narrow and deeper waters are found nearby.

On average, individuals in the Hawaii stock would be impacted less than once per year. Without a population abundance, it is not possible to estimate the annual effects per individual to the Worldwide stock. There is no predicted risk of auditory injury to either stock population. There are only a few temporary auditory effects to the Worldwide stock and no temporary auditory impacts to the Hawaii stock. The vast majority of effects to both stocks are behavioral responses. Several instances of behavioral disturbance over a year are unlikely to have any long-term consequences for individuals. The risk of effects may be reduced through visual observation mitigation, especially since short-finned pilot whales tend to travel in large groups up to 50 individuals.

The risk of repeated exposures to individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. Short-finned pilot whales are medium-sized, income breeding odontocetes with a slow pace of life, making them somewhat resilient to missed foraging opportunities due to acoustic disturbance, except for during lactation. Both populations are nomadic and move within their range year-round. Therefore, the risk of repeated exposures to individuals is likely similar within the population. However, because of their longer generation times, this population would require more time to recover if significantly impacted.

Several instances of predicted behavioral responses or temporary auditory effects are unlikely to result in any long-term on individuals. Based on the above analysis, long-term consequences for the Hawaii stock and Worldwide stock of short-finned pilot whales dolphins are unlikely.

Table 2-40: Estimated Effects to Short-finned Pilot Whale Stocks over a Maximum Year of Proposed Activities

Stock	*BEH*	*TTS*	*AINJ*	*Population Abundance[1]*	*Annual Effects per Individual*	*Annual Injurious Effects per Individual*
Hawaii	76	-	-	19,242	0.00	0.00
Worldwide [Nsd]	1,081	2	-	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Asterisk (*) indicates no reliable abundance estimate is available.
[1] Population abundance values come from most recent NMFS Pacific Ocean Stock Assessment Reports (Caretta et al. 2024), where available.

2.4.2.13 Sperm Whale (*Physeter macrocephalus*)*

Sperm whales are in the HF cetacean auditory group and the Odontocete behavioral group. Three stocks are in the Study Area – the Hawaii stock, the North Pacific stock and a combination of those that are not managed under NMFS, classified as a “Worldwide” stock. Sperm whales are listed as endangered throughout their range with no designated DPSs. Model-predicted impacts are presented in Table 2-41.

With a large global distribution, sperm whales are primarily found in deep (greater than 1,000 m) polar, temperate, and tropical waters of the world’s oceans, as well as in semi-enclosed waters (e.g., Sea of Japan). They generally have higher abundances in deep water and areas of high productivity. Their migration patterns are not well understood. Some whales show seasonal north-south migrations, while others, particularly whales in warm equatorial waters, show no clear seasonal migration pattern (Whitehead 2018). The Hawaii stock is more residential and occur in Hawaiian waters year-round.

On average, individuals in the Hawaii stock would be impacted less than once per year. Without a population abundance, it is not possible to estimate the annual effects per individual to the North Pacific or Worldwide stocks. There is no predicted risk of auditory injury for any of the stocks. While there is a chance of temporary auditory effects to the North Pacific stock, the likelihood of occurrence is less than once per year. Additionally, there would be some impacts to behavioral responses across all stocks. Several instances of behavioral disturbance over a year are unlikely to have any long-term consequences for individuals.

The risk of repeated impacts on individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. As large odontocetes with a slow pace of life, sperm whales are likely more resilient to missed foraging opportunities due to acoustic disturbance than smaller odontocetes. Still, sperm whales are income breeders and may be more susceptible to impacts due to lost foraging opportunities during reproduction, especially if they occur during lactation (Farmer et al. 2018). Sperm whales are somewhat migratory, but their movement ecology is demographically dependent. Nursery groups of females, calves and non-adult males are more residential, staying near warm equatorial breeding grounds throughout the year. Groups of adult males are more migratory, traveling from warm waters in the summer to feeding grounds as far north as the Arctic. Migratory whales may be less susceptible to repeated impacts than residential whales. Because of their longer generation times, this population would require more time to recover if significantly impacted. In addition, these stocks of sperm whales are endangered with unknown population trends, although it is possible that sperm whales in the North Pacific stock have a stable population.

The limited instances of predicted behavioral and temporary auditory impacts are unlikely to result in any long-term impacts to individuals. Long-term consequences to any of the sperm whale stocks are unlikely.

The use of SURTASS LFA sound source during training activities may affect, and are likely to adversely affect, sperm whales.

Table 2-41: Estimated Effects to Sperm Whale Stocks over a Maximum Year of Proposed Activities

Stock	*BEH*	*TTS*	*AINJ*	*Population Abundance[1]*	*Annual Effects per Individual*	*Annual Injurious Effects per Individual*
Hawaii	15	-	-	5,707	0.00	0.00
North Pacific	224	(1)	-	*	*	*
Worldwide [Nsd]	37	-	-	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Values in parentheses are rounded up from less than 0.5 based on the 7-year rounding rules discussed in Section 2.4.
Asterisk (*) indicates no reliable abundance estimate is available.
[1] Population abundance values come from most recent NMFS Pacific Ocean Stock Assessment Reports (Carretta et al. 2023), where available.

2.4.2.14 Spinner Dolphin (*Stenella longirostris*)

Spinner dolphins are in the HF cetacean auditory group and the Odontocete behavioral group. Five spinner dolphin stocks are in the Study Area – the Hawaiian Islands Stock Complex (including the Kauai and Niihau stock, the Hawaii Island stock, the Hawaii Pelagic stock, and the Oahu/4-Islands stock) and a combination of those that are not managed under NMFS, classified as a “Worldwide” stock. Model-predicted impacts are presented in Table 2-42. Effects were estimated for the Hawaii Pelagic and Worldwide stocks only.

Spinner dolphins are pantropical, occurring in tropical and subtropical oceanic waters. Spinner dolphins are found in coastal regions of Hawaii, the eastern Pacific, Indian Ocean, and off Southeast Asia, usually resting in the shallow waters of bays of oceanic islands and atolls. The distribution of the Hawaii Island stock of spinner dolphins extends from the coast of Hawaii out to 10 nautical miles from shore. Spinner dolphins in Hawaii have a higher abundance along the leeward coasts of all the major islands and around several of the atolls northwest of the main Hawaiian Islands in water shallower than 4,000 m in depth. The Hawaii Pelagic stock of spinner dolphins is often found in waters with a shallow thermocline (rapid temperature difference with depth) which concentrates open sea organisms in and above it, which spinner dolphins feed on. The Kauai and Niihau stock of spinner dolphins generally congregate in shallow coastal waters with depths from 50 to 4,000 m. The waters off Kauai are particularly popular for spinner dolphins. The Oahu/ 4-Islands stock of spinner dolphins generally congregates in shallow coastal waters with depths from 50 to 4,000 m.

Without a population abundance, it is not possible to estimate the annual effects per individual to the Hawaii Pelagic or Worldwide stocks. There is no predicted risk of auditory injury to either stock. There is a slight chance—at most once per year—of temporary auditory effects to either stock. The vast majority of effects to both stocks would be behavioral responses. Several instances of behavioral disturbance over a year are unlikely to have any long-term consequences for individuals. The risk of effects may be reduced through visual observation mitigation, as spinner dolphins have relatively higher sightability.

The risk of repeated exposures to individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. As income breeders with a small body and a fast pace of life, spinner dolphins are less resilient to missed foraging opportunities due to acoustic disturbance, especially during lactation. Because this stock is nomadic, the risk of repeated exposures to individuals is likely similar within the population as animals move throughout their range. Risk of impacts would also be similar across seasons and critical life functions. The population trend for all stocks of spinner dolphins in the Study Area are unknown. Although reproduction in populations with a fast pace of life are more sensitive to foraging disruption, these populations are quick to recover.

A few instances of predicted behavioral responses over a year are unlikely to have any long-term consequences for individuals. Based on the above analysis, long-term consequences for the Hawaii Pelagic stock and the Worldwide stock of spinner dolphins are unlikely.

Table 2-42: Estimated Effects to Spinner Dolphin Stocks over a Maximum Year of Proposed Activities

Stock	*BEH*	*TTS*	*AINJ*	*Population Abundance*	*Annual Effects per Individual*	*Annual Injurious Effects per Individual*
Hawaii Pelagic	14	(1)	-	*	*	*
Worldwide [Nsd]	275	(1)	-	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Values in parentheses are rounded up from less than 0.5 based on the 7-year rounding rules discussed in Section 2.4.
Asterisk (*) indicates no reliable abundance estimate is available.

2.4.2.15 Stejneger's Beaked Whale (*Mesoplodon stejnegeri*)

Stejneger's beaked whales are in the HF cetacean auditory group and the Sensitive behavioral group. Only one stock exists in the Study Area –a combination of those that are not managed under NMFS, classified as a "Worldwide" stock. Model-predicted impacts are presented in Table 2-43. Stejneger's beaked whale are a part of the *Mesoplodon* genus. Most *Mesoplodon* spp. are not well known due to difficulty in identifying individual species at-sea; therefore, most information presented about their behavior has been documented to genus level only.

Most *Mesoplodon* species have a wide distribution and are not residential to any location within the Study Area. *Mesoplodon* beaked whales are distributed in all of the world's oceans in deep (greater than 200 m) pelagic waters and are occasionally sighted in waters over the continental shelf. In the North Pacific Ocean, Stejneger's beaked whales occur in temperate to subarctic waters and are more common closer to Alaska than other parts of the Study Area.

Without a population abundance, it is not possible to estimate the annual effects per individual to the Worldwide stock. There is no predicted risk of auditory injury or temporary auditory effects to Stejneger's beaked whales. Most impacts are behavioral responses because beaked whales are in the Sensitive behavioral group and are likely to avoid noise sources.

The risk of repeated impacts on individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. As medium-sized odontocetes with a medium pace of life, Stejneger's beaked whales are likely moderately resilient to missed foraging opportunities due to acoustic disturbance. While beaked whales are mixed breeders (i.e., behaviorally income breeders), they demonstrate capital breeding strategies during gestation and lactation (Keen et al. 2021), so they may be more vulnerable to prolonged loss of foraging opportunities during gestation. Because Mesoplodont beaked whales have a nomadic movement ecology, the risk of repeated impacts on individuals is likely similar within the population as animals move throughout their range.

Several instances of predicted behavioral impacts are unlikely to result in any long-term impacts on individuals. Based on the above analysis, long-term consequences for Stejneger's beaked whales are unlikely.

Table 2-43: Estimated Effects to Stejneger's Beaked Whale Stocks over a Maximum Year of Proposed Activities

Stock	*BEH*	*TTS*	*AINJ*	*Population Abundance*	*Annual Effects per Individual*	*Annual Injurious Effects per Individual*
Worldwide [Nsd]	37,258	-	-	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Asterisk (*) indicates no reliable abundance estimate is available.

2.4.2.16 Striped Dolphin (*Stenella coeruleoalba*)

Striped dolphins are in the HF cetacean auditory group and the Odontocete behavioral group. Two striped dolphin stocks are in the Study Area – the Hawaii stock and a combination of those that are not managed under NMFS, classified as a "Worldwide" stock. Model-predicted impacts are presented in Table 2-44.

Striped dolphins may be found in coastal waters in areas with very narrow continental shelves or where deep waters are found close to shore. They are common in tropical and warm-temperate oceanic waters of the Pacific and Indian Oceans, as well as adjacent seas. In the Hawaiian Islands, they regularly occur in the warm tropical waters. The Hawaii stock of striped dolphins is present year-round in waters primarily seaward of the 1,000-m depth contour, but they are occasionally sighted closer to shore, from a depth range of 100 to 1,000 m. In the western North Pacific Ocean, striped dolphins rarely occur in the Sea of Japan, East China Sea, Yellow Sea, and Okhotsk Sea.

On average, individuals in the Hawaii stock would be impacted less than once per year. Without a population abundance, it is not possible to estimate the annual effects per individual to the Worldwide stock. There is no predicted risk of auditory injury to either stock. There would be only a few temporary auditory effects to either stock. The vast majority of effects would be behavioral responses. Several instances of behavioral disturbance over a year are unlikely to have any long-term consequences for individuals. The risk of effects may be reduced through visual observation mitigation, especially since striped dolphins tend to travel in large groups.

The risk of repeated exposures to individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. As income breeders with a small body and medium pace of life, striped dolphins are somewhat resilient to missed foraging opportunities due to acoustic disturbance, except for during lactation. Striped dolphins are nomadic, so the risk of repeated exposures to individuals is likely similar within the population as animals move throughout their range year-round. Both stocks of striped dolphins have unknown population trends. Because of their longer generation times, this population would require more time to recover if significantly impacted.

Several instances of predicted behavioral responses or temporary auditory effects are unlikely to result in any long-term impacts on individuals. Based on the above analysis, long-term consequences for the Hawaii Pelagic stock and Worldwide stock of striped dolphins are unlikely.

Table 2-44: Estimated Effects to Striped Dolphin Stocks over a Maximum Year of Proposed Activities

Stock	*BEH*	*TTS*	*AINJ*	*Population Abundance[1]*	*Annual Effects per Individual*	*Annual Injurious Effects per Individual*
Hawaii	199	(1)	-	64,343	0.00	0.00
Worldwide Nsd	4,325	2	-	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Values in parentheses are rounded up from less than 0.5 based on the 7-year rounding rules discussed in Section 2.4.
Asterisk (*) indicates no reliable abundance estimate is available.
[1] Population abundance values come from most recent NMFS Pacific Ocean Stock Assessment Reports (Carretta et al. 2023), where available.

2.4.3 Impacts on Pinnipeds

The pinnipeds analyzed below are either in the Phocid Carnivores in Water (PCW) or the Otariids and other non-phocid marine carnivores in Water (OCW) auditory groups. The updated PCW criteria reflect greater susceptibility to auditory effects at low and mid-frequencies than previously analyzed. The updated OCW criteria reflects substantially greater susceptibility to auditory effects across their hearing range compared to previous analyses. For sonar exposures, the updated Pinniped in-water behavioral response function indicates greater sensitivity to behavioral disturbance compared to the prior analysis. As described in Section 2.2.2 (Quantifying Impacts on Hearing), the methods to model avoidance of sonars have been revised to base a species' probability of an avoidance responses on the behavioral response function. In addition, the cut-off conditions for predicting significant behavioral responses have been revised as shown in Section 2.2.3 (Quantifying Behavioral Responses to Sonars). These factors interact in complex ways that make comparing the results of this analysis to prior analyses challenging. Overall impacts due to sonar have increased for pinnipeds compared to the prior analysis, which is primarily due to the changes in auditory and behavioral criteria mentioned above, and changes to species densities (see the *Density TR*).

2.4.3.1 Bearded Seal (*Erignathus barbatus*)*

Bearded seals are in the PCW hearing group and the pinniped behavioral group. Only one stock exists in the Study Area – the Beringia stock. The Beringia DPS is ESA-listed as threatened. Model-predicted impacts are presented in Table 2-45. While this DPS predominantly occurs outside of the Study Area, there have been sightings of vagrant individuals within the Study Area.

Bearded seals have a discontinuous circumpolar distribution, ranging from the Arctic, to as far south as the subarctic areas of Hokkaido in the Western Pacific. They inhabit shallow continental shelf waters that are restricted to seasonal sea ice. In addition to sea ice, their seasonal distribution is limited by distribution of benthic prey. Bearded seals are not considered migratory; however, they do follow the advance and retreat of sea ice formation. Therefore, when present within the Study Area, they are predominantly found further south of the Arctic circle, away from sea ice and in the colder season. No effects to bearded seals are expected in the warm season.

Without a population abundance, it is not possible to estimate the annual effects per individual for bearded seals. There are no auditory injuries or temporary auditory effects predicted for this stock. Less than one behavioral response is predicted throughout the year. Single instances of behavioral disturbance over a year are unlikely to have any long-term consequences for individuals.

The risk of repeated impacts on individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. Bearded seals are small capital breeders, but pinnipeds have a relatively lower energy requirement for their body size, which may moderate any impact due to foraging disruption. Population trends for bearded seals are unknown. Their fast pace of life means that bearded seals would require less time to recover if significantly impacted.

A few behavioral disturbances over a year are unlikely to have any long-term consequences for individuals. Based on the above analysis, long-term consequences for the Beringia stock of bearded seals are unlikely.

The use of SURTASS LFA sound source during training activities <u>may affect, and are likely to adversely affect</u>, bearded seals.

Table 2-45: Estimated Effects to Bearded Seal Stocks over a Maximum Year of Proposed Activities

Stock	***BEH***	***TTS***	***AINJ***	***Population Abundance[1]***	***Annual Effects per Individual***	***Annual Injurious Effects per Individual***
Beringia	(1)	-	-	301,836	0.00	0.00

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Values in parentheses are rounded up from less than 0.5 based on the 7-year rounding rules discussed in Section 2.4.
Asterisk (*) indicates no reliable abundance estimate is available.
[1] Population abundance values come from most recent NMFS Pacific Ocean Stock Assessment Reports (Carretta et al. 2023), where available.

2.4.3.2 Harbor Seal (*Phoca vitulina*)

Harbor seals are in the PCW hearing group and Pinniped behavioral group. The only stock of harbor seals in the Study Area is the California stock. Model-predicted impacts to the California stock are presented in Table 2-46.

The California stock of harbor seals occupy bays, estuaries, and inlets and prefer waters near haul out locations. They are found in temperate and polar regions in the Northern Hemisphere. Within the Study Area, seals are found from the Aleutian Islands across to the Commander Islands, Russia, down south to Kamchatka through the Kuril Islands to Hokkaido, Japan. Harbor seals are considered non-migratory, although tagging evidence suggests they can travel far outside of their natal ranges for seasonally available food sources or to give birth. They are highly gregarious at haul out sites, with daily haul outs, based on tidal cycles.

On average, individuals in this stock would be impacted less than once per year. There are no auditory injuries or temporary auditory effects predicted for this stock. At most, a single behavioral impact is predicted throughout the year. Single instances of behavioral disturbance over a year are unlikely to have any long-term consequences for individuals.

The risk of repeated impacts to individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. Harbor seals have a fast pace of life, but pinnipeds have a relatively lower energy requirement for their body size, which may moderate any impact due to foraging disruption. The California stock of harbor seals is mostly residential, so the risk of repeated effects is unlikely as individuals within the population that inhabit Port Hueneme and San Nicholas Island are outside the Study Area. Their fast pace of life and increasing population trend means that this population would require less time to recover if significantly impacted.

A few instances of behavioral disturbance over a year are unlikely to have any long-term consequences for individuals. Based on the above analysis, long-term consequences for the California stock of harbor seals are unlikely.

Table 2-46: Estimated Effects to Harbor Seal Stocks over a Maximum Year of Proposed Activities

Stock	***BEH***	***TTS***	***AINJ***	***Population Abundance[1]***	***Annual Effects per Individual***	***Annual Injurious Effects per Individual***
California	(1)	-	-	30,968	0.00	0.00

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Values in parentheses are rounded up from less than 0.5 based on the 7-year rounding rules discussed in Section 2.4.
Asterisk (*) indicates no reliable abundance estimate is available.
[1] Population abundance values come from most recent NMFS Pacific Ocean Stock Assessment Reports (Carretta et al. 2023), where available.

2.4.3.3 Hawaiian Monk Seal (*Neomonachus schauinslandi*)*

Hawaiian monk seals are in the PCW hearing group and Pinniped behavioral group. Model-predicted impacts are presented in Table 2-47. The only stock of Hawaiian monk seals in the Study Area is the Hawaiian stock which is endangered throughout its range. Although Hawaiian monk seals are analyzed using the same criteria and thresholds as other pinnipeds, the best available scientific information suggests that their hearing is less sensitive than other pinnipeds (Ruscher et al. 2021; Sills et al. 2021). Therefore, the quantitative analysis presented below is likely to be conservative.

Hawaiian monk seals are residents of the main Hawaiian Islands and Northwest Hawaiian Islands where they breed, but sightings have been reported south of the Hawaiian island chain. They mostly inhabit nearshore or shallow waters but have been observed traveling between islands, atolls, and submerged reefs, and even on occasion making pelagic foraging trips. Hawaiian monk seals are generally solitary, and while some individuals adhere to a single island, others regularly travel between islands within their range year-round.

On average, individuals in the Hawaii stock would be impacted less than once per year. The potential for repeated effects to individuals is almost nonexistent. There are no auditory injuries or temporary auditory effects predicted for this stock. Only a single behavioral response is predicted throughout the year. Single instances of behavioral disturbance over a year are unlikely to have any long-term consequences for individuals.

The risk of repeated impacts to individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. Hawaiian monk seals have a fast pace of life and capital breeding strategy which makes them more resilient to short-term foraging disruptions. Their primary habitat in the Northwestern Hawaiian Islands is within the Hawaii region, and their main Hawaiian Islands habitat is within Hawaii. Because Hawaiian monk seals are residential, and the population is located entirely within the Hawaii region, the risk of repeated exposure is higher for this species compared to other pinnipeds with nomadic or migratory movement ecology.

Although Hawaiian monk seals are endangered, they have a stable and possibly increasing population trend. One to a few instances of behavioral disturbance over a year are unlikely to have any long-term consequences for individuals. Based on the above analysis, long-term consequences for the Hawaiian stock of Hawaiian monk seals are unlikely.

The use of SURTASS LFA sound source during training activities <u>may affect, and are likely to adversely affect</u>, Hawaiian monk seals.

Table 2-47: Estimated Effects to Hawaiian Monk Seal Stocks over a Maximum Year of Proposed Activities

Stock	*BEH*	*TTS*	*AINJ*	*Population Abundance[1]*	*Annual Effects per Individual*	*Annual Injurious Effects per Individual*
Hawaii	1	-	-	1,564	0.00	0.00

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Asterisk (*) indicates no reliable abundance estimate is available.
[1] Population abundance values come from most recent NMFS Pacific Ocean Stock Assessment Reports (Carretta et al. 2023), where available.

2.4.3.4 Northern Fur Seal (*Callorhinus ursinus*)

Only one stock exists in the Study Area –a combination of those that are not managed under NMFS, classified as a “Worldwide” stock. Fur seals are in the OCW hearing group and the Pinniped behavioral group. Model-predicted impacts to the Worldwide stock are presented in Table 2-48.

Northern fur seals are found primarily over the edge of the continental shelf and slope in the north Pacific. They are widely distributed from about 35 °N northward to the Bering Sea, including the Sea of Okhotsk and the Sea of Japan. Adults come ashore for about 40 days during the breeding season and remain on land during most of that period. In late fall, seals leave their rookeries and migrate southward to foraging areas for the winter. Therefore, they are predominantly found further south, away from sea ice and within the Study Area in the colder season. No effects to northern fur seals are expected in the warm season.

Without a population abundance, it is not possible to estimate the annual effects per individual to the Worldwide stock. There are no auditory injuries or temporary auditory effects predicted for this stock. The majority of impacts are multiple behavioral disturbances throughout the year.

The risk of repeated impacts to individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. Northern fur seals have a fast pace of life, but pinnipeds have a relatively lower energy requirement for their body size, which may moderate any impact due to foraging disruption. The Worldwide stock of northern fur seals is considered migratory, so the risk of repeated impacts on individuals is lower. Although the Worldwide stock is declining, they are migratory and therefore less susceptible to repeated impacts as they travel seasonally through their range. Northern fur seals have shorter generation times, so this stock would require less time to recover if significantly impacted.

A few instances of disturbance over a year are unlikely to have any long-term consequences for individuals. Based on the above analysis, long-term consequences for the Worldwide stock of Northern fur seals are unlikely.

Table 2-48: Estimated Effects to Northern Fur Seal Stocks over a Maximum Year of Proposed Activities

Stock	*BEH*	*TTS*	*AINJ*	*Population Abundance*	*Annual Effects per Individual*	*Annual Injurious Effects per Individual*
Worldwide [Nsd]	1,296	0	-	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Asterisk (*) indicates no reliable abundance estimate is available.

2.4.3.5 Ribbon Seal (*Histriophoca fasciata)*

Ribbon seals are in the PCW hearing group and the pinniped behavioral group. Only one stock exists in the Study Area – a combination of those that are not managed under NMFS, classified as a "Worldwide" stock. Model-predicted impacts are presented in Table 2-49.

Ribbon seals are a pagophilic (ice-dependent) species with a distribution limited to the northernmost Pacific Ocean and Arctic Ocean including the Chukchi Sea, with predominant occurrences in the Bering Sea and Sea of Okhotsk. They are associated with the southern edge of the pack ice from winter through early summer, where they pup and molt on the ice. During the summer months, they tend to be more pelagic, encompassing a broader distributional range less associated with the sea ice.

Without a population abundance, it is not possible to estimate the annual effects per individual for ribbon seals. The risk of auditory injury is very low, with only less than one instance per year predicted. Most impacts to ribbon seals are temporary auditory effects and behavioral responses. Although these effects occur frequently throughout the year, they are only temporary disturbances, therefore, these instances are unlikely to have any long-term consequences for individuals.

The risk of repeated impacts to individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. Ribbon seals have a fast pace of life, but pinnipeds have a relatively lower energy requirement for their body size, which may moderate any impact due to foraging disruption. The Worldwide stock of ribbon seals is considered semi-resident and nomadic, so the risk of repeated impacts on individuals is lower. Although the Worldwide stock is declining, they are migratory and therefore less susceptible to repeated impacts as they travel seasonally through their range. Ribbon seals have shorter generation times, so this stock would require less time to recover if significantly impacted.

A large amount of temporary auditory effects and behavioral responses over a year, while likely to have short-term impacts to individuals, are unlikely to have any long-term consequences. Based on the above analysis, long-term consequences for ribbon seals are unlikely.

Table 2-49: Estimated Effects to Ribbon Seal Stocks over a Maximum Year of Proposed Activities

Stock	*BEH*	*TTS*	*AINJ*	*Population Abundance*	*Annual Effects per Individual*	*Annual Injurious Effects per Individual*
Worldwide [Nsd]	3,376	34,279	(1)	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Values in parentheses are rounded up from less than 0.5 based on the 7-year rounding rules discussed in Section 2.4.
Asterisk (*) indicates no reliable abundance estimate is available.

2.4.3.6 Ringed Seal (*Phoca [pusa] hispida*)*

Ringed seals are in the PCW hearing group and the pinniped behavioral group. The Arctic subspecies (*P. h. hispida*), which includes seals in the Arctic and Bering Seas, and the Okhotsk subspecies (*P. h. ochotensis*), which includes seals in the Sea of Okhotsk and the northern Sea of Japan, both border the Study Area and are listed as threatened under the ESA. While both subspecies occur outside of the Study Area, there have been sightings of vagrant individuals from these subspecies within the Study Area. For analysis purposes, these were combined into one stock, not managed under NMFS, classified as a “Worldwide” stock. Model-predicted impacts are presented in Table 2-50.

Ringed seals have a continuous, circumpolar Arctic distribution that continues into the straits, Hudson Bay, and the Bering Sea. Isolated populations also exist outside the Arctic. Their distributions strongly correlate with pack and shore-fast ice, depending on the season and time of year. Therefore, when present within the Study Area, they are predominantly found further south of the Arctic circle, away from sea ice and in the colder season. No effects to ringed seals are expected in the warm season.

Without a population abundance, it is not possible to estimate the annual effects per individual for ringed seals. There are no auditory injuries predicted for this stock. There is less than a single temporary auditory effect predicted throughout the year and minimal behavioral responses are predicted. These instances of behavioral disturbance over a year are unlikely to have any long-term consequences for individuals.

The risk of repeated impacts on individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. Ringed seals are small capital breeders, but pinnipeds have a relatively lower energy requirement for their body size, which may moderate any impact due to foraging disruption. Population trends for ringed seals are unknown, but likely stable. Their fast pace of life means that ringed seals would require less time to recover if significantly impacted.

A few instances of behavioral disturbance and limited temporary auditory effects over a year are unlikely to have any long-term consequences for individuals. Based on the above analysis, long-term consequences for ringed seals are unlikely.

The use of SURTASS LFA sound source during training activities <u>may affect, and are likely to adversely affect</u>, ringed seals.

Table 2-50: Estimated Effects to Ringed Seal Stocks over a Maximum Year of Proposed Activities

Stock	BEH	TTS	AINJ	Population Abundance	Annual Effects per Individual	Annual Injurious Effects per Individual
Worldwide Nsd	24	(1)	-	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Values in parentheses are rounded up from less than 0.5 based on the 7-year rounding rules discussed in Section 2.4.
Asterisk (*) indicates no reliable abundance estimate is available.

2.4.3.7 Spotted Seal (*Phoca largha*)*

Spotted seals are in the PCW hearing group and the pinniped behavioral group. Only one stock exists in the Study Area – the Alaska Bering Stock, which encompasses the Southern DPS. The southern DPS is a foreign ESA-listed species that is threatened throughout its range. Model-predicted impacts are presented in Table 2-51.

Spotted seals occur in cold temperate and polar waters of the North Pacific and Arctic Oceans, including the Yellow Sea, East China Sea, Sea of Japan, Sea of Okhotsk, Bering Sea, and Chukchi Sea. They are found either in the open ocean or in pack-ice habitats throughout the year, including the ice over continental shelves during the winter and spring. They haul out on sea ice, but they also come ashore on land during the ice-free seasons of the year. Their range contracts and expands in correlation to ice cover, with their distribution being the most concentrated during colder, winter months.

Without a population abundance, it is not possible to estimate the annual effects per individual for spotted seals. There are no auditory injuries predicted for this stock. There is less than a single temporary auditory effect predicted throughout the year. The majority of impacts would be from behavioral responses. These instances of behavioral disturbance over a year are unlikely to have any long-term consequences for individuals.

The risk of repeated impacts on individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. Spotted seals are small capital breeders, but pinnipeds have a relatively lower energy requirement for their body size, which may moderate any impact due to foraging disruption. Population trends for spotted seals are unknown. Their fast pace of life means that spotted seals would require less time to recover if significantly impacted.

A few instances of behavioral disturbance and limited temporary auditory effects over a year are unlikely to have any long-term consequences for individuals. Based on the above analysis, long-term consequences for spotted seals are unlikely.

The use of SURTASS LFA sound source during training activities <u>may affect, and are likely to adversely affect</u>, spotted seals.

Table 2-51: Estimated Effects to Spotted Seal Stocks over a Maximum Year of Proposed Activities

Stock	*BEH*	*TTS*	*AINJ*	*Population Abundance*	*Annual Effects per Individual*	*Annual Injurious Effects per Individual*
Southern DPS	70	(1)	-	*	*	*

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Values in parentheses are rounded up from less than 0.5 based on the 7-year rounding rules discussed in Section 2.4.
Asterisk (*) indicates no reliable abundance estimate is available.

2.4.3.8 Steller Sea Lion (*Eumetopias jubatus*)*

Steller sea lions are in the OCW hearing group and the Pinniped behavioral group. Only one stock exists in the Study Area – the Western DPS. The Western DPS is ESA-listed as endangered throughout its range. Model-predicted impacts are presented in Table 2-52.

Steller sea lions are found in temperate and sub-polar waters. They are widely distributed throughout the North Pacific Ocean, ranging from central California, up and across the southern Bering Sea, down to Japan and Korea, including the Sea of Japan and Sea of Okhotsk. They occur in coastal to outer continental shelf waters and cross deep oceanic waters in parts of their range. They can make long-distance movements, but they are generally considered non-migratory. However, some individuals, particularly females, have exhibited migratory behaviors

On average, individuals in the Western DPS would be impacted less than once per year. There are no auditory injuries or non-auditory injuries predicted for the stock. There is less than a single behavioral response predicted throughout the year. One instance of behavioral disturbance over a year is unlikely to have any long-term consequences for individuals.

The risk of repeated impacts on individuals and consequences to populations from disturbances of individuals can be mediated by certain life history traits of a species. Steller sea lions are small capital breeders, but pinnipeds have a relatively lower energy requirement for their body size, which may moderate any impact due to foraging disruption. Population trends for spotted seals are unknown. Their fast pace of life means that Steller sea lions would require less time to recover if significantly impacted.

A single behavioral disturbance over a year is unlikely to have any long-term consequences for individuals. Based on the above analysis, long-term consequences for Steller sea lions are unlikely.

The use of SURTASS LFA sound source during training activities <u>may affect, and are likely to adversely affect</u>, Steller sea lions.

Table 2-52: Estimated Effects to Steller Sea Lion Stocks over a Maximum Year of Proposed Activities

Stock	*BEH*	*TTS*	*AINJ*	*Population Abundance*	*Annual Effects per Individual*	*Annual Injurious Effects per Individual*
Western DPS	(1)	-	-	49,837	0.00	0.00

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
For BEH, TTS, AINJ annual estimated effects: A dash (-) indicates a (true zero).
Values in parentheses are rounded up from less than 0.5 based on the 7-year rounding rules discussed in Section 2.4.
Asterisk (*) indicates no reliable abundance estimate is available.
[1] Population abundance values come from most recent NMFS Alaska Ocean Stock Assessment Reports (Young 2023), where available.

2.4.4 Impact Summary Tables

The tables in in this section show maximum impacts due to sonar use during SURTASS LFA sonar training activities to all stocks under both Action Alternatives. Stocks for which no take is requested are not shown. The maximum annual impacts per stock are the same values presented in each species impact assessment above. See Table 2-53 for annual impacts and Table 2-54 for impacts summed over a seven-year period.

1 **Table 2-53: Estimated Effects to Marine Mammal Stocks from SURTASS LFA Sonar over One Year of Maximum Sonar Use**

Species	Stock or Population	Alternative 1 (Preferred Alt)			Alternative 2		
		BEH	TTS	AINJ	BEH	TTS	AINJ
ESA-Listed							
Blue whale	Worldwide [Nsd]	1	1,061	3	1	1,585	5
	Central North Pacific	1	12	-	1	18	-
Fin whale	Worldwide [Nsd]	2	5,736	32	3	8,573	47
	Hawai'i	0	16	-	1	24	-
Humpback whale	Western North Pacific stock and DPS	5	1,128	4	8	1,685	6
North Pacific right whale	Worldwide [Nsd]	0	325	2	0	485	3
Sei whale	Worldwide [Nsd]	5	2,016	9	8	3,012	13
	Hawai'i	1	4	1	1	7	1
False killer whale	Main Hawaiian Islands Insular	1	-	-	1	-	-
Sperm whale	Worldwide [Nsd]	37	-	-	54	-	-
	North Pacific	224	1	-	335	1	-
	Hawai'i	15	-	-	22	-	-
Hawaiian monk seal	Hawai'i	1	-	-	2	-	-
Ringed seal	Worldwide [Nsd]	24	1	-	36	1	-
Steller sea lion	Western	1	-	-	1	-	-
Non ESA-Listed							
Antarctic minke whale	Worldwide [Nsd]	4	44	-	5	66	-
Bryde's whale	Worldwide [Nsd]	17	799	1	25	1,195	2
	Hawai'i	1	6	-	2	8	-
Humpback whale	Worldwide [Nsd]	1	2	-	1	3	-
	CNP stock and HI DPS	2	11	-	2	16	-
Minke whale	Worldwide [Nsd]	53	2,967	6	80	4,434	9
	Hawai'i	1	2	-	1	3	-
Omura's whale	Worldwide [Nsd]	1	216	1	2	322	1
Bottlenose dolphin	Worldwide [Nsd]	1,897	4	-	2,835	5	-
	Hawai'i Pelagic	31	1	-	46	1	-
Common dolphin	Worldwide [Nsd]	1,712	1	-	2,559	1	-
Dall's porpoise	Worldwide [Nsd]	3,019	1	-	4,511	1	-
Dwarf sperm whale	Worldwide [Nsd]	718	1	-	1,073	1	-
	Hawai'i	151	-	-	226	-	-
False killer whale	Worldwide [Nsd]	60	-	-	90	-	-
	Hawai'i Pelagic	7	-	-	11	-	-

Species	Stock or Population	Alternative 1 (Preferred Alt)			Alternative 2		
		BEH	TTS	AINJ	BEH	TTS	AINJ
Fraser's dolphin	Worldwide Nsd	464	1	-	693	1	-
	Hawai'i	151	1	-	226	1	-
Killer whale	Worldwide Nsd	172	1	-	257	2	-
	Hawai'i	1	-	-	1	-	-
Melon-headed whale	Worldwide Nsd	536	1	-	800	1	-
	Hawaiian Islands	107	-	-	160	-	-
Northern right whale dolphin	Worldwide Nsd	10	-	-	15	-	-
Pacific white-sided dolphin	North Pacific	49	-	-	73	-	-
Pantropical spotted dolphin	Worldwide Nsd	2,784	1	-	4,161	1	-
	Hawai'i Pelagic	233	-	-	348	-	-
Pygmy killer whale	Worldwide Nsd	317	1	-	473	1	-
	Hawai'i	32	-	-	47	-	-
Pygmy sperm whale	Worldwide Nsd	863	1	-	1,289	1	-
	Hawai'i	151	1	-	226	1	-
Risso's dolphin	Worldwide Nsd	1,574	1	-	2,352	1	-
	Hawai'i	38	-	-	56	-	-
Rough-toothed dolphin	Worldwide Nsd	508	-	-	759	-	-
	Hawai'i	299	-	-	447	-	-
Short-finned pilot whale	Worldwide Nsd	1,081	2	-	1,616	3	-
	Hawai'i	76	-	-	113	-	-
Spinner dolphin	Worldwide Nsd	275	1	-	411	1	-
	Hawai'i Pelagic	14	1	-	21	1	-
Striped dolphin	Worldwide Nsd	4,325	2	-	6,463	2	-
	Hawai'i Pelagic	199	1	-	297	1	-
Baird's beaked whale	Worldwide Nsd	64,875	0	-	96,960	0	-
Blainville's beaked whale	Worldwide Nsd	61,964	-	-	92,610	-	-
	Hawai'i	2,073	-	-	3,099	-	-
Deraniyagala beaked whale	Worldwide Nsd	9,448	-	-	14,120	-	-
Ginkgo-toothed beaked whale	Worldwide Nsd	30,341	1	-	45,346	1	-
Goose-beaked whale	Worldwide Nsd	111,484	1	-	166,621	1	-
	Hawai'i	9,185	-	-	13,727	-	-
Hubbs' beaked whale	Worldwide Nsd	25,289	-	-	37,796	-	-
Longman's beaked whale	Worldwide Nsd	69,987	1	-	104,600	1	-
	Hawai'i	5,017	-	-	7,498	-	-
Stejneger's beaked whale	Worldwide Nsd	37,258	-	-	55,684	-	-

Species	Stock or Population	Alternative 1 (Preferred Alt)			Alternative 2		
		BEH	TTS	AINJ	BEH	TTS	AINJ
Bearded seal	Beringia	1	-	-	1	-	-
Harbor seal	California	1	-	-	1	-	-
Northern fur seal	Worldwide [Nsd]	1,296	0	-	1,936	0	-
Ribbon seal	Worldwide [Nsd]	3,376	34,274	1	5,046	51,225	1
Sea otter	Southern Alaska	0	-	-	0	-	-
Spotted seal	Alaska Bering DPS	70	1	-	104	1	-

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
A dash (-) indicates a (true zero) and zero (0) indicates a rounded value less than 0.5.
Stocks are not shown if no effects are estimated.
Nsd = No stock designation under MMPA.
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Table 2-54: Estimated Effects to Marine Mammal Stocks from SURTASS LFA Sonar Over Seven Years of Maximum Sonar Use

Species	Stock or Population	Alternative 1			Alternative 2		
		BEH	TTS	AINJ	BEH	TTS	AINJ
ESA-Listed							
Blue whale	Worldwide Nsd	4	7,422	21	5	11,092	32
	Central North Pacific	1	82	-	1	122	-
Fin whale	Worldwide Nsd	13	40,152	218	19	60,009	326
	Hawai'i	0	111	-	1	165	-
Humpback whale	Western North Pacific stock and DPS	34	7,892	24	50	11,795	36
North Pacific right whale	Worldwide Nsd	0	2,271	11	0	3,394	16
Sei whale	Worldwide Nsd	34	14,106	58	50	21,082	87
	Hawai'i	2	28	1	4	43	1
False killer whale	Main Hawaiian Islands Insular	1	-	-	1	-	-
Sperm whale	Worldwide Nsd	253	-	-	378	-	-
	North Pacific	1,568	1	-	2,344	1	-
	Hawai'i	101	-	-	152	-	-
Hawaiian monk seal	Hawai'i	7	-	-	10	-	-
Ringed seal	Worldwide Nsd	164	1	-	246	1	-
Steller sea lion	Western	2	-	-	3	-	-
Non ESA-Listed							
Antarctic minke whale	Worldwide Nsd	22	305	-	33	456	-
Bryde's whale	Worldwide Nsd	115	5,593	5	172	8,359	8
	Hawai'i	5	36	-	8	55	-
Humpback whale	Worldwide Nsd	1	12	-	1	18	-
	CNP stock and HI DPS	8	71	-	12	106	-
Minke whale	Worldwide Nsd	371	20,764	42	554	31,033	63
	Hawai'i	3	12	-	4	18	-
Omura's whale	Worldwide Nsd	7	1,506	3	10	2,251	4
Bottlenose dolphin	Worldwide Nsd	13,276	23	-	19,841	34	-
	Hawai'i Pelagic	213	2	-	318	2	-
Common dolphin	Worldwide Nsd	11,984	3	-	17,911	4	-
Dall's porpoise	Worldwide Nsd	21,128	2	-	31,577	3	-
Dwarf sperm whale	Worldwide Nsd	5,024	1	-	7,509	2	-
	Hawai'i	1,056	-	-	1,579	-	-
False killer whale	Worldwide Nsd	420	-	-	627	-	-
	Hawai'i Pelagic	49	-	-	73	-	-
Fraser's dolphin	Worldwide Nsd	3,244	3	-	4,848	5	-

Species	Stock or Population	Alternative 1 BEH	Alternative 1 TTS	Alternative 1 AINJ	Alternative 2 BEH	Alternative 2 TTS	Alternative 2 AINJ
	Hawai'i	1,054	2	-	1,576	2	-
Killer whale	Worldwide Nsd	1,200	6	-	1,793	10	-
	Hawai'i	4	-	-	6	-	-
Melon-headed whale	Worldwide Nsd	3,747	2	-	5,599	2	-
	Hawaiian Islands	749	-	-	1,120	-	-
Northern right whale dolphin	Worldwide Nsd	67	-	-	100	-	-
Pacific white-sided dolphin	North Pacific	342	-	-	511	-	-
Pantropical spotted dolphin	Worldwide Nsd	19,485	5	-	29,121	7	-
	Hawai'i Pelagic	1,626	-	-	2,430	-	-
Pygmy killer whale	Worldwide Nsd	2,213	1	-	3,307	1	-
	Hawai'i	218	-	-	326	-	-
Pygmy sperm whale	Worldwide Nsd	6,037	2	-	9,022	2	-
	Hawai'i	1,057	1	-	1,580	1	-
Risso's dolphin	Worldwide Nsd	11,013	2	-	16,460	2	-
	Hawai'i	262	-	-	392	-	-
Rough-toothed dolphin	Worldwide Nsd	3,555	-	-	5,313	-	-
	Hawai'i	2,092	-	-	3,126	-	-
Short-finned pilot whale	Worldwide Nsd	7,567	12	-	11,310	18	-
	Hawai'i	528	-	-	789	-	-
Spinner dolphin	Worldwide Nsd	1,923	1	-	2,874	2	-
	Hawai'i Pelagic	97	1	-	145	1	-
Striped dolphin	Worldwide Nsd	30,269	8	-	45,238	12	-
	Hawai'i Pelagic	1,391	2	-	2,078	3	-
Baird's beaked whale	Worldwide Nsd	454,121	0	-	678,714	0	-
Blainville's beaked whale	Worldwide Nsd	433,748	-	-	648,265	-	-
	Hawai'i	14,511	-	-	21,687	-	-
Deraniyagala beaked whale	Worldwide Nsd	66,130	-	-	98,836	-	-
Ginkgo-toothed beaked whale	Worldwide Nsd	212,383	1	-	317,420	1	-
Goose-beaked whale	Worldwide Nsd	780,388	1	-	1,166,341	2	-
	Hawai'i	64,291	-	-	96,087	-	-
Hubbs' beaked whale	Worldwide Nsd	177,021	-	-	264,569	-	-
Longman's beaked whale	Worldwide Nsd	489,906	2	-	732,197	2	-
	Hawai'i	35,116	-	-	52,483	-	-
Stejneger's beaked whale	Worldwide Nsd	260,803	-	-	389,787	-	-
Bearded seal	Beringia	1	-	-	2	-	-

Species	Stock or Population	Alternative 1			Alternative 2		
		BEH	TTS	AINJ	BEH	TTS	AINJ
Harbor seal	California	1	-	-	2	-	-
Northern fur seal	Worldwide [Nsd]	9,067	0	-	13,551	0	-
Ribbon seal	Worldwide [Nsd]	23,632	239,918	2	35,320	358,573	2
Sea otter	Southern Alaska	0	-	-	0	-	-
Spotted seal	Alaska Bering DPS	486	1	-	726	2	-

BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AINJ = Auditory Injury
A dash (-) indicates a (true zero) and zero (0) indicates a rounded value less than 0.5.
Stocks are not shown if no effects are estimated.
Nsd = No stock designation under MMPA.
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2.5 RANGES TO EFFECTS

The following section provides the range (distance) over which specific physiological or behavioral effects are expected to occur based on the acoustic and explosive criteria in the *Criteria and Thresholds TR*, and the acoustic and explosive propagation calculations from NAEMO described in the *Quantitative Analysis TR*. Ranges are determined by modeling the distance that noise from a source will need to propagate to reach exposure level thresholds specific to a hearing group that will cause behavioral response, TTS, and AINJ. Ranges to effects are utilized to help predict impacts from acoustic and explosive sources and assess the benefit of mitigation zones.

Tables present median and standard deviation ranges to effects for each hearing group. Ranges to effects consider propagation effects of sources modeled at different locations (i.e., analysis points), seasons, source depths, and radials (i.e., each analysis point considers propagation effects in different x-y directions by modeling 18 radials in azimuthal increments of 20° to obtain 360° coverage around an analysis point).

Boxplots visually present the distribution, variance, and outlier ranges for a given combination of a source or bin, hearing group, and effect. On the boxplots, outliers are plotted as dots, the lowest and highest non-outlier ranges are the extent of the left and right horizontal lines respectively that extend from the sides of a colored box, and the 25th, 50th (i.e., median), and 75th percentiles are the left edge, center line, and right edge of a colored box respectively.

2.5.1 RANGES TO EFFECTS TO MARINE MAMMALS

Ranges to effects for sonar were determined by modeling the distance that sound would need to propagate to reach exposure level thresholds specific to a hearing group that would cause behavioral response, TTS, and AINJ, as described in the *Criteria and Thresholds TR*. The ranges do not account for an animal avoiding a source nor for the movement of the platform, both of which would influence the actual range to onset of auditory effects during an actual exposure.

The tables below provide the ranges to TTS and AINJ for an exposure duration of 60 seconds for SURTASS LFA. Due to the lower acoustic thresholds for TTS versus AINJ, ranges to TTS are longer. Successive pings can be expected to add together, further increasing the range to the onset of TTS and AINJ.

The mean, 5th, and 95th percentile behavioral response curves below, provide the probability of behavioral response as a function of range for the sensitive species (beaked whales), mysticete (all baleen whales), odontocete (most toothed whales, most porpoises, and dolphins), and pinniped (true seals and sea lions) behavioral response groups. Boxplots visually present the distribution, variance, and outlier ranges for a given combination of a source or bin, hearing group, and effect. On the boxplots, outliers are plotted as dots, the lowest and highest non-outlier ranges are the extent of the left and right horizontal lines respectively that extend from the sides of a colored box, and the 25*th*, 50*th* (i.e., median), and 75*th* percentiles are the left edge, center line, and right edge of a colored box respectively.

Table 2-55: Cetacean Ranges to Effects for Sonar

Group	*TTS*	*AINJ*
HF	0 m (70 m)	0 m (0 m)
VHF	0 m (0 m)	0 m (0 m)
VLF	65,097 m (21,323 m)	1,000 m (393 m)
LF	3,500 m (14,373 m)	10 m (247 m)

Median ranges with standard deviation ranges in parentheses
HF = High Frequency Cetaceans, VHF = Very High Frequency Cetaceans, VLF = Very Low Frequency Cetaceans, LF = Low Frequency Cetaceans
TTS = Temporary Threshold Shift, AINJ = Auditory Injury

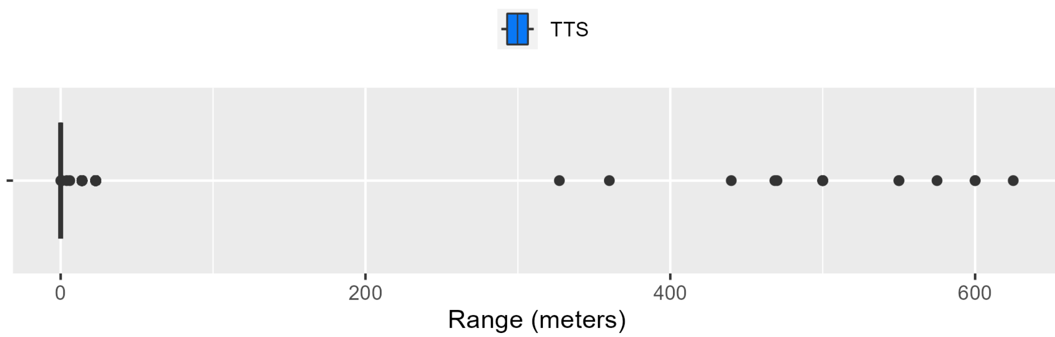

Figure 2-5: HF Cetacean Ranges to Temporary Threshold Shift for Sonar

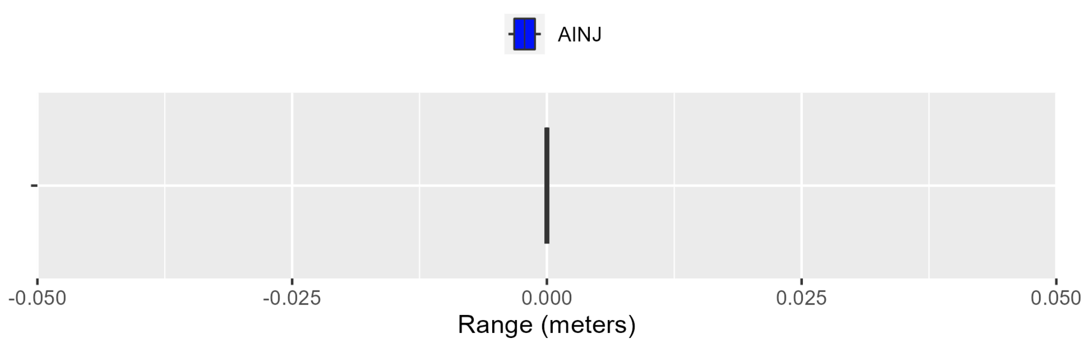

Figure 2-6: HF Cetacean Ranges to Auditory Injury for Sonar

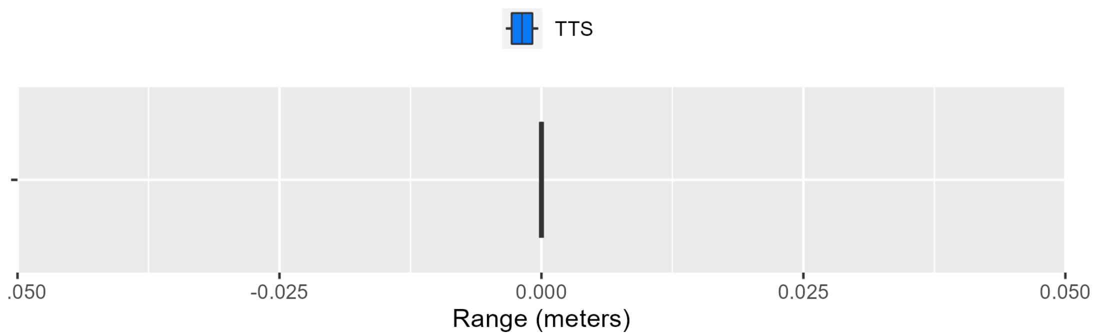

Figure 2-7: VHF Cetacean Ranges to Temporary Threshold Shift for Sonar

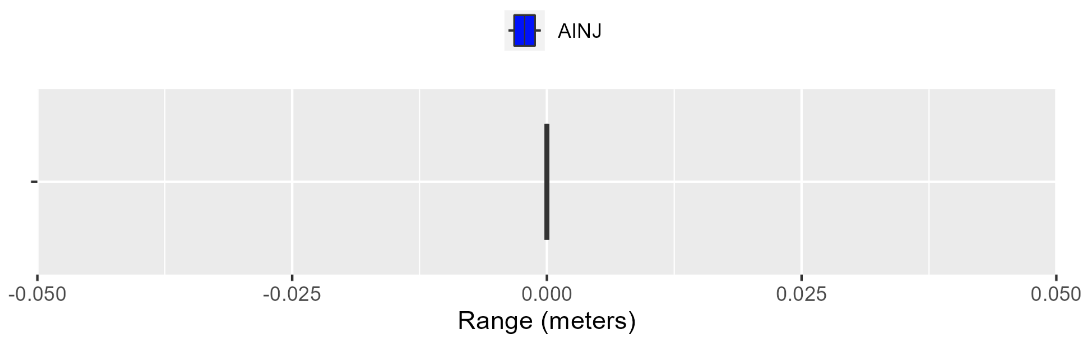

Figure 2-8: VHF Cetacean Ranges to Auditory Injury for Sonar

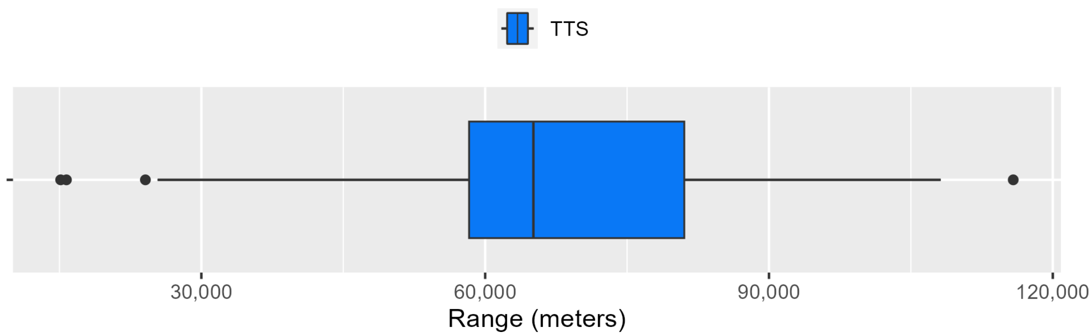

Figure 2-9: VLF Cetacean Ranges to Temporary Threshold Shift for Sonar

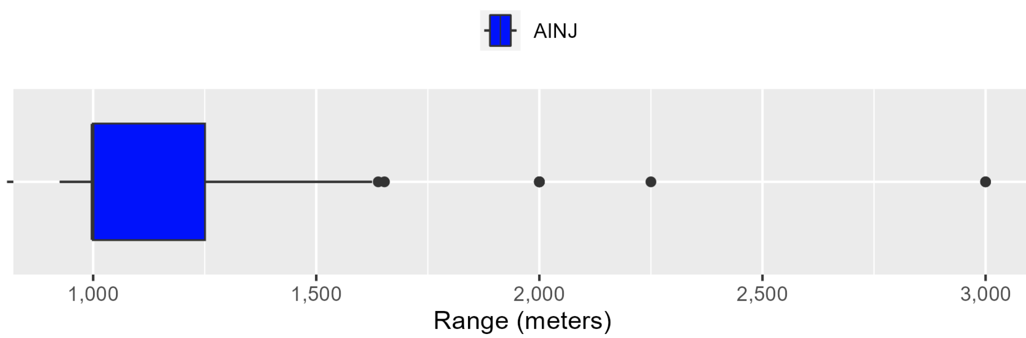

Figure 2-10: VLF Cetacean Ranges to Auditory Injury for Sonar

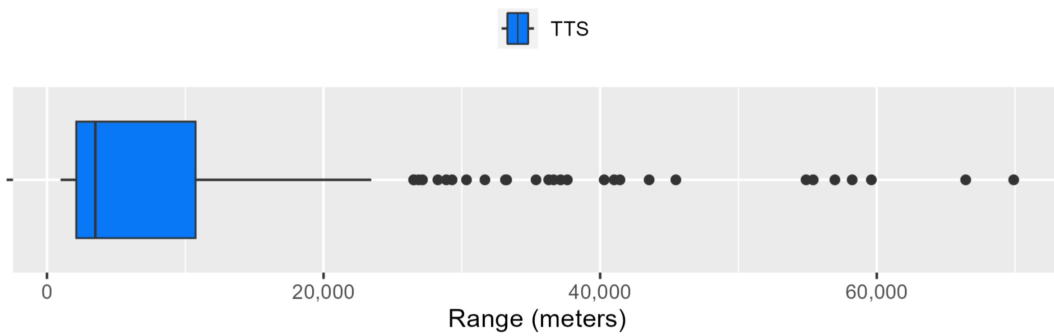

Figure 2-11: LF Cetacean Ranges to Temporary Threshold Shift for Sonar

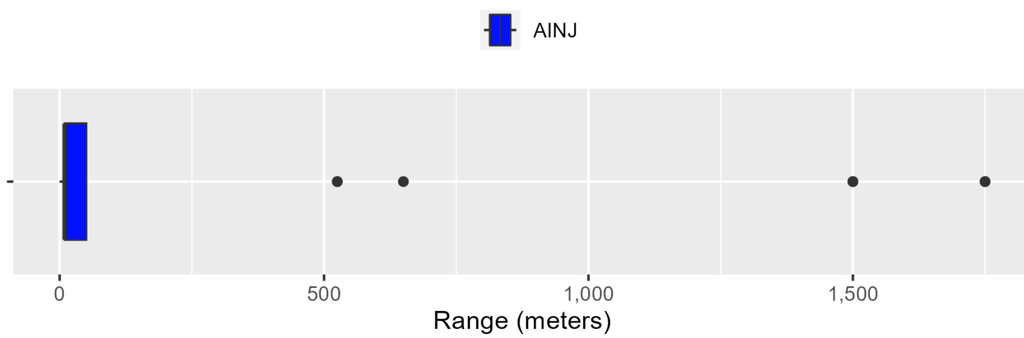

Figure 2-12: LF Cetacean Ranges to Auditory Injury for Sonar

Table 2-56: Pinniped in Water Ranges to Effects for Sonar

Group	*TTS*	*AINJ*
PW	2,500 m (5,755 m)	0 m (95 m)
OW	0 m (0 m)	0 m (0 m)

Median ranges with standard deviation ranges in parentheses
PW = Phocids in Water, OW = Otariids in Water
TTS = Temporary Threshold Shift, AINJ = Auditory Injury

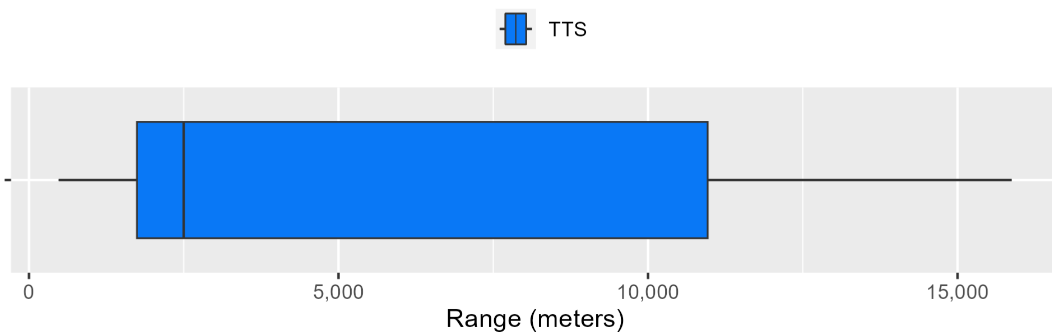

Figure 2-13: Phocids in Water Ranges to Temporary Threshold Shift for Sonar

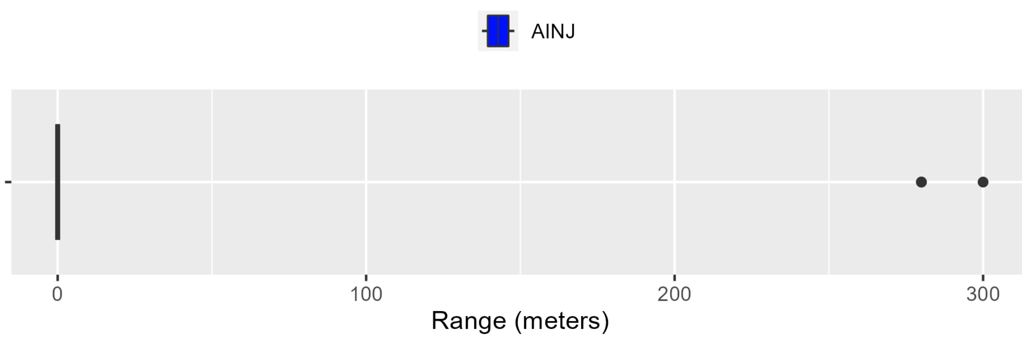

Figure 2-14: Phocids in Water Ranges to Auditory Injury for Sonar

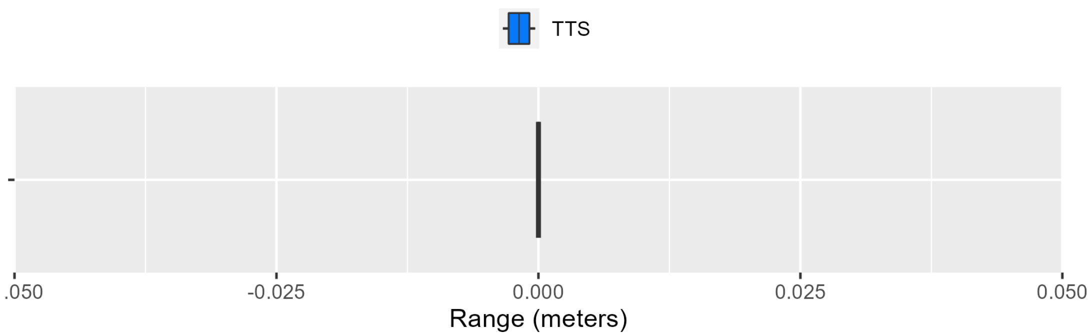

Figure 2-15: Otariids in Water Ranges to Temporary Threshold Shift for Sonar

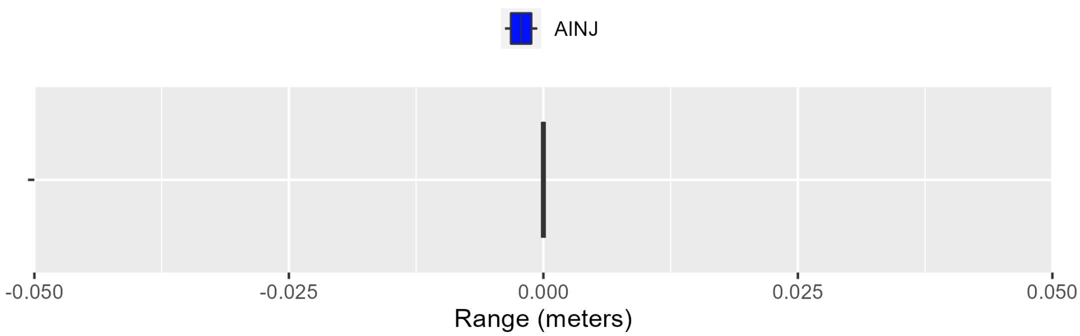

Figure 2-16: Otariids in Water Ranges to Auditory Injury for Sonar

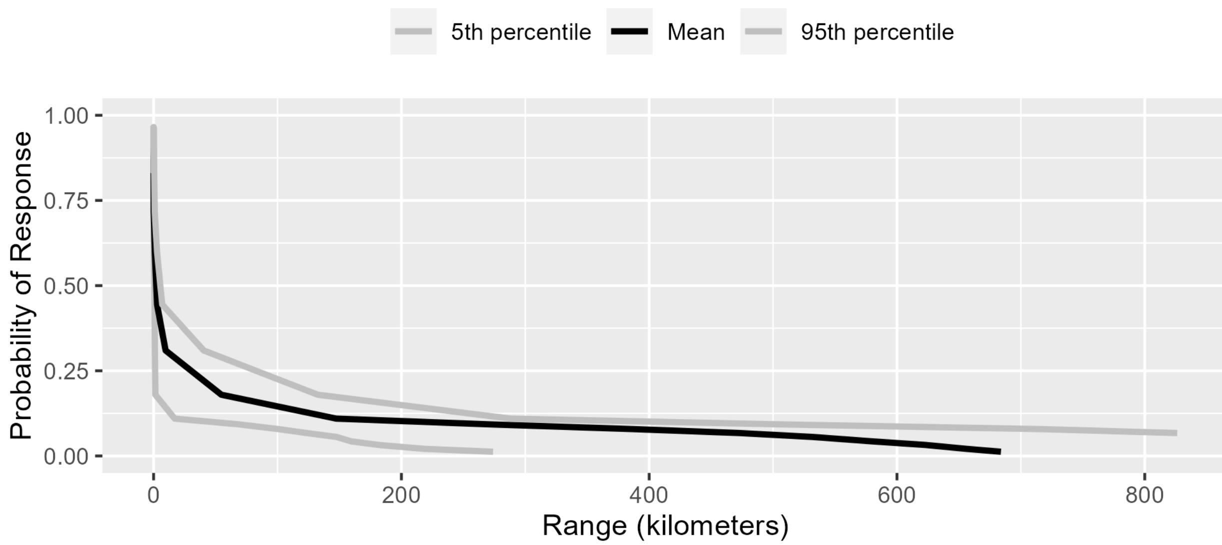

Figure 2-17: Probability of Behavioral Response to Sonar as a Function of Range for Odontocetes

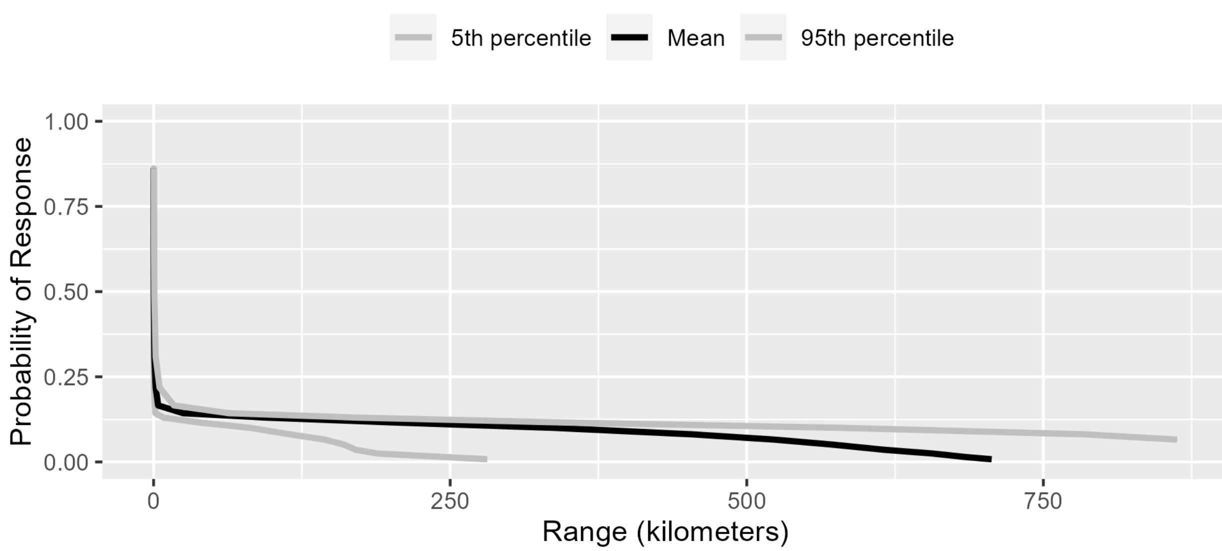

Figure 2-18: Probability of Behavioral Response to Sonar as a Function of Range for Mysticetes

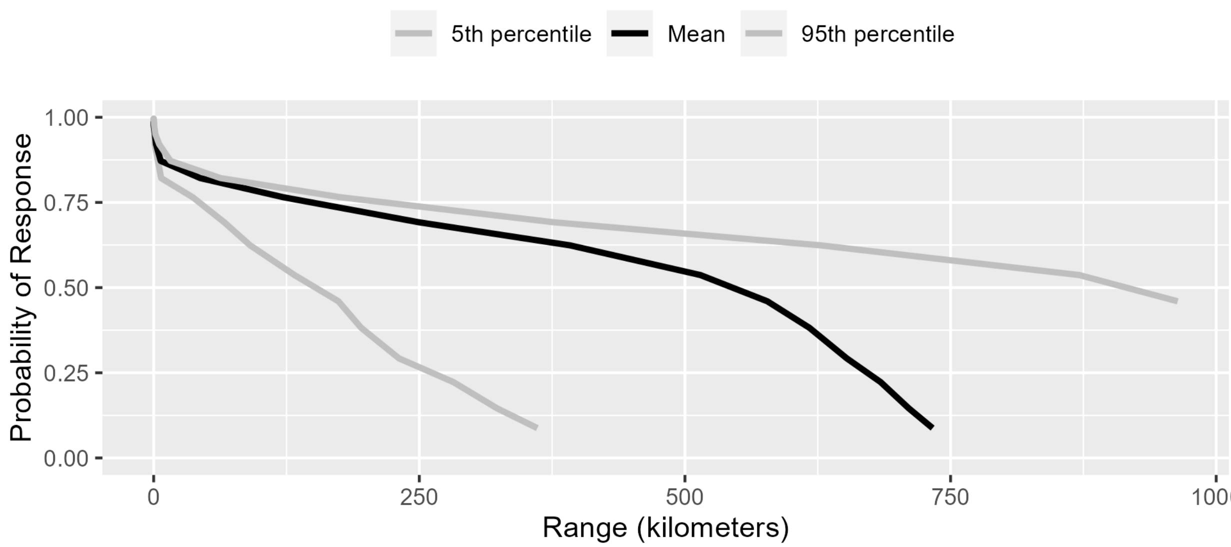

Figure 2-19: Probability of Behavioral Response to Sonar as a Function of Range for Sensitive Species

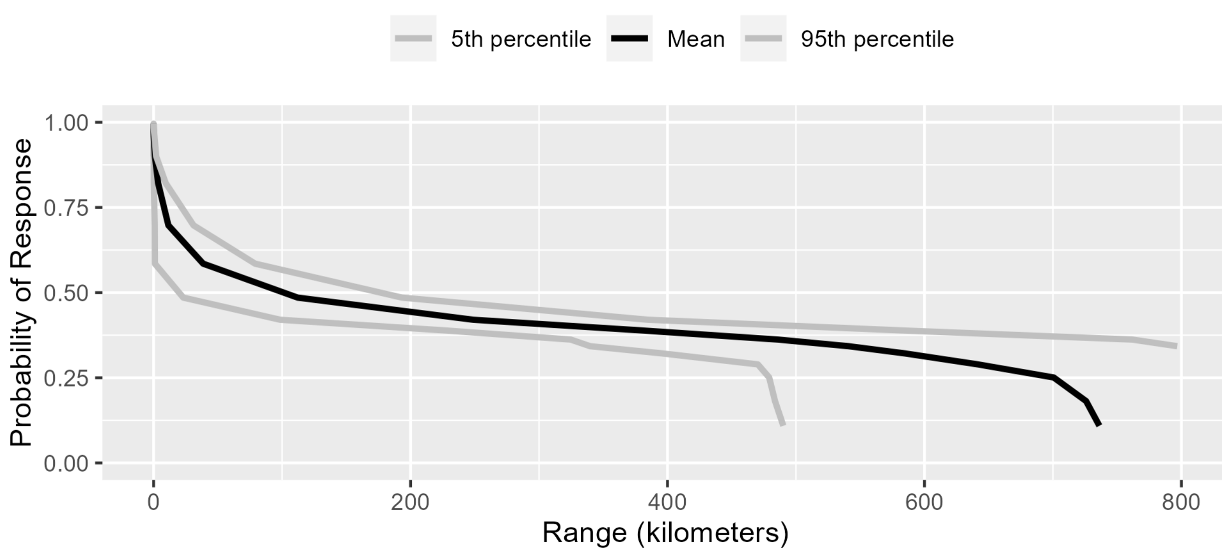

Figure 2-20: Probability of Behavioral Response to Sonar as a Function of Range for Pinnipeds

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APPENDIX E Recreational Dive Sites in the Study Area

This appendix is the supporting recreational dive site information for Section 3.8.1.2 of the Draft SEIS/OEIS. The recreational dive sites listed herein are located within the Study Area and are listed by country and by region or water body within that country, per availability of information (Table E-1). The maximum water depth is provided when available.

Accordingly, the first step in compiling information on the recreational dive sites within the Study Area began with compiling a list of the countries in the Study Area with ocean coastlines. There are 24 countries with marine coastlines located within the Study Area. However, recreational dive site information was not available for all countries. Recreational dive information for the eastern portion of the Russian Federation and for the Democratic People's Republic of Korea was sparse or had no dive sites listed (PADI 2023b). The British Indian Ocean Territory (BIOT) is located in the Study Area, but it is not a tourist destination (scuba and underwater swimming equipment is prohibited) (BIOT 2019). Thus, no information on recreational dive sites in the BIOT, the Russian Federation, or the Democratic People's Republic of Korea are included herein. For countries such as Indonesia, Malaysia, or Australia, only part of the country is located within the Study Area, and dive sites were only compiled for those regions within the Study Area.

Information on recreational dive sites in the remaining countries that fall within the Study Area, including the U.S. (Hawaii, Guam, and CNMI), was compiled from publicly available sources. The compiled recreational dive sites are listed by country. Two websites were particularly useful in compiling information on dive sites: the Professional Association of Diving Instructors (PADI 2023a, 2023b) and the Scuba Schools International (SSI 2023a, 2023b; 2023c). Information on dive sites was also obtained from other available sources, particularly sources that were only focused on specific regions of an individual country. Dive sites for countries were numerous, and for practical purposes, only those most popular or highly rated were included in Table E-1. Based on dive sites where maximum water depth was provided, most recreational dive sites in the Study Area are located in waters less than 130 feet (40 meters).

Table E-1. Recreational Dive Sites in the Study Area by Country and Region

Country	*Region*	*Dive Site Name*[1]	*Maximum Water Depth*	*Reference (s)*
Brunei Darussalam		Abana Reef		(PADI 2023b)
		American Wreck		(PADI 2023b)
		Australian Wreck		(PADI 2023b)
		Baiei Maru Wreck		(PADI 2023b)
		Blue Water Wreck	130 ft (40 m)	(PADI 2023b)
		Cement Wreck		(PADI 2023b)
		Labuan Wreck		(PADI 2023b)
		Oil Rig Reef	60 ft (18 m)	(PADI 2023b)
		Pacific Boxer Wreck		(PADI 2023b)
		Petani Mistral Wreck		(PADI 2023b)
		Southern Glory Wreck		(PADI 2023b)
		Yuho Maru Wreck		(PADI 2023b)
The Commonwealth of Australia	Christmas Islands	Eidsvold Wreck	60 ft (18 m)	(Arrival Guides 2023)
		Flying Fish Cove	60 ft (18 m)	(Arrival Guides 2023)
		Million Dollar Bommie	23 ft (7 m)	(Arrival Guides 2023)
		The Morgue	82 ft (25 m)	(Arrival Guides 2023)
		Perpendicular Wall	118 ft (36 m)	(Arrival Guides 2023)
		Rhoda Wall	100 ft (30.5 m)	(Arrival Guides 2023)
		ThunderCliff Cave		(Arrival Guides 2023; PADI 2023a)
		West White Beach Cave	39 ft (12 m)	(Arrival Guides 2023)
	Cocos (Keeling) Islands	Cabbage Patch	60 ft (18 m)	(Dive Global 2023)
		Cannons	65 ft (20 m)	(Dive Global 2023)
		Cologne Gardens	164 ft (50 m)	(Dive Global 2023)
		Direction Island		(Dive Global 2023)
		Garden of Eden		(Dive Global 2023)
		Manta Ray Corner	29 ft (9 m)	(Dive Global 2023)
		Pulu Keeling National Park		(Dive Global 2023)
		Shark Alley		(Dive Global 2023)
		The Towers		(Dive Global 2023)
		Two Caves		(Dive Global 2023)
	Western Australia	Angel Island		(Wormald 2023)
		Aquarium Reef I		(Wormald 2023)
		Batavia Shipwreck (Abrolhos Islands)	20 ft (6 m)	(WannaDive 2023)
		Blizzard Ridge Lighthouse Bay		(Wormald 2023)
		Coral Bay		(Wormald 2023)
		Explosives		(Wormald 2023)
		Five Mile Reef (Ninagloo Reef)	60 ft (18 m)	(WannaDive 2023)
		Kevin's Reef	Less than 33 ft (10 m)	(Wormald 2023)
		Marney Bay		(Wormald 2023)
		Navy Pier (Exmouth)		(Wormald 2023)

Country	Region	Dive Site Name[1]	Maximum Water Depth	Reference (s)
The Commonwealth of Australia (cont.)	Western Australia (cont.)	North Isladn (Abrolhos Islands)	65 ft (20 m)	(WannaDive 2023)
		Outer Reef Boomies (Ninagloo Reef)	75 ft (23 m)	(WannaDive 2023)
		Rowley Shoals		(WannaDive 2023)
		Shark Bay		(WannaDive 2023)
		Sponge Gardens	20 ft (6 m)	(WannaDive 2023)
The Democratic Socialist Republic of Sri Lanka		Aluth Gala		(PADI 2023b)
		Barracuda Reef, Colombo		(Schofield and Wormald 2022)
		Black Coral Point		(PADI 2023b)
		Boiler Wreck Batticaloa	33 ft (10 m)	(PADI 2023b)
		Bull Dog Reef, Kalpitiya		(Schofield and Wormald 2022)
		Dondra Point		(PADI 2023b)
		Earl of Shaftesbury		(PADI 2023b)
		Gala Pita Gala		(PADI 2023b)
		Goda Gala	75 ft (23 m)	(PADI 2023b)
		Great Bassess Reef		(Schofield and Wormald 2022)
		HMS Hermes	174 ft (53 m)	(PADI 2023b)
		Katana	60 ft (18 m)	(PADI 2023b)
		Kirala Gala		(PADI 2023b)
		Knife Rock	39 ft (12 m)	(PADI 2023b)
		Moray Point		(PADI 2023b)
		Mortar Rock	26 ft (8 m)	(PADI 2023b)
		Napolioan Reef		(PADI 2023b)
		Navy Island	36 ft (11 m)	(PADI 2023b)
		Navy Underwater Dive Museum and Wreck	60 ft (18 m)	(PADI 2023b)
		Pigeon Island (back side)	46 ft (14 m)	(PADI 2023b)
		Pigeon Rock	39 ft (12 m)	(PADI 2023b)
		Polhena Reef		(PADI 2023b)
		Rock Wall		(PADI 2023b)
		The Second and Third Reef, Negombo		(Schofield and Wormald 2022)
		Silva Point		(PADI 2023b)
		Sithanane Pare	60 ft (18 m)	(PADI 2023b)
		S S Conch	69 ft (21 m)	(PADI 2023b)
		S S Orestes	72 ft (22 m)	(PADI 2023b)
		S S Rangoon		(PADI 2023b)
		Swami Rock (Taprobane Reef)		(Schofield and Wormald 2022)
		Welluore Rock	39 ft (12 m)	(PADI 2023b)
		White Rock Batticaloa	39 ft (12 m)	(PADI 2023b)
The Federated States of Micronesia	Chuuk (Truk) Lagoon	Betty Bomber		(SSI 2020)
		Emily Flying Boat		(SSI 2020)

Country	*Region*	*Dive Site Name*[1]	*Maximum Water Depth*	*Reference (s)*
The Federated States of Micronesia (cont.)		Ghost Fleet WWII Wrecks		(SSI 2020)
		Heian Maru		(SSI 2020)
		Hoki Maru		(SSI 2020)
		IJN Fumitsuki		(SSI 2020)
		Kensho Maru		(SSI 2020)
		Kiyosumi Maru		(SSI 2020)
		Nippo Maru		(SSI 2020)
		Rio de Janeiro Maru		(SSI 2020)
		San Francisco Maru/The Million Dollar Wreck		(SSI 2020)
		Sankisan Maru		(SSI 2020)
		Shinkoku Maru		(SSI 2020)
		Unkai Maru		(SSI 2020)
		Yamagiri Maru		(SSI 2020)
		Yubai Maru		(SSI 2020)
	Kosrae Island	Blue Hole		(SSI 2023c)
		Hiroshi Point		(SSI 2023c)
		Walung Drop-Off		(SSI 2023c)
	Palau Island	Blue Corner	72 ft (22 m)	(SSI 2023b)
		German Channel	56 ft (17 m)	(SSI 2023b)
	Palau Island (cont.)	Palau Iro Maru Wreck	46 ft (14 m)	(SSI 2023b)
	Pohnpei Island	Areu Passage Inner Reef Wall	108 ft (33 m)	(PADI 2023b)
		Coral Garden	65 ft (20 m)	(PADI 2023b)
		Dauhauk Bridge	98 ft (30 m)	(PADI 2023b)
		Manta Road	60 ft (18 m)	(PADI 2023b)
		Pehleng Corner	60 ft (18 m)	(PADI 2023b)
	Yap	Rainbow Reef		(PADI 2023a)
		Vertigo		(PADI 2023a)
		Yap Caverns		(PADI 2023a)
Japan		Cape Hedo Dome		(PADI 2023b)
		Cape Maeda (Blue Cave)	130 ft (40 m)	(PADI 2023b)
		Horseshoe Beach	130 ft (40 m)	(PADI 2023b)
		Jam, Kadena North	65 ft (20 m)	(PADI 2023b)
		Kadena North Steps		(PADI 2023b)
		Kin Red	46 ft (14 m)	(PADI 2023b)
		Mermaid's Grotto	130 ft (40 m)	(PADI 2023b)
		Mikomota Island	115 ft (35 m)	(PADI 2023b)
		Okishima	33 ft (10 m)	(PADI 2023b)
		Sea Wall the Center	75 ft (23 m)	(PADI 2023b)
		Sunabe South Steps, Sunabe Seawall	65 ft (20 m)	(PADI 2023b)
		Tatsunokuchi	82 ft (25 m)	(PADI 2023b)
		Toilet Bowl	130 ft (40 m)	(PADI 2023b)
		USS Emmons		(PADI 2023b)

Country	***Region***	***Dive Site Name[1]***	***Maximum Water Depth***	***Reference (s)***
Japan (cont.)		Water Treatment Plant		(PADI 2023b)
		Zamami Island		(PADI 2023b)
The Kingdom of Cambodia		Atlantic	52 ft (16 m)	(PADI 2023b)
		Back Door	49 ft (15 m)	(PADI 2023b)
		Coral Bay	39 ft (12 m)	(PADI 2023b)
		Coral Bay 2		(PADI 2023b)
		Dive shop point	52 ft (16 m)	(PADI 2023b)
		East Reef	26 ft (8 m)	(PADI 2023b)
		Fabrice's Monkey Island	26 ft (8 m)	(PADI 2023b)
		Fly By	46 ft (14 m)	(PADI 2023b)
		Giraffe	46 ft (14 m)	(PADI 2023b)
		Koh Moan	65 ft (20 m)	(PADI 2023b)
		Koh Rong Corner		(PADI 2023b)
		Long Beach Reef		(PADI 2023b)
		Rocky Ridge	79 ft (24 m)	(PADI 2023b)
		Sponge Garden	46 ft (14 m)	(PADI 2023b)
		Sunset Beach Corner	33 ft (10 m)	(PADI 2023b)
		Tree House		(PADI 2023b)
		Vietnamese Bay	43 ft (13 m)	(PADI 2023b)
The Kingdom of Thailand		Alhambra Rock	82 ft (25 m)	(PADI 2023b)
		AlotMeant	26 ft (8 m)	(PADI 2023b)
		Anemone Reef	79 ft (24 m)	(PADI 2023b)
		Angthong Marine Park	52 - 82 ft (16 - 25 m)	(PADI 2023b)
		Ao Kluai	33 ft (10 m)	(PADI 2023b)
		Ao Sane Beach	39 ft (12 m)	(PADI 2023b)
		Ao Tum	46 ft (14 m)	(PADI 2023b)
		Aow Leuk	33 m (10 m)	(PADI 2023b)
		Artificial Reef & Coral Nursery	65 ft (20 m)	(PADI 2023b)
		Aussie Reef – Racha Noi	98 ft (30 m)	(PADI 2023b)
		Banana Bay Racha Noi	82 ft (25 m)	(PADI 2023b)
		Bangsak Wreck		(PADI 2023b)
		Ban's Artificial Reef	39 ft (12 m)	(PADI 2023b)
		Bida Nog Island	112 ft (34 m)	(PADI 2023b)
		Bida Nok Bay	82 – 92 ft (25 – 28 m)	(PADI 2023b)
		Boonsung Wreck	60 ft (18 m)	(PADI 2023b)
		Breman Ship Wreck		(PADI 2023b)
		Buddha Island	49 ft (15 m)	(PADI 2023b)
		Bungalow Bay, Racha Yai	33 ft (10 m)	(PADI 2023b)
		Buoyancy World	52 ft (16 m)	(PADI 2023b)
		Camera Bay, Racha Noi	98 ft (30 m)	(PADI 2023b)
		Chumphon Pinnacle	98 ft (30 m)	(PADI 2023b)
		Green Rock	72 ft (22 m)	(PADI 2023b)
		Haad Yao		(PADI 2023b)

Country	*Region*	*Dive Site Name*[1]	*Maximum Water Depth*	*Reference (s)*
The Kingdom of Thailand (cont.)		Had Nuan (Koh Lan Vak)		(PADI 2023b)
		Hardeep (Suddadip Wreck)	105 ft (32 m)	(PADI 2023b)
		Harruby Wreck	65 ft (20 m)	(PADI 2023b)
		Hideaway Bay		(PADI 2023b)
		Hi Klai		(PADI 2023b)
		Hin Bida		(PADI 2023b)
		Hin Chedi/Rhino Horns	52 ft (16 m)	(PADI 2023b)
		Hin Daeng	98 ft (30 m)	(PADI 2023b)
		Hin gue dueng (The Pinnacle)	98 ft (30 m)	(PADI 2023b)
		Hin Klai (Garan heng)	56 ft (17 m)	(PADI 2023b)
		Hin kuak maa (three fingers)	65 ft (20 m)	(PADI 2023b)
		Hin Lak Ngam	92 ft (28 m)	(PADI 2023b)
		Hin Luk Bath	82 ft (25 m)	(PADI 2023b)
		Hin Muang		(PADI 2023b)
		Hin Ngam	39 ft (12 m)	(PADI 2023b)
		Hin Pae/Rocky Pinnacle	95 ft (29 m)	(PADI 2023b)
		Hin Pee Wee	92 ft (28 m)	(PADI 2023b)
		Hin Raab	72 ft (22 m)	(PADI 2023b)
		Hin Tai Nam (Blueberry Hill)	60 ft (18 m)	(PADI 2023b)
		Hin Wong Bay	65 ft (20 m)	(PADI 2023b)
		Hin Wong Pinnacles		(PADI 2023b)
		Hin Yetti	46 ft (14 m)	(PADI 2023b)
		HTMS Chang Wreck	98 – 112 ft (30 – 34 m)	(PADI 2023b)
		HTMS Khram Shipwreck		(PADI 2023b)
		HTMS Kled Keaw Shipwreck	85 ft (26 m)	(PADI 2023b)
		HTMS Kut Shipwreck		(PADI 2023b)
		HTMS Mataporn Shipwreck		(PADI 2023b)
		HTMS PRAB 741 Wreck	79 ft (24 m)	(PADI 2023b)
		HTMS Sattakut	98 ft (30 m)	(PADI 2023b)
		Japanese Gardens	65 ft (20 m)	(PADI 2023b)
		Junkyard Reef	39 ft (12 m)	(PADI 2023b)
		Kata Beach North	46 ft (14 m)	(PADI 2023b)
		Kata Beach South		(PADI 2023b)
		Khao Na Yak		(PADI 2023b)
		King Cruiser Wreck		(PADI 2023b)
		Koh Bida Nai & Nok		(PADI 2023b)
		Koh Bon		(PADI 2023b)
		Koh Chan		(PADI 2023b)
		Koh Chuang		(PADI 2023b)

Country	*Region*	*Dive Site Name[1]*	*Maximum Water Depth*	*Reference (s)*
The Kingdom of Thailand (cont.)		Koh Doc Mai		(PADI 2023b)
		Koh Ha	98 ft (30 m)	(PADI 2023b)
		Koh Klung Badan Bay		(PADI 2023b)
		Koh Klung Badan South		(PADI 2023b)
		Koh Krock		(PADI 2023b)
		Koh Ma	82 ft (25 m)	(PADI 2023b)
		Koh Manwichai – Finger Reef		(PADI 2023b)
		Koh Ngam Noi	52 ft (16 m)	(PADI 2023b)
		Koh Pai		(PADI 2023b)
		Koh Reath	46 ft (14 m)	(PADI 2023b)
		Koh Rin		(PADI 2023b)
		Koh Rok		(PADI 2023b)
		Koh Sak Deep Reef		(PADI 2023b)
		Koh Sak East		(PADI 2023b)
		Koh Sak West		(PADI 2023b)
		Koh Sii		(PADI 2023b)
		Koh Tachai Similan National Park		(PADI 2023b)
		Koh Talang Steps	98 ft (30 m)	(PADI 2023b)
		Koh Talu	130 ft (40 m)	(PADI 2023b)
		Koh Yawabon		(PADI 2023b)
		Koh Yawasam		(PADI 2023b)
		Kong Rang National Park	49 ft (15 m)	(PADI 2023b)
		Laem Thien		(PADI 2023b)
		Lighthouse Bay	46 ft (14 m)	(PADI 2023b)
		Mai Thon	49 ft (15 m)	(PADI 2023b)
		Mango Bay	39 ft (12 m)	(PADI 2023b)
		Marina Bay/Marita's Rock	130 ft (40 m)	(PADI 2023b)
		Monkey Reef	60 ft (18 m)	(PADI 2023b)
		Nui Beach		(PADI 2023b)
		Palong Well	69 ft (21 m)	(PADI 2023b)
		Phi Phi Islands	98 ft (30 m)	(PADI 2023b)
		Pottery	39 ft (12 m)	(PADI 2023b)
		Racha Noi	130 ft (40 m)	(PADI 2023b)
		Racha Yai	89 ft (27 m)	(PADI 2023b)
		Red Rock	72 ft (22 m)	(PADI 2023b)
		Richelieu Rock		(PADI 2023b)
		Sail Rock	148 ft (45 m)	(PADI 2023b)
		Samaesan		(PADI 2023b)
		Sam Laem	89 ft (27 m)	(PADI 2023b)
		Shark Fin Rock		(PADI 2023b)
		Shark Island	79 ft (24 m)	(PADI 2023b)
		Shark Point		(PADI 2023b)
		Siam Bay, Racha Yai	65 ft (20 m)	(PADI 2023b)
		Similan Islands National Park		(PADI 2023b)

Country	***Region***	***Dive Site Name[1]***	***Maximum Water Depth***	***Reference (s)***
The Kingdom of Thailand (cont.)		Soneva Reef	46 ft (14 m)	(PADI 2023b)
		South Point – Koh Larn		(PADI 2023b)
		South Tip	98 ft (30 m)	(PADI 2023b)
		Southwest	92 ft (28 m)	(PADI 2023b)
		Southwest Pinnacle	98 ft (30 m)	(PADI 2023b)
		Stonehenge	82 ft (25 m)	(PADI 2023b)
		Submarine Reef Koh Sak		(PADI 2023b)
		Surin Islands National Marine Park		(PADI 2023b)
		T11 Wreck	49 ft (15 m)	(PADI 2023b)
		Tanote Bay	60 ft (18 m)	(PADI 2023b)
		Three Trees		(PADI 2023b)
		Twins	60 ft (18 m)	(PADI 2023b)
		Viking Cove		(PADI 2023b)
		White Rock	92 ft (28 m)	(PADI 2023b)
		Yanui Beach	46 ft (14 m)	(PADI 2023b)
Malaysia		Agyll's Reef		(PADI 2023b)
		Gem & Kapas Island		(PADI 2023b)
		Amigo House Sand	39 ft (12 m)	(PADI 2023b)
		Batu Layar	60 ft (18 m)	(PADI 2023b)
		Batu Nisan	39 ft (12 m)	(PADI 2023b)
		Beras Laut	39 ft (12 m)	(PADI 2023b)
		Berlabuh	92 ft (28 m)	(PADI 2023b)
		Cepu		(PADI 2023b)
		Chebeh Island		(PADI 2023b)
		Coral Garden	60 ft (18 m)	(PADI 2023b)
		D' Lagoon	39 ft (12 m)	(PADI 2023b)
		Fan Canyon	95 ft (29 m)	(PADI 2023b)
		Grouper Farm	79 ft (24 m)	(PADI 2023b)
		Intan Bay		(PADI 2023b)
		KM Sipadan	105 ft (32 m)	(PADI 2023b)
		Labas Island		(PADI 2023b)
		Lembu Rock	65-82 ft (20-25 m)	(PADI 2023b)
		Perhentian Island		(PADI 2023b)
		Police Wreck	60 ft (18 m)	(PADI 2023b)
		Pulau Renggis		(PADI 2023b)
		Redang Island	130 ft (40 m)	(PADI 2023b)
		San Choi Wreck	60 ft (18 m)	(PADI 2023b)
Malaysia (cont.)		Serenggeh	65 ft (20 m)	(PADI 2023b)
		Shark Point		(PADI 2023b)
		Soyak Island		(PADI 2023b)

Country	Region	Dive Site Name[1]	Maximum Water Depth	Reference (s)
		Sugar Wreck	60 ft (18 m)	(PADI 2023b)
		Terembu Tiga		(PADI 2023b)
		Varella Wreck		(PADI 2023b)
People's Republic of Bangladesh		Artatore	82 ft (25 m)	(SSI 2023a)
		Bangladesh Wreck	95 ft (29 m)	(SSI 2023a)
		Koludarac Bay		(SSI 2023a)
		Koludarac Cave	125 ft (38 m)	(SSI 2023a)
		Male Srakane Cave	29 ft (9 m)	(SSI 2023a)
		Srakane Wall	148 ft (45 m)	(SSI 2023a)
		Susak-secca Margarina	130 ft (40 m)	(SSI 2023a)
		Vale Inglese, Koludarac		(SSI 2023a)
		Wreck Etnea, Unije	16 ft (5 m)	(SSI 2023a)
		Zabodaski South	16 ft (5 m)	(SSI 2023a)
People's Republic of China		Baifu Bay	92 ft (28 m)	(PADI 2023b)
		Dalian, Liaoning: Old Pian Island	98 ft (30 m)	(PADI 2023b)
		Dongpai Island	72 ft (22 m)	(PADI 2023b)
		Guangdong: Wanshan Island, Zhuhai	82 ft (25 m)	(PADI 2023b)
		Hainan: Dijiezhou Island	98 ft (30 m)	(PADI 2023b)
		Hainan: Wuzhizhou Island	98 ft (30 m)	(PADI 2023b)
		Sharp Island	39 ft (12 m)	(PADI 2023b)
The Republic of China (Taiwan)		Confucius Rock	92 ft (28 m)	(PADI 2023b)
		Soft Coral	60 ft (18 m)	(PADI 2023b)
The Republic of India		Aquarium	46 ft (14 m)	(PADI 2023b)
		Bounty Bay	23 ft (7 m)	(PADI 2023b)
		Broken Ledge	79 ft (24 m)	(PADI 2023b)
		Dixon's Pinnacle	115 ft (35 m)	(PADI 2023b)
		Emerald Reef		(PADI 2023b)
		Halcyon	39 ft (12 m)	(PADI 2023b)
		Inchkeith Wreck	60 ft (18 m)	(PADI 2023b)
		Jackson's Bar	105 ft (32 m)	(PADI 2023b)
		Johnny's Gorge	85 ft (26 m)	(PADI 2023b)
		Kovalam	39 - 65 ft (12-20 m)	(PADI 2023b)
		Minerva Ledge	79 ft (24 m)	(PADI 2023b)
		Neil's Rock		(PADI 2023b)
		Nemo Reef	52 ft (16 m)	(PADI 2023b)
		Neptune Memorial Reef		(PADI 2023b)
		Nivati Rock Light House	72 ft (22 m)	(PADI 2023b)
		Pilot Reef	72 ft (22 m)	(PADI 2023b)
The Republic of India (cont.)		Puffer Paradise	33 ft (10 m)	(PADI 2023b)
		Ravines	115 ft (35 m)	(PADI 2023b)
		Red Light House	39 ft (12 m)	(PADI 2023b)
		Sail Rock	39 ft (12 m)	(PADI 2023b)

Country	*Region*	*Dive Site Name[1]*	*Maximum Water Depth*	*Reference (s)*
		Shelter Cove	23 ft (7 m)	(PADI 2023b)
		Slope	65 ft (20 m)	(PADI 2023b)
		Suzy's Wreck	49 ft (15 m)	(PADI 2023b)
		The Wall	180 ft (55 m)	(PADI 2023b)
		Tribe Gate	49 ft (15 m)	(PADI 2023b)
		Turbo Tunnel	26 ft (8 m)	(PADI 2023b)
		Turtle Beach	72-98 ft (22-30 m)	(PADI 2023b)
		Wall of Wonder	98 ft (30 m)	(PADI 2023b)
		White House Rock	130 ft (40 m)	(PADI 2023b)
The Republic of Indonesia	Penida Island	Amok		(PADI 2023b)
		Batu Nunggul		(PADI 2023b)
		Blue Corner	130 ft (40 m)	(PADI 2023b)
		Buyuk		(PADI 2023b)
		Ceningan Wall		(PADI 2023b)
		Crystal Bay		(PADI 2023b)
		Gamat Bay		(PADI 2023b)
	Penida Island (cont.)	Gili Asahan		(PADI 2023b)
		Karang Sari		(PADI 2023b)
		Mangrove		(PADI 2023b)
		Mangrove Point	130 ft (40 m)	(PADI 2023b)
		Manta Bay 3 – The Crack	82 ft (25 m)	(PADI 2023b)
		Ped		(PADI 2023b)
		Pura Mas Gading		(PADI 2023b)
		Sampalan	82 ft (25 m)	(PADI 2023b)
		SD		(PADI 2023b)
		Semaya		(PADI 2023b)
		Sental		(PADI 2023b)
		Toyapakeh		(PADI 2023b)
		Tugu		(PADI 2023b)
		Cannibal Rock	148 ft (45 m)	(PADI 2023b)
		Gili Asahan		(PADI 2023b)
		Gili Medas		(PADI 2023b)
		Gili Sarang		(PADI 2023b)
		Magnet		(PADI 2023b)
		Nusu Dua Reef		(PADI 2023b)
		Pink Beach		(PADI 2023b)
		The Labyrinth	98 ft (30 m)	(PADI 2023b)
The Republic of Korea		Dive 11 Resort	39 ft (12 m)	(PADI 2023b)
		Okishima	33 ft (10 m)	(PADI 2023b)
The Republic of the Maldives		Addu Manta Point	98 ft (30 m)	(PADI 2023b)
		Alimas Faru	72 ft (22 m)	(PADI 2023b)
		Ali Thila	65 ft (20 m)	(PADI 2023b)
		Bathala Thila	98 ft (30 m)	(PADI 2023b)
		Blue Hole		(PADI 2023b)
		Boava Faru	98 ft (30 m)	(PADI 2023b)
		Bodu Hohola	130 (40 m)	(PADI 2023b)
The Republic of the Maldives		British Loyalty Wreck	98 ft (30 m)	(PADI 2023b)
		Dega Thia	98 ft (30 m)	(PADI 2023b)

Country	*Region*	*Dive Site Name[1]*	*Maximum Water Depth*	*Reference (s)*
(cont.)		Demon Point	130 ft (40 m)	(PADI 2023b)
		Dhonfanu Thila	98 ft (30 m)	(PADI 2023b)
		Falhuma House Reef	60 ft (18 m)	(PADI 2023b)
		Farikede	98 ft (30 m)	(PADI 2023b)
		Felidhoo House Reef	65 ft (20 m)	(PADI 2023b)
		Fiha House Reef North	98 ft (30 m)	(PADI 2023b)
		Fiha House Reef South	98 ft (30 m)	(PADI 2023b)
		Fushi Faru	82 ft (25 m)	(PADI 2023b)
		Fushi Kandu		(PADI 2023b)
		Jack Faru	98 ft (30 m)	(PADI 2023b)
		Kahambu Giri	98 ft (30 m)	(PADI 2023b)
		Kottey Corner		(PADI 2023b)
		Lhohi Giri	98 ft (30 m)	(PADI 2023b)
		Lhohi Paradise	82 ft (25 m)	(PADI 2023b)
		Lhohi Thila	98 ft (30 m)	(PADI 2023b)
		Maakana Corner	98 ft (30 m)	(PADI 2023b)
		Maaya Thila		(PADI 2023b)
		Madigaa	46 ft (14 m)	(PADI 2023b)
		Madivaru Corner	98 ft (30 m)	(PADI 2023b)
		Male Caves Dive site	98 ft (30 m)	(PADI 2023b)
		Marc's Dream	98 ft (30 m)	(PADI 2023b)
		Moofushi Shark Corner	98 ft (30 m)	(PADI 2023b)
		One Rock	98 ft (30 m)	(PADI 2023b)
		Rannalhi Bodu Giri	98 ft (30 m)	(PADI 2023b)
		Rasdhoo Beyru	98 ft (30 m)	(PADI 2023b)
		Rasdhoo Channel	98 ft (30 m)	(PADI 2023b)
		Soft Coral Pass	98 ft (30 m)	(PADI 2023b)
		Solha Corner		(PADI 2023b)
		Tiger Harbor		(PADI 2023b)
		Veligandu East	98 ft (30 m)	(PADI 2023b)
		Villingili Coral Garden	82 ft (25 m)	(PADI 2023b)
The Republic of Marshall Islands		Arno Atoll		(PADI 2023a)
		Bikini Atoll		(PADI 2023a)
		Rongelap Atoll		(PADI 2023a)
The Republic of Palau		Blue Corner		(PADI 2023b)
		Ulong Channel		(PADI 2023b)
The Republic of Singapore		Open Ocean Habitat	39 ft (12 m)	(PADI 2023b)
		Pulau Hantu	60 ft (18 m)	(PADI 2023b)
		Pulau Jong	98 ft (30 m)	(PADI 2023b)
		Shark Tank	29 ft (9 m)	(PADI 2023b)
The Republic of the Union of Myanmar		Black Rock		(Sunrise Divers 2023)
		Burma Banks		(Sunrise Divers 2023)
		High Rock		(Sunrise Divers 2023)
		In Through the Out Door		(Sunrise Divers 2023)
		North East Little Torres		(Sunrise Divers 2023)
		Western Rocky		(Sunrise Divers 2023)
		Cemetery Bay	49 ft (15 m)	(PADI 2023b)

Country	***Region***	***Dive Site Name[1]***	***Maximum Water Depth***	***Reference (s)***
Socialist Republic of Vietnam		Debbies Beach		(PADI 2023b)
		Electric Nose		(PADI 2023b)
		Hon Tai	98 ft (30 m)	(PADI 2023b)
		Hon Tam	39 ft (12 m)	(PADI 2023b)
		Madonna Rock	115 ft (35 m)	(PADI 2023b)
		Mama Hanh Beach		(PADI 2023b)
		Moray Beach		(PADI 2023b)
		Nha Trang		(PADI 2023b)
		Phat Wall	60 ft (18 m)	(PADI 2023b)
		Rainbow Reef		(PADI 2023b)
		Seahorse Bay		(PADI 2023b)
		Three Kings	130 (40 m)	(PADI 2023b)
		Tiger Wall		(PADI 2023b)
		U-Turn	39 ft (12 m)	(PADI 2023b)
		Whale Island		(PADI 2023b)
The U.S. of America and Its Territories	Commonwealth of the Northern Mariana Islands	Banzai		(PADI 2023b)
		East Bay		(PADI 2023b)
		Grotto		(PADI 2023b)
		H8K Japanese Sea Reconnaissance Plane		(PADI 2023b)
		Lau Lau Beach		(PADI 2023b)
		Lau Lau Dive Site	130 ft (40 m)	(PADI 2023b)
		Naftan		(PADI 2023b)
		Obyan		(PADI 2023b)
		Ship Wreck (Showan Maru)	26 ft (8 m)	(PADI 2023b)
		Spot Light		(PADI 2023b)
		Sub Chaser		(PADI 2023b)
		Wing Arch		(PADI 2023b)
		Wing Crevasse		(PADI 2023b)
	Guam	American Tanker	130 ft (40 m)	(PADI 2023b)
		Amphitehater		(PADI 2023b)
		Amtrak		(PADI 2023b)
		Barge Reer		(PADI 2023b)
		Barracuda Rock		(PADI 2023b)
		Blue and White		(PADI 2023b)
		Blue Hole	130 ft (40 m)	(PADI 2023b)
		Coral Gardens		(PADI 2023b)
		Finger Reef		(PADI 2023b)
		Fish Eye		(PADI 2023b)
		Gab Gab	100 ft (30.5 m)	(PADI 2023b)
		Gab Gab II	120 ft (37 m)	(PADI 2023b)
		Hap's Reef		(PADI 2023b)
		Harley Reef		(PADI 2023b)
The U.S. of America and Its Territories (cont.)		Kitsugawa Maru	103 ft (31 m)	(PADI 2023b)
		Octopus Reef	130 ft (40 m)	(PADI 2023b)
		OutHouse Beach		(PADI 2023b)
		SeaBee Junkyard		(PADI 2023b)
		Shark Pit		(PADI 2023b)

Country	*Region*	*Dive Site Name[1]*	*Maximum Water Depth*	*Reference (s)*
		SMS Cormoran	120 ft (37 m)	(PADI 2023b)
		Tarzan Cave		(PADI 2023b)
		The Tunnel		(PADI 2023b)
		Tokai Maru	120 ft (37 m)	(PADI 2023b)
		Tumon Bay		(PADI 2023b)
		Turtle Rock		(PADI 2023b)
		Val Bomber	100 ft (30.5 m)	(PADI 2023b)
		Western Shoals		(PADI 2023b)
	Island of Hawaii, Hawaii	Manta dive-garden eel cove		(PADI 2023b)
		Nudi Madness	30 ft (9.5 m)	(PADI 2023b)
		Outside Crystal Cove	90 ft (27.5 m)	(PADI 2023b)
		Paniau North	80 ft (24.5 m)	(PADI 2023b)
		Turtle Mound Mauna Lani Makaiwa Bay		(PADI 2023b)
	Island of Maui, Hawaii	Airport Beach	80 ft (24.5 m)	(PADI 2023b)
		Bare Harbor North	100 ft (30.5 m)	(PADI 2023b)
		Bare Harbor South	100 ft (30.5 m)	(PADI 2023b)
		Black Rock	40 ft (12.5 m)	(PADI 2023b)
	Island of Maui, Hawaii	Carthaginian II Wreck	95 ft (29 m)	(PADI 2023b)
		Cliff House	40 ft (12.5 m)	(PADI 2023b)
		Coral Gardens	60 ft (18 m)	(PADI 2023b)
		Double Arches	60 ft (18 m)	(PADI 2023b)
		Enenue at Molokini	30 ft (9.5 m)	(PADI 2023b)
		First Cathedrals	70 ft (21.5 m)	(PADI 2023b)
		Fish Rock	60 ft (18 m)	(PADI 2023b)
		Five Caves at Makena Landing		(PADI 2023b)
		Fish Graves at Makena Landing		(PADI 2023b)
		Five Sisters	100 ft (30.5 m)	(PADI 2023b)
		Hammer Time	100 ft (30.5 m)	(PADI 2023b)
		Honolua Bay	50 ft (15.5 m)	(PADI 2023b)
		Keawakapu South		(PADI 2023b)
		Knob Hill	60 ft (18 m)	(PADI 2023b)
		Lighthouse	70 ft (21.5 m)	(PADI 2023b)
		Mala Wharf	35 ft (10.5 m)	(PADI 2023b)
		McGregor Point	30 ft (9.5 m)	(PADI 2023b)
		Menpachi Caves	70 ft (21.5 m)	(PADI 2023b)
		Mokapu Beach		(PADI 2023b)
		Molokini Back Wall	100 ft (30.5 m)	(PADI 2023b)
		Monolith	80 ft (24.5 m)	(PADI 2023b)
		Olowalu beach	40 ft (12.5 m)	(PADI 2023b)
The U.S. of America and Its Territories (cont.)		Polo Beach Middle Reef		(PADI 2023b)
		Polo Beach North		(PADI 2023b)
		Red Hill	30 ft (9.5 m)	(PADI 2023b)
		Reefs End at Molokini Crater		(PADI 2023b)

Country	***Region***	***Dive Site Name[1]***	***Maximum Water Depth***	***Reference (s)***
	Island of Maui, Hawaii (cont.)	Second Cathedral	70 ft (21.5 m)	(PADI 2023b)
		Sergeant Major	60 ft (18 m)	(PADI 2023b)
		Shark Fin	50 ft (15.5 m)	(PADI 2023b)
		South Kihei Boat Ramp Shore Dive		(PADI 2023b)
		Ulua Beach		(PADI 2023b)
		Wailea Beach North		(PADI 2023b)
		Wailea South		(PADI 2023b)
		Wash Rock	70 ft (21.5 m)	(PADI 2023b)
		White Rock North		(PADI 2023b)
		White Rock South		(PADI 2023b)
	Island of Molokai, Hawaii	Fish Rain	100 ft (30.5 m)	(PADI 2023b)
	Island of Oahu, Hawaii	Corsair		(PADI 2023b)
		Corsair WWII		(PADI 2023b)
		Haleiwa Trench		(PADI 2023b)
		Horseshoe Reef	40 ft (12.5 m)	(PADI 2023b)
		Kewalo Pipe		(PADI 2023b)
		LCU		(PADI 2023b)
		Navy Tug		(PADI 2023b)
		Sea Tiger		(PADI 2023b)
		Sharks Cove		(PADI 2023b)
		YO-257 & San Pedro		(PADI 2023b)
	Island of Kauai, Hawaii	Hale O Honu/ House of Turtles	110 ft (33.5 m)	(PADI 2023b)
		Koloa Landing Dive Site		(PADI 2023b)
		Sheraton Caverns		(PADI 2023b)
	Pacific Remote Islands	Baker Island		(PADI 2023a)

cont. = continue; ft = feet; m = meters
[1]Only the main dive sites for each country and region are listed. This does not rule out that other dive sites are found at the locations.

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Appendix F Marine Mammal Offshore Biologically Important Area (OBIA) Analysis

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Abbreviations and Acronyms

Acronym	Definition
°E	degrees East longitude
°N	degrees North latitude
°W	degrees West longitude
ASHBW	Arabian Sea Humpback Whale
CBD	Convention on Biological Diversity
CSR	coastal standoff range
dB re 1 µPa	decibels referenced to 1 micropascal
DEIS	Draft Environmental Impact Analysis
DPS	distinct population segment
EBSA	Ecologically or Biologically Significant Marine Area(s)
EEZ	Exclusive Economic Zone
ESA	Endangered Species Act
ft	feet
HBW	humpback whale
IMMA	Important Marine Mammal Area(s)
IUCN	International Union for Conservation of Nature
km	kilometer(s)
LF	low frequency
LFA	low frequency active
m	meter(s)
MHI	Main Hawaiian Islands
MMPATF	Marine Mammal Protected Area Task Force
MNM	marine national monument
Navy	United States Department of the Navy
NIO	Northern Indian Ocean

Acronym	Definition
NM	nautical miles
NMFS	National Marine Fisheries Service
NMS	National Marine Sanctuary
NOAA	National Oceanic and Atmospheric Administration
NRDC	Natural Resources Defense Council
NWHI	Northwest Hawaiian Islands
OBIA	Offshore Biologically Important Area(s)
PICEAS	The Pacific Islands Cetacean Ecosystem Assessment
RL	Received Level
rms	root mean square
SEIS/SOEIS	Supplemental Environmental Impact Statement/Supplemental Overseas Environmental Impact Statement
SoNG	Swatch-of-No-Ground
SPL	sound pressure level
SSC	Species Survival Commission
SST	sea surface temperature
SURTASS	Surveillance Towed Array Sensor System
U.S.	United States
USFWS	U.S. Fish and Wildlife Service
WCPA	World Commission of Protected Areas
WDPA	World Database of Protected Areas

F.1 Marine Mammal Offshore Biologically Important Areas

F.1.1 Introduction

This appendix provides more detailed information about the United States Department of the Navy (Navy) and National Marine Fisheries Service (NMFS) assessment of marine areas as potential marine mammal OBIAs for Surveillance Towed Array Sensor System (SURTASS) low frequency active (LFA) sonar, discussed briefly in Section 4.4.2. OBIAs are areas of biological importance to marine mammals that lie outside the coastal standoff range (CSR; i.e., 12 nautical miles [NM; 22 kilometer (km)]) and within the SURTASS LFA sonar Study. In past documentation and authorizations for SURTASS LFA sonar, 39 marine mammal OBIAs were designated globally (**Error! Reference source not found.**), with 14 occurring in the Pacific SURTASS LFA Study Area (**Error! Reference source not found.**).

The Navy applies the following OBIA mitigation measure during training and testing activities using SURTASS LFA sonar. First, the SURTASS LFA sonar-generated sound field would be below received levels (RLs) of 180 decibels referenced to 1 micropascal (dB re 1 µPa) (root mean square [rms]) (sound pressure level [SPL]) 0.54 NM (1 [km]) from the outer boundary of OBIAs during the biologically important period that have been determined by NMFS and the Navy. Second, no more than 25 percent of the authorized amount of SURTASS LFA sonar would be used for training and testing activities within 10 NM (18.5 km) of any single OBIA during any year, unless the following condition is met: should national security present a requirement to conduct more than 25 percent of the authorized hours of SURTASS LFA sonar within 10 NM (18.5 km) of any single OBIA during any year, naval units would obtain permission from the appropriate designated Command authority prior to commencement of the activity. The Navy would provide NMFS with notification as soon as is practicable and include the information (e.g., sonar hours) in its annual activity reports submitted to NMFS. Additionally, per agreement with the State of Hawaii, SURTASS LFA sonar would not be used in the waters over Penguin Bank, HI, to a water depth of 600 feet (ft; 183 meters [m]) and would be operated such that the sound fields would not exceed RLs of 145 dB re 1 µPa (rms) (SPL) in Hawaii State waters.

Information is provided in this appendix to show which of the reviewed marine areas met the OBIA selection criteria and factors. The process for selection includes a stepwise analysis based on four criteria: Criterion 1: Geographic; Criterion 2: LF-Hearing Cetaceans; Criterion 3: Biological Importance; and Criterion 4: Navy Practicability. For full consideration, a marine area would need to first meet Criterion 1, then Criterion 2, then Criterion 3. Marine areas that satisfied these three criteria were then analyzed for Navy practicability. Marine areas that did not meet the OBIA selection criteria were not further considered as potential OBIAs by the Navy and NMFS. Marine areas were not further considered if they did not meet Criterion 1 (Geography) or Criterion 2 (LF-Hearing). A marine area meeting these two criteria was assessed for Criterion 3 (Biological Importance). If the available data, information, and literature did not provide sufficient support that important biological activity was occurring in the marine area, it was no longer considered for OBIA selection. Marine areas that met Criteria 1, 2, and 3 were recommended for OBIA selection and assessed for Criterion 4: Navy Practicability. If the areas met Criterion 4, they are designated as OBIAs in this SEIS/SOEIS. Some marine areas meeting Criterion 1 and 2 but not Criteria 3 (i.e., not designated OBIAs) have been retained on the OBIA Watch List for SURTASS LFA sonar and would be re-evaluated in the future as more information becomes available.

An additional consideration for OBIA designation combines fundamental geographic and biologic considerations that converge the location of a species habitat with co-occurrence of SURTASS LFA sonar activities. To be considered in this SEIS/SOEIS, a marine mammal species must occur in waters in which

SURTASS LFA sonar activities could be conducted (Section 3.6). Some marine mammal species, such as the dugong as well as coastal dolphins and porpoises (e.g., Irrawaddy dolphin and finless porpoise), occur in inshore and shallow coastal waters. SURTASS LFA sonar activities would not be conducted in such inshore waters even if these shallow, coastal waters are located in the Study Area and outside CSR. Thus, such coastal and inshore occurring marine mammal species, including the dugong, coastal and river dolphins, and shallow-water porpoises have been excluded from further consideration in this SEIS/SOEIS. Accordingly, OBIAs do not address these very shallow water species.

The bulk of this appendix includes summaries of the marine areas that met OBIA selection criteria and factors and were thus further considered by the Navy and NMFS as OBIAs. The marine area summaries describe and detail all available information about the marine mammal species and important biological activities conducted in the assessed marine areas. Maps and references are provided so readers can readily review the available information. Marine areas considered as candidate OBIAs (i.e., areas that meet Criteria 1 through 3) are presented first (Part I; Section F.2) followed by those areas not further considered as possible OBIAs but added to the OBIA Watch List (Part II; Section F.3).

Table F-1. Thirty-nine Current or Existing Worldwide Offshore Biologically Important Areas (OBIAs) for SURTASS LFA Sonar, the Relevant Low-Frequency Marine Mammal Species, and the Effective Seasonal Period for each OBIA

OBIA Number	*Name of OBIA*	*Location/Water Body*	*Relevant Low-Frequency Marine Mammal Species*	*Effectiveness Seasonal Period*
1	Georges Bank	Northwest Atlantic Ocean	NARW	Year-round
2	Roseway Basin Right Whale Conservation Area	Northwest Atlantic Ocean	NARW	June through December, annually
3	Great South Channel, U.S. Gulf of Maine, and Stellwagen Bank NMS	Northwest Atlantic Ocean / Gulf of Maine	NARW	January 1 to November 14, annually; year-round for Stellwagen Bank NMS
4	Southeastern U.S. Right Whale Critical Habitat	Northwest Atlantic Ocean	NARW	November 15 to April 15, annually
5	Gulf of Alaska	Gulf of Alaska	North Pacific right whale	March through August, annually
6	Navidad Bank	Northwest Atlantic Ocean / Caribbean Sea	HBW	December through April, annually
7	Coastal Western Africa (Cameroon to Angola)	Southeast Atlantic Ocean	HBW and blue whale	June through October, annually
8	Patagonian Shelf Break	Southwest Atlantic Ocean	Southern elephant seal	Year-round
9	Argentina Southern Right Whale	Southwest Atlantic Ocean	Southern right whale	May through December, annually
10	Central California	Northeastern Pacific Ocean	HBW and blue whale	June through November, annually
11	Antarctic Convergence Zone	Southern Ocean	HBW, blue, fin, sei, minke, and Southern right whales	October through March, annually
12	Offshore Piltun and Chayvo	Northwest Pacific Ocean / Sea of Okhotsk	Western Pacific gray whale	June through November, annually
13	Eastern Madagascar Coastal Waters	Western Indian Ocean	HBW and blue whale	July through September, annually for HBW breeding, November through December for migrating blue whales
14	Southern Madagascar (Madagascar Plateau, Madagascar Ridge, and Walters Shoal)	Western Indian Ocean	HBW, blue (pygmy), and Bryde's whales	November through December, annually
15	Ligurian-Corsican-Provençal Basin and	Northern Mediterranean Sea	Fin whale	July to August, annually

OBIA Number	*Name of OBIA*	*Location/Water Body*	*Relevant Low-Frequency Marine Mammal Species*	*Effectiveness Seasonal Period*
	Western Pelagos Sanctuary			
16	Costa Rica Dome	Eastern Tropical Pacific Ocean	HBW and blue whale	Year-round
17	Great Barrier Reef	Southwest Pacific Ocean / Coral Sea	HBW minke whale (dwarf)	May through September, annually
18	Bonney Upwelling	Southern Ocean	Blue, blue (pygmy), and Southern right Whales	December through May, annually
19	Olympic Coast NMS and The Prairie, Barkley Canyon, and Nitinat Canyon	Northeast Pacific Ocean	HBW	Olympic NMS: December, January, March, April, and May, annually; The Prairie, Barkley Canyon, and Nitinat Canyon: June through September, annually
20	Abrolhos Bank	Southwest Atlantic Ocean	HBW	August through November, annually
21	Grand Manan North Atlantic Right Whale Critical Habitat	Northwest Atlantic Ocean / Bay of Fundy	NARW	June through December, annually
22	Eastern Gulf of Mexico	Gulf of Mexico	Bryde's whale	Year-round
23	Southern Coastal Chile	Southeast Pacific Ocean / Gulf of Corcovado	Blue whale	February to April, annually
24	Perth Canyon	Southeast Indian Ocean; southwestern Australia	Blue, blue (pygmy), and sperm whales	January through May, annually
25	Southwest Australia Canyons	Southern Ocean; southwestern Australia	Sperm whale	Year-round
26	Main Hawaiian Islands	Central North Pacific Ocean	HBW	November to April, annually
27	Northwestern Hawaiian Islands	Central North Pacific Ocean	HBW	December to April, annually
28	Marianas Islands	Western North Pacific Ocean	HBW	February to April, annually

OBIA Number	*Name of OBIA*	*Location/Water Body*	*Relevant Low-Frequency Marine Mammal Species*	*Effectiveness Seasonal Period*
29	Ryukyu-Philippines	Western North Pacific Ocean	HBW	January to April, annually
30	Ogasawara—Sperm Whale	Western North Pacific Ocean	Sperm whale	June to September, annually
31	Ogasawara-Kazin—Humpback Whale	Western North Pacific Ocean	HBW	December to May, annually
32	Honshu	Western North Pacific Ocean	Gray whale	January to May, annually
33	Southeast Kamchatka	Western North Pacific Ocean	HBW, fin, gray (Western North Pacific), and right whales (North Pacific)	June to September, annually
34	Gulf of Thailand	Eastern Indian Ocean	Bryde’s whale	April to November, annually
35	Western Australia—Blue Whale	Eastern Indian Ocean	Blue whale (pygmy)	May to November, annually
36	Western Australia—Humpback Whale	Eastern Indian Ocean	HBW	May to December, annually
37	Southern Bali	Eastern Indian Ocean	Bryde’s, sei, HBW, Omura’s, and sperm whales	October to November, annually
38	Swatch-of-No-Ground (SoNG)	Northern Indian Ocean / Bay of Bengal	Bryde’s whale	Year-round
39	Sri Lanka	Eastern Indian Ocean	Blue (pygmy) and sperm whales	October to April, annually

HBW = Humpback whale; NARW = North Atlantic right whale; NMS = National Marine Sanctuary; OBIA = Offshore Biologically Important Area

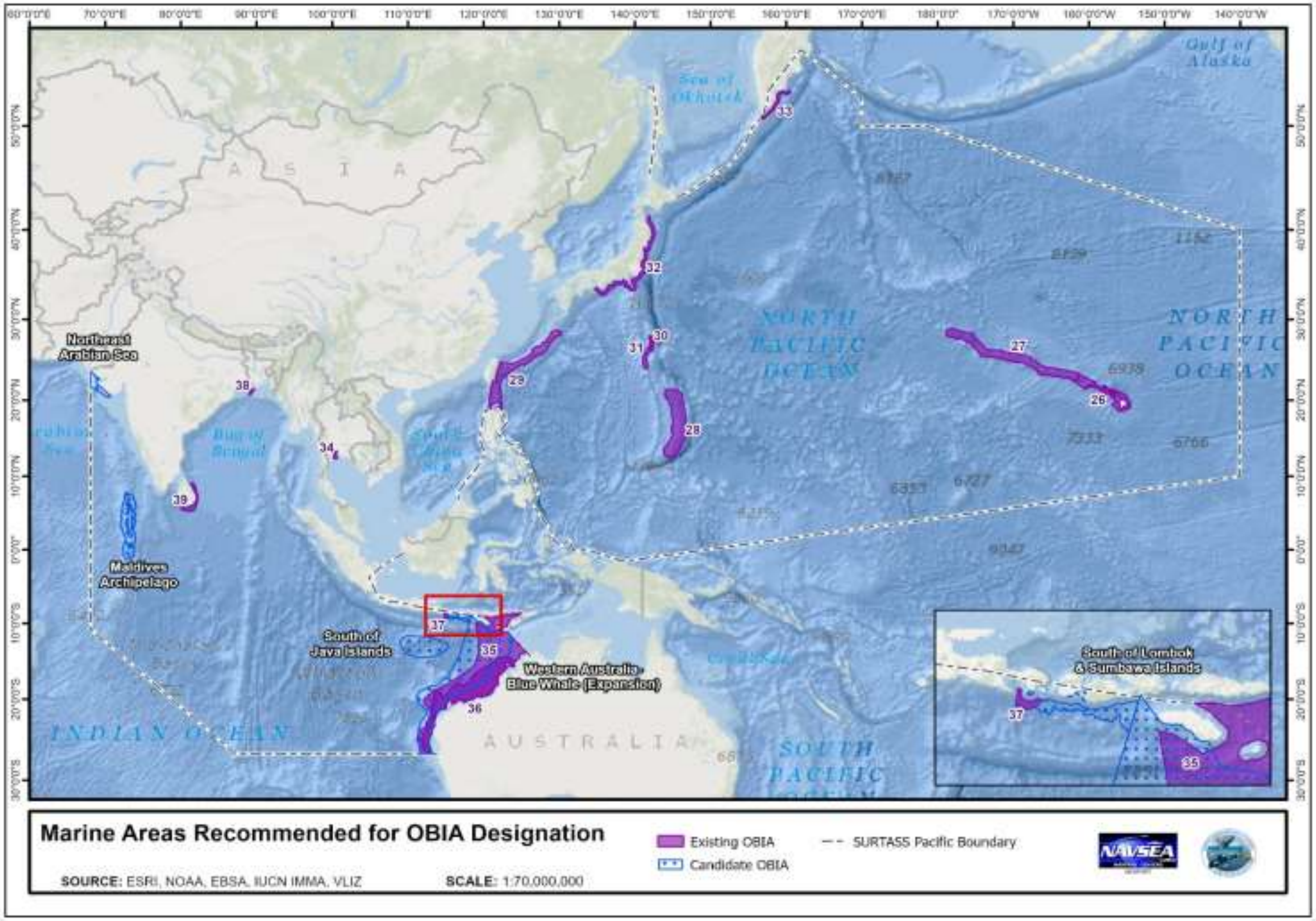

Figure F-1. Locations of the 5 Candidate and 14 Existing Marine Mammal Offshore Biologically Important Areas (OBIAs) for SURTASS LFA Sonar (Numbers Correspond to OBIAs in Error! Reference source not found.**)**

F.1.2 OBIA Selection Criteria

The process of identifying potential marine mammal OBIAs involves an assessment by both NMFS and the Navy to identify marine areas that meet established criteria. In the comprehensive reassessment of potential OBIAs for marine mammals conducted for the 2012 SEIS/SOEIS (DoN 2012), NMFS and the Navy established geographical and biological criteria as the basis for consideration of an area's eligibility as a candidate OBIA. These selection criteria have been used in subsequent analyses, including the 2019 SEIS/SOEIS and this present document. The process for selection includes a stepwise analysis based on four criteria: Criterion 1: Geographic; Criterion 2: LF-Hearing Cetaceans; Criterion 3: Biological Importance; and Criterion 4: Navy Practicability. For full consideration, a marine area would need to first meet Criterion 1, then Criterion 2, then Criterion 3. Marine areas that satisfied these three criteria were then analyzed for Navy practicability. Any marine areas that met all four criteria are presented in this document for OBIA designation.

F.1.2.1 Criterion 1: Geography

First, a marine area must be located at least partly in the SURTASS LFA sonar Study Area (Figure F-1) and partly outside of the CSR (i.e., the area within 12 NM of any emergent land including islands or island systems) for OBIA consideration. The CSR already receives the same protection as OBIAs, and therefore marine areas entirely within the CSR are not considered for further OBIA analysis.

F.1.2.2 Criterion 2: Low-Frequency Hearing Sensitivity

Second, a marine area must have evidence of the presence of cetaceans that specialize in LF-hearing, such as all baleen whales, or marine mammals that have demonstrated sensitivity to LF sounds, such as sperm whales (*Physeter macrocephalus*) and elephant seals (*Mirounga spp.*). SURTASS LFA sonar transmissions are well below the range of best hearing sensitivity for most other odontocetes and pinnipeds based on the measured hearing thresholds (DoN 2025; Houser et al. 2008; Houser et al. 2024; Kastelein et al. 2009; NMFS 2024). The intent of OBIAs is to protect those marine mammal species most likely to hear and be affected by SURTASS LFA sonar transmissions and to provide them additional protections during periods when they are conducting biologically significant activities. Thus, the primary focus of the OBIA mitigation measure is on LF-hearing sensitive species.

F.1.2.3 Criterion 3: Biological Importance

Third, if a marine area meets Criteria 1 and 2, it must also have known biological importance to the relevant species present. As such, the marine area must meet at least one of the following biological subcriteria to be considered as an OBIA. When direct data relevant to one of the biological subcriteria are limited, other available data and information may be used if those data and information, either alone or in combination with the limited direct data, are sufficient to establish that the biological criteria are met:

- *Presence of Small, Distinct Populations with Limited Distributions*: A marine area in which small, distinct populations of marine mammals occur and whose distributional range are limited.
- *Particularly High Densities*: A marine area of high density for one or more species of marine mammals. High density areas are those marine waters where the density within a definable area (and potentially, time) measurably and meaningfully exceeds the average density of the species or stock within the region. The exact basis for the identification of "high density areas" may differ across species/stocks and regions, depending on the available information and should be evaluated on a stock-by-stock or

species-by-species basis, although combining species or stocks may be appropriate in some situations. The best source of data for this determination is publicly- available, direct measurements from survey data.

- *Known Breeding/Calving Grounds*: A marine area representing a location of known breeding or calving. Potential designation under this criterion is indicative that these areas are concentrated areas for at least this one biologically important activity. For the purposes of this SEIS/OEIS, "concentrated" means that more of the animals are engaged in the behavior at the location (and perhaps time) than are typically engaged in that behavior elsewhere.
- *Known Foraging Grounds*: A marine area representing a location of known foraging. Potential designation under this criterion is indicative that these areas are concentrated areas for at least this one biologically important activity. For the purposes of this SEIS/OEIS, "concentrated" means that more of the animals are engaged in the behavior at the location (and perhaps time) than are typically engaged in that behavior elsewhere.
- *Known Migration Route(s)*: A marine area representing a location of a known migration route(s). Potential designation under this criterion is indicative that these areas are concentrated areas for at least this one biologically important activity. For the purposes of this SEIS/OEIS, "concentrated" means that more of the animals are engaged in the behavior at the location (and perhaps time) than are typically engaged in that behavior elsewhere.
- *Critical Habitat as Designated Under the U.S. Endangered Species Act*: ESA critical habitat is one type of marine area that may be considered when assessing and designating OBIAs for SURTASS LFA sonar. Typically, a wealth of information and data are available on the habitat and the biologically important behavior(s) conducted in those waters by an ESA-listed marine mammal. However, ESA critical habitat is designated for the specific purpose of supporting the recovery of a species whose existence is threatened or endangered, and the geographic area contains physical and/or biological features that are essential to the conservation of the threatened or endangered species. Thus, the purpose for designating critical habitat differs from the purpose for designating OBIAs, which is to expand upon the protection of the CSR and avoid or reduce the potential for impacts associated with exposure to SURTASS LFA sonar transmissions and activities in areas beyond the coastal standoff distance where marine mammals are known to engage in specific behaviors that may lead to more severe impacts if interrupted. Thus, critical habitat is just one of the factors considered when assessing the biological importance of an area to a marine mammal, and the presence of critical habitat does not result in a marine area automatically being designated an OBIA for SURTASS LFA sonar.

F.1.2.4 Criterion 4: Navy Practicability

If an area meets the (1) geographic, (2) presence of LF cetaceans, and (3) biological importance criteria, it is considered a candidate OBIA and the Navy conducts a practicability assessment, including consideration of personnel safety, practicality of implementation, and impacts on the effectiveness of SURTASS LFA active sonar testing and training activities. If the candidate area passes the practicability assessment, then the marine area is considered to meet all criteria for designation as a SURTASS LFA sonar OBIA for marine mammals. If the Navy determines that it is not practicable to designate the area as an OBIA, the Navy would identify the concerns that lead to this conclusion and discuss with NMFS whether modifications could be made to the proposed OBIA to alleviate the Navy's practicability concerns.

F.1.3 Potential Marine Mammal OBIAs for SURTASS LFA Sonar

Navy and NMFS's comprehensive assessment of marine areas as OBIA candidates included a thorough review of the Important Marine Mammal Areas (IMMAs), Ecologically or Biologically Significant Marine Areas (EBSAs), areas listed in the World Database of Protected Areas (WDPA), Mission Blue Hope Spots, Pew Bertarelli Ocean Legacy Sites, High Seas Alliance Hot Spots, National Oceanic and Atmospheric Administration (NOAA) National Marine Sanctuaries (NMS), NMFS ESA Critical Habitat, and areas previously included on the OBIA Watch List or that otherwise previously received full assessment for potential OBIA designation. The OBIA Watch List includes potential marine areas already identified and reviewed by the Navy and NMFS but for which documentation on the importance of the area to marine mammals has not been established or is lacking in detail.

A summary of the sources, including the number of marine areas identified from each, are described in **Error! Reference source not found.** More detailed information about the number of marine areas assessed from each region and that met assessment criteria can be found in Table F-5. Descriptions of these marine area data sources are included in the following subsections.

Table F-2. Sources Used to Identify Marine Areas for Analysis

Organization	*Area Designation*	*Marine Areas Collected for Analysis*[1,2]	*Reference*	*Notes*
International Union for Conservation of Nature (IUCN) Marine Mammal Protected Areas Task Force (MMPATF)	Important Marine Mammal Area (IMMA)	123	(IUCN MMPATF 2024)	
United Nations Environment Programme (UNEP) Convention on Biological Diversity (CBD)	Ecologically or Biologically Significant Area (EBSA)	180	(UNEP CBD 2024)	
United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC) and IUCN World Commission on Protected Areas (WCPA)	World Database on Protected Areas	102	(UNEP-WCMC and IUCN-WCPA 2024)	Includes various international, national, and subnational areas that meet protected area criteria
NMFS and the Navy	OBIA Watch List	16	n/a	Includes all marine areas previously analyzed for OBIA designation and added to the NMFS-Navy OBIA Watch List
NMFS and the Navy	Marine areas previously analyzed for OBIA designation	4	n/a	Includes marine areas previously analyzed for OBIA designation but not added to the NMFS-Navy OBIA Watch List

Organization	***Area Designation***	***Marine Areas Collected for Analysis[1,2]***	***Reference***	***Notes***
NOAA	National Marine Sanctuaries	1	(NOAA 2025)	Includes Papahānaumokuākea National Marine Sanctuary, which is part of OBIA #27 Northwestern Hawaiian Islands.
NMFS	ESA Critical Habitat	0	(National Oceanic and Atmospheric Administration (NOAA) 2024)	No new relevant areas have been designated in Study Area since previous analysis.
Mission Blue	Hope Spot	3	(Mission Blue 2024)	
Pew Trusts	Pew Bertarelli Ocean Legacy Site	4	(Pew 2024)	
High Seas Alliance	Hot Spot	1	(High Seas Alliance 2024)	

CBD = Convention on Biological Diversity; EBSA = Ecologically or Biologically Significant Area; IMMA = Important Marine Mammal Area; IUCN = International Union for Conservation of Nature; MMPATF = Marine Mammal Protected Area Task Force; NMFS = National Marine Fisheries Service; NOAA = National Oceanic and Atmospheric Association; OBIA = Offshore Biologically Important Area; UNEP = United Nations Environment Programme; UNEP-WCMC = United Nations Environment Programme World Conservation Monitoring Centre; WCPA = World Commission on Protected Areas

[1]Some marine areas have multiple designations or are included in multiple databases. As a result, the total number of marine areas analyzed in the Study Area (n=413) is fewer than the sum of the sources in this Table (n=434).

[2]Marine area counts are only for the Pacific and Indian oceans.

A total of 413 candidate marine areas in the Pacific and Indian Oceans were identified and added to a database for recordkeeping and analysis. The database was built on a previous version assembled for the 2019 SEIS/SOEIS OBIA analysis, but was produced specifically for this current iteration of the process. The database contains marine areas throughout the Atlantic, Pacific, and Indian Oceans. However, for the purposes of this SEIS/OEIS, only those marine areas located in the Pacific and Indian Oceans were considered for analysis because of their potential to overlap with the Study Area. In some cases, marine areas had multiple designations and were collected from multiple sources; in these cases, duplicates were merged, edited, or deleted as appropriate to improve analysis. Each marine area entry in the database includes information such as location, species present, designations, references, and other data, as available and appropriate (i.e., marine areas that did not meet Criteria 1 or 2 were typically not carried through for further analysis and may not contain full reference or summary information). The database also includes input forms (for marine areas and literature references), queries, and report templates to streamline current and future use.

The analysis evaluated marine areas in a stepwise and iterative fashion beginning with Criteria 1 and proceeding through Criteria 3 if all necessary thresholds were met. Many marine areas were eliminated from further analysis by failing to meet either Criteria 1 or 2.

- *Analysis for Criterion 1 (Geography)*: The initial assessment step was a geospatial analysis to resolve whether marine areas were located at least partially within the Study Area and outside the CSR (i.e., greater than 12 NM from emergent land). Analysis typically used Geographic Information System (GIS) software and the best available geospatial data to analyze boundary positions. Spatial GIS data for many of the assessed marine areas were publicly available. In some cases, where GIS data were unavailable, overlap with the Study Area and CSR were determined by comparing map images. If it was unclear whether a marine area overlapped with the Study Area, it was carried forward in the analysis to ensure any relevant areas were not inappropriately disqualified. Marine areas that met Criterion 1 carried forward to the Criterion 2 Analysis. Areas that did not meet criterion 1 were removed from consideration (but remain in the database).
- *Analysis for Criterion 2 (Presence of LF-Hearing Marine Mammals)*: The second assessment step investigated the potential presence of LF-hearing marine mammals in the marine areas. Many areas are designated for their importance or relevance to other marine taxa, such as coral reefs, or for general marine conservation factors. This step is not the evaluation of a marine area against the OBIA biological criteria, but merely separates out those marine areas in which LF-hearing marine mammal species potentially occur. Many marine areas with formal designations, such as Ecologically or Biologically Significant Areas (EBSAs) and Important Marine Mammal Areas (IMMAs), have readily available area descriptions that identify what marine mammal species are present in the area. If such descriptions were unavailable, literature searches were used to determine whether LF-hearing marine mammals occurred in the marine area in question. Marine areas that met Criterion 2 carried forward to the Criterion 3 Analysis. Areas that did not meet criterion 2 were removed from consideration (but remain in the database).
- *Analysis for Criterion 3 (Biological Importance)*: The final assessment step involved the investigation of marine areas through published peer-reviewed, government, and gray literature, to determine whether biologically important activities for LF-hearing marine mammals occurred in the areas. Gray literature includes reports and other documents created by reputable organizations, such as national or international environmental or scientific non-governmental organizations, which are published but not necessarily peer-reviewed. In some cases, lay literature (e.g., media reports or websites, such as for whale watch companies) was used to supplement analysis, particularly in data-poor regions. Literature reviews were conducted largely through Google Scholar; search terms typically included: "[candidate marine area]" "whale" OR "whales" OR "cetacean" OR "cetaceans". This search string was then limited to literature published since the previous analysis of the candidate marine area (if available). These searches were supplemented with searches of the Navy Best Available Science Portal for relevant key words. Literature reviews were then complemented by further investigation of key authors' work, gray and government sources (e.g., EBSA records, national government agency websites and reports), searches via other key words (e.g., nearby geographic or oceanographic features or areas, if applicable), and, in some cases, lay sources (e.g., media or whale watching

information). Other sources were identified and used as appropriate. Together, this analysis informed qualitative rankings of the subcriteria in Criteria 3 (see **Error! Reference source not found.**).

Based largely on Criterion 3 evaluation (after Criteria 1 and 2 were met), marine areas were assigned one of three determinations: (1) Not recommended for OBIA designation; (2) Not recommended for OBIA designation but recommended for inclusion on Watch List; and (3) Recommended for OBIA designation. **Error! Reference source not found.** shows the 38 marine areas that underwent analysis for Criterion 3, including whether they were recommended for OBIA designation. In applying the Criterion 3 assessment, the final determination for a marine area was informed by its total score across the six biological subcriteria and expert opinion. The total score was calculated by adding each subcriterion's rank for a given marine area (see **Error! Reference source not found.**). Expert opinion was used to interpret the scores and inform final determinations. For example, a marine area that scored highly on small and distinct population (e.g., for the Arabian Sea Humpback Whale) but lower on other subcriteria may still be recommended for OBIA designation due largely to its unusual importance for that particular whale population. Alternately, a marine area that scored slightly lower than another may be considered higher priority given its proximity or adjacency to an existing OBIA. In the latter case, expansion or modification of an existing OBIA was noted in the determination, where appropriate.

Table F-3. Ranking Key for Criterion 3 (Biological Importance) Subcriteria

Subcriteria	*Rank*	*Description*
Small, distinct populations Particularly high densities Breeding or calving grounds Foraging grounds Migration route(s) ESA Critical Habitat	0	Not eligible, not applicable.
	1	Not eligible, insufficient data.
	2	Eligible for consideration, requires more data.
	3	Eligible for consideration, adequate justification.
	4	Eligible for consideration, strong justification.
	5	Unknown.
	6	Not investigated due to ineligibility under Criterion 1.
	7	Not investigated due to ineligibility under Criterion 2.
	8	Area is within an existing OBIA.

Table F-4. Marine Areas that Underwent Criterion 3 Analysis for Biological Importance

Marine Area Number	*Marine Area Name*	*Ocean Area*	*Effective Seasonal Period*	*Previously on OBIA Watch List*	*Candidate OBIA Name*
Candidate OBIAs: Marine Areas Recommended for OBIA Designation					
1	Eastern Indian Ocean Blue Whale Migratory Route	East Indian Ocean	May to November		Western Australia—Blue Whale[1]
2	West of the Maldives	Central Indian Ocean	October to May	X	Maldives Archipelago
3	Eastern Arabian Sea/West-South Indian Coast	Arabian Sea	Year-round	X	Northeast Arabian Sea
4	South of Java Island	East Indian Ocean	May to November		South of Java Island
5	Southern Java/Sumbawa Islands; Western Lesser Sunda Islands and Sumba Coastal Area IMMA	East Indian Ocean	May to November	X	South of Lombok and Sumbawa Islands
Watch List: Marine Areas Not Recommended for OBIA Designation, but for Inclusion on Watch List					
6	Micronesian Islands	South West Pacific Ocean		X	
7	Pacific Islands Heritage Marine National Monument—Palmyra and Johnson Atolls and Kingman Reef	South West Pacific Ocean		X	
8	Pacific Islands Heritage Marine National Monument—Wake Island	North West Pacific Ocean		X	
9	Polar Front/Kuroshio Extension Front	North West Pacific Ocean		X	
10	Coastal Northern Bay of Bengal IMMA	Central Indian Ocean		X	
11	Kien Giang and Kep Archipelago IMMA	East Asian Seas		X	
12	Lakshadweep Archipelago	Central Indian Ocean		X	
13	Raja Ampat/Northern Bird’s Head EBSA	East Asian Seas		X	
14	Southern Andaman Islands IMMA	East Indian Ocean		X	
15	West of Sri Lanka (3°to 12°N, 74° to 80°E)	Central Indian Ocean		X	
16	Coastal/Offshore Gulf of Mannar EBSA	Central Indian Ocean		X	
17	Southern Australia—Southern Right Whale Calving Areas	Australia-New Zealand		X	

Marine Area Number	*Marine Area Name*	*Ocean Area*	*Effective Seasonal Period*	*Previously on OBIA Watch List*	*Candidate OBIA Name*
18	Gulf of Mannar and Palk Bay IMMA	Central Indian Ocean			
19	Nijhum Dwip Marine Reserve	Central Indian Ocean			
20	Kuroshio Current South of Honshu	East Asian Seas			
21	Emperor Seamount Chain and Northern Hawaiian Ridge	North Central Pacific Ocean			
22	Upwelling Zone of the Sumatra-Java Coast	East Indian Ocean			
23	Mariana Trench Marine National Monument—Trench Unit	South West Pacific			
24	Papahānaumokuākea National Marine Sanctuary[2]	North Central Pacific			
Marine Areas Not Recommended for OBIA Designation or Inclusion on Watch List					
25	North Pacific Transition Zone	North Central Pacific Ocean		X	
26	Argo-Rowley Terrace	Australia-New Zealand			
27	Bangladesh Marine Reserve	Central Indian Ocean			
28	British Indian Ocean Territory Marine Protected Area (Chagos)	Central Indian Ocean			
29	Luconia Shoals National Park	East Asian Seas			
30	Sagami Trough and Island and Seamount Chain of Izu-Ogasawara	East Asian Seas			
31	Nankai Trough	East Asian Seas			
32	West Kuril Trench, Japan Trench, Izu-Ogasawara Trench and North of Mariana Trench	East Asian Seas			
33	Christmas and Cocos (Keeling) Islands	East Indian Ocean			
34	Satun-Langkawi Archipelago IMMA	East Indian Ocean			
35	Ryukyu Trench Area	East Asian Seas			
36	Remetau Group: South-West Caroline Islands and Northern New Guinea	South West Pacific Ocean			
37	Benham/Philippine Rise	East Asian Seas			

Marine Area Number	*Marine Area Name*	*Ocean Area*	*Effective Seasonal Period*	*Previously on OBIA Watch List*	*Candidate OBIA Name*
38	Arabian Sea Oxygen Minimum Zone	Arabian Sea			

[1]Recommended expansion of the Western Australia—Blue Whale OBIA to include entirety of Eastern Indian Ocean Blue Whale Migratory Route. [2]Coastal portions (approximately 12-30 NM offshore) of Papahānaumokuākea National Marine Sanctuary are part of existing OBIA #27 Northwestern Hawaiian Islands. The remaining portions (approximately 30-200 NM offshore) are included on the OBIA Watch List.

Table F-5. Number and Types of Marine Areas Assessed as Potential OBIAs and Their Locations Relative to the Study Area and Coastal Standoff Range for SURTASS LFA Sonar

Marine Area Region	*Total Number Marine Areas*	*Number of Marine Areas Located in Study Area[1] for SURTASS LFA Sonar (Criterion 1: Geography)*	*Number of Marine Areas Located in Study Area and Outside[2] the Coastal Standoff Range (Criterion 1: Geography)*	*Number of Marine Areas in LFA Study Area Relevant to LF-Hearing Cetaceans (Criterion 2: LF-Hearing Cetaceans)*	*Number of Marine Areas Already Located in Existing OBIA*	*Number of Marine Areas Further Assessed*
IUCN WCPA-SSC Important Marine Mammal Areas (IMMAs)[1]						
Arabian Sea	14	4	1	1	0	1
Australia-New Zealand	31	6	2	2	2	0
Central Indian Ocean	3	3	3	3	0	3
East Africa	23	0	0	0	0	0
East Asian Seas	2	2	2	2	1	1
East Indian Ocean	29	19	11	10	5	5
North Central Pacific	5	5	3	3	3	0
South West Pacific	16	1	0	0	0	0
Total IMMAs	123	40	22	21	11	10

Marine Area Region	*Total Number Marine Areas*	*Number of Marine Areas Located in Study Area[1] for SURTASS LFA Sonar (Criterion 1: Geography)*	*Number of Marine Areas Located in Study Area and Outside[2] the Coastal Standoff Range (Criterion 1: Geography)*	*Number of Marine Areas in LFA Study Area Relevant to LF-Hearing Cetaceans (Criterion 2: LF-Hearing Cetaceans)*	*Number of Marine Areas Already Located in Existing OBIA*	*Number of Marine Areas Further Assessed*
UNEP Ecologically or Biologically Significant Areas (EBSAs)						
Arabian Sea	30	1	1	1	0	1
Australia-New Zealand	9	1	1	0	0	0
Central Indian Ocean	7	7	4	3	2	1
East Africa	29	0	0	0	0	0
East Asian Seas	34	30	13	12	5	7
East Indian Ocean	5	5	4	2	0	2
North and South Pacific	12	3	3	0	0	0
North Central Pacific	2	2	2	2	0	2
North East Pacific	10	1	1	0	0	0
North West Pacific	9	4	4	2	2	0
South East Pacific	18	0	0	0	0	0
South West Pacific	12	2	2	1	0	1
West Africa	3	0	0	0	0	0
Total EBSAs	180	56	35	23	9	14
UNEP-WCMC and IUCN-WCPA World Database on Protected Areas (WDPA)						
Australia-New Zealand	8	8	6	5	4	1
Central Indian Ocean	60	60	4	4	0	4
East Asian Seas	8	8	8	3	0	3
East Indian Ocean	1	1	0	0	0	0
North and South Pacific	9	8	5	2	2	0
North West Pacific	14	8	5	2	0	2
South West Pacific	2	2	0	0	0	0
Total WDPA Sites	102	95	28	16	6	10

Marine Area Region	*Total Number Marine Areas*	*Number of Marine Areas Located in Study Area[1] for SURTASS LFA Sonar (Criterion 1: Geography)*	*Number of Marine Areas Located in Study Area and Outside[2] the Coastal Standoff Range (Criterion 1: Geography)*	*Number of Marine Areas in LFA Study Area Relevant to LF-Hearing Cetaceans (Criterion 2: LF-Hearing Cetaceans)*	*Number of Marine Areas Already Located in Existing OBIA*	*Number of Marine Areas Further Assessed*
OBIA Watchlist Areas						
Arabian Sea	1	1	1	1	0	1
Australia-New Zealand	1	1	1	1	0	1
Central Indian Ocean	5	5	5	5	0	5
East Asian Seas	2	2	2	2	0	2
East Indian Ocean	2	2	2	2	0	2
North Central Pacific	1	1	1	1	0	1
North West Pacific	2	2	2	2	0	2
South West Pacific	2	2	2	2	0	2
Total OBIA Watchlist	16	16	16	16	0	16
Marine Areas Further Assessed in Previous Analyses						
East Asian Seas	1	1	1	1	0	1
North and South Pacific	1	1	1	0	0	0
North West Pacific	2	2	2	0	0	0
Total Previously Analyzed Areas	4	4	4	1	0	1
NOAA National Marine Sanctuaries						
North Central Pacific	1	1	1	1	0	1
Total Sanctuaries	1	1	1	1	0	1
NMFS Endangered Species Act Critical Habitat						
Total Critical Habitat Areas	0	0	0	0	0	0
Mission Blue Hope Spots						
Central Indian Ocean	1	1	1	1	0	1
North East Pacific	1	0	0	0	0	0
South West Pacific	1	1	1	1	0	1
Total Hope Spots	3	2	2	2	0	2

Marine Area Region	*Total Number Marine Areas*	*Number of Marine Areas Located in Study Area[1] for SURTASS LFA Sonar (Criterion 1: Geography)*	*Number of Marine Areas Located in Study Area and Outside[2] the Coastal Standoff Range (Criterion 1: Geography)*	*Number of Marine Areas in LFA Study Area Relevant to LF-Hearing Cetaceans (Criterion 2: LF-Hearing Cetaceans)*	*Number of Marine Areas Already Located in Existing OBIA*	*Number of Marine Areas Further Assessed*
Pew Bertarelli Ocean Legacy Sites						
Central Indian Ocean	1	1	1	1	0	1
East Indian Ocean	1	1	1	1	0	1
South West Pacific	2	2	2	1	0	1
Total Ocean Legacy Sites	4	4	4	3	0	3
High Seas Alliance Hot Spots						
North Central Pacific	1	1	1	1	0	1
Total Hot Spots	1	1	1	1	0	1
Other Sources						
Total Areas from Other Sources	0	0	0	0	0	0

[1]Some marine areas may have multiple designations. As a result, in some cases, marine areas or portions of marine areas may have duplicate entries in the database. Direct (i.e., identical one-to-one) duplicates were removed from the database for analysis; however, some duplicative entries remained for completeness (e.g., an area that was added as both an IMMA and EBSA). Consequently, some counts and totals may vary slightly from simple summations across regions or categories. [2]At least part of marine area located within Study Area for SURTASS LFA sonar. [3]At least part of the marine area is located outside the LFA CSR.

The following subsections describe the primary types of designated marine areas assessed by the Navy and NMFS as potential marine mammal OBIAs for SURTASS LFA sonar, providing additional information regarding Table F-5. In some cases, marine areas held multiple designations or were listed in multiple sources (e.g., the Coastal Northern Bay of Bengal IMMA is both an IMMA and an area already included on the OBIA Watch List). In other cases, a portion of a marine area may also hold a separate and overlapping designation (e.g., The Palau NMS contains the Palau Southwest EBSA). In these cases, duplicate or nested entries were maintained, merged, or revised as appropriate for analysis.

F.1.3.1 OBIA Watch List Marine Areas

The Navy and NMFS have maintained the OBIA Watch List, which is a list of potential marine areas already identified and reviewed as potential OBIAs but for which documentation on the importance of the area to marine mammals has not been established or is lacking in detail. These areas, however, continue to be periodically assessed as additional information becomes available.

Many of the marine areas on the OBIA Watch List are not located in the current Study Area. The Watch List areas that are located within the Study Area were re-evaluated as part of the present assessment (**Error! Reference source not found.** and Table F-6). This included 16 areas ranging from broad areas of the Pacific Ocean, such as the waters of the Micronesian Islands region, to smaller designated or protected areas largely within individual countries' EEZ, such as the Southern Andaman Islands IMMA. Basic information and prior review indicate that marine mammals occur or are likely to occur in the waters of all 16 Watch List areas.

Table F-6. Sixteen OBIA Watch List Areas Reassessed for OBIA Designation

Marine Area Region	*Marine Area Name*
Australia-New Zealand	Southern Australia—Southern Right Whale Calving Areas
Arabian Sea	Eastern Arabian Sea/West-South Indian Coast
Central Indian Ocean	Coastal Northern Bay of Bengal IMMA
	Lakshadweep Archipelago
	West of Sri Lanka (3 ° to 12 °N, 74 ° to 80 °E)
	Coastal/Offshore Gulf of Mannar EBSA
	West of the Maldives
East Asian Seas	Kien Giang and Kep Archipelago IMMA
	Raja Ampat/Northern Bird's Head EBSA
East Indian Ocean	Southern Andaman Islands IMMA
	Southern Java/Sumbawa Islands; Western Lesser Sunda Islands and Sumba Coastal Area IMMA
North Central Pacific Ocean	North Pacific Transition Zone
North West Pacific Ocean	Pacific Islands Heritage Marine National Monument—Wake Island
	Polar Front/Kuroshio Extension Front
South West Pacific Ocean	Micronesian Islands
	Pacific Islands Heritage Marine National Monument—Palmyra and Johnston Atolls and Kingman Reef

The present analysis assessed updated literature, research, and other information to determine whether any Watch List areas should be designated OBIAs. The analysis found that three Watch List areas should be designated OBIAs based on new and emerging research regarding important biological activities within the areas: (1) West of the Maldives, (2) Eastern Arabian Sea/West-South Indian Coast, and (3) Southern Java/Sumbawa Islands; Western Lesser Sunda Islands and Sumba Coastal Area IMMA. Conversely, the present analysis determined that one Watch List area be removed from the Watch List: North Pacific Transition Zone (NPTZ). The NPTZ was initially analyzed and included on the Watch List due to the presence of northern elephant seals, an LF-sensitive species. However, despite their presence—and the presence of baleen whales in some portions of the NPTZ—there are no data to suggest important biological activities (i.e., Criterion 3) in the marine area, and particularly throughout the entirety of the NPTZ. The NPTZ is a broad swath of the North Pacific Ocean, and while it is possible that certain important biological activities occur within portions of the NPTZ, these activities would imply the need for smaller-scale analysis of those marine areas, rather than the designation of the entirety of the NPTZ. For these reasons, the NPTZ was removed from the OBIA Watch List.

The remaining 12 Watch List areas that were neither recommended for OBIA designation nor removed from the Watch List will remain on the list. Although all available literature and information were researched and reviewed, due to a lack of new supporting information and data regarding important biological activities for LF-hearing marine mammals, the Navy and NMFS' conclusions on these 12 areas remain unchanged. Throughout the course of the marine area analysis, 7 additional areas in the SURTASS Study Area were added to the OBIA Watch List, for a total of 19 OBIA Watch List areas moving forward. These areas will be periodically reassessed for OBIA designation as new information becomes available.

F.1.3.2 NOAA National Marine Sanctuaries

National Marine Sanctuaries are designated to protect habitat, species, or archaeological sites within United States waters, while marine national monuments (MNM) are designated to protect objects of historical or scientific significance. Throughout U.S. waters, the NMS System consists of 18 sanctuaries and 2 MNMs. Four sites occur within the SURTASS LFA sonar Study Area: Papahānaumokuākea NMS, Papahānaumokuākea MNM, the Hawaiian Islands Humpback Whale NMS, and the Pacific Islands Heritage MNM.

The marine portion of Papahānaumokuākea MNM was designated as Papahānaumokuākea NMS in 2025 and assessed for OBIA designation in the present SEIS/SOEIS. This did not remove the MNM designation; rather, the NMS is coextensive with the marine portion of the MNM and includes all waters and submerged lands of the approximately 582,570 square mile area (1,508,850 square kilometers). Previously, as Papahānaumokuākea MNM, the coastal portion (12-30 NM offshore) of what is now also Papahānaumokuākea NMS was designated as part of existing OBIA #27 Northwestern Hawaiian Islands. In the present SEIS/SOEIS analysis, the remaining offshore portion of Papahānaumokuākea NMS (30-200 NM) met Criterion 1 (Geography) and Criterion 2 (LF-Hearing) and was subsequently carried forward for full assessment against Criterion 3 (Biological Importance) and consideration for OBIA designation. Two parts of the Pacific Islands Heritage MNM were analyzed separately: (1) Wake Island and (2) Palmyra and Johnston Atolls and Kingman Reef. These two marine areas were previously included on the OBIA Watch List and consequently were re-analyzed for full assessment against Criterion 3 (Biological Importance). Although not part of the NMS System, the Trench Unit of the Mariana Trench MNM was also analyzed for full assessment against Criterion 3 (Biological Criterion); the Islands Unit of the Mariana Trench MNM was previously designated an OBIA (OBIA #28 Marianas Islands) in the 2019 SEIS/SOEIS.

F.1.3.3 ESA Critical Habitat Areas

Critical habitat is defined under the ESA as the specific areas within the geographic range occupied by an ESA-listed species in which physical or biological features essential to the conservation of the species are found and that may require special management consideration or protection (16 United States Code §1532(5)(A), 1978). The ESA requires NMFS and U.S. Fish and Wildlife Service (USFWS) to designate critical habitat when prudent and determinable for any species that it lists under the ESA, except foreign species.

No new critical habitat for LF-hearing marine mammals was designated in the Study Area since the 2019 SEIS/SOEIS. Accordingly, no critical habitat areas were assessed for OBIA designation in the present SEIS/SOEIS.

F.1.3.4 Important Marine Mammal Areas (IMMAs)

IMMAs are marine areas identified and defined by the Marine Mammal Protected Area Task Force (MMPATF), which is a joint effort of the International Union for Conservation of Nature (IUCN) World Commission of Protected Areas (WCPA) and Species Survival Commission (SSC) and the International Committee on Marine Mammal Protected Areas . IMMAs are defined as “discrete portions of habitat that are important to one or more marine mammal species; represent priority sites for marine mammal conservation worldwide without management implications; and merit protection and monitoring” (IUCN WCPA-SSC Joint Task Force on Biodiversity and Protected Areas and IUCN WCPA-SSC Joint Task Force on Marine Mammal Protected Areas 2015). The purpose of IMMA designation is to assist in the prioritization of marine conservation and protection measures by governments and other groups. To achieve this goal, the task force engages experts and evidence holders in regional processes to identify and analyze prospective IMMAs across those ocean areas. The MMPATF has developed geospatial tools and a standardized process for the identification of IMMA data that ensure the consistent and comprehensive identification of areas important to marine mammals.

The IMMA selection criteria are designed to capture aspects of the biology, ecology, and population structure of marine mammals. The IMMA criteria are not hierarchical but prospective IMMAs are assessed sequentially in the given criteria order. As such, candidate IMMAs must only satisfy one of the criteria and/or sub-criteria to successfully qualify for IMMA status. IMMAs are selected according to the following criteria (IUCN-MMPATF, 2018):

- Criterion A—Species or Population Vulnerability
- Criterion B—Distribution and Abundance
    - Sub-criterion B1—Small and Resident Populations
    - Sub-criterion B2—Aggregations
- Criterion C—Key Life Activities
    - Sub-criterion C1—Reproductive Areas
    - Sub-criterion C2—Feeding Areas

    - Sub-criterion C3—Migration Routes
- Criterion D—Special Attributes
    - Sub-criterion D1—Distinctiveness
    - Sub-criterion D2—Diversity

As of April 2025, 325 IMMAs have been identified in 10 regions designated by the MMPATF; four of these regions overlap with the SURTASS LFA Study Area: the Pacific Islands; North East Indian Ocean and South East Asian Seas; Western Indian Ocean and Arabian Seas; and Australia, New Zealand and South East Indian Ocean.[1] These regions hold 123 IMMAs that were potentially relevant to the SURTASS LFA Study Area and were consequently included in the OBIA marine area analysis (Table F-7 and Figure F-2). Most of the 123 IMMAs are located either outside the Study Area (e.g., in the western Arabian Sea), within the 12-NM CSR (e.g., designated primarily for coastal and non-LF species, such as sirenians and delphinids), or in areas already designated as OBIAs. As a result, 21 of the 122 IMMAs analyzed met Criterion 1 (Geography). Of these, 10 IMMAs met Criterion 2 (LF-Hearing) and were subsequently carried forward for full assessment against Criterion 3 (Biological Importance) and consideration for OBIA designation.

[1]Regional categorizations for IMMAs, EBSAs, and other designations are determined by their respective organizations and working groups. For the purposes of the OBIA analysis and the database that underlies it, however, marine areas were re-categorized into different smaller regions to ensure consistency across the entirety of the database. As a result, the regions that marine areas are categorized into for analysis may not share the same names as those used by designating organizations.

Table F-7. Important Marine Mammal Areas (IMMAs) Reviewed as Potential Marine Mammals Offshore Biologically Important Areas (OBIAs) for SURTASS LFA Sonar

Marine Area Region	*IMMA Name*	*Criterion 1: Geography*	*Criterion 2: LF-Hearing Cetaceans*	*Relevant Marine Mammal(s)*	*Important Biological Activity*	*Carried Forward for Criterion 3 Review: Biological Importance*
Arabian Sea	Dhofar IMMA	N				N
	Farasan Archipelago IMMA	N				N
	Gulf of Kutch IMMA	N				N
	Gulf of Masirah and Offshore Waters IMMA	N				N
	Gulf of Salwa IMMA	N				N
	Indus Estuary and Creeks IMMA	N				N
	Miani Hor IMMA	N				N
	Muscat Coastal Waters and Offshore Canyons IMMA	N				N
	Nakhiloo Coastal Waters IMMA	N				N
	Northeast Arabian Sea IMMA	Y	Y	HBW (Arabian Sea), blue, and Bryde's whales	Foraging, migration, and small/distinct population	Y
	Northern Gulf and Confluence of Tigris, Euphrates and Kuran IMMA	N				N
	Oman Arabian Sea IMMA	N				N
	Sindhudurg-Karwar IMMA	N				N
	Southern Gulf and Coastal Waters IMMA	N				N
Australia-New Zealand	Albany Canyon Region IMMA	N				N
	Australian East Coast Migratory Corridor IMMA	N				N
	Central and Western Torres Strait IMMA	N				N
	Central West Coast, North Island IMMA	N				N
	Coast and Shelf Waters of Eastern Te Waipounamu IMMA	N				N
	Dampier Archipelago IMMA	N				N
	Geographe Bay to Eucla Shelf and Coastal Waters IMMA	N				N
	Gourdon Bay to Bigge Island IMMA	N				N
	Great Barrier Ribbon Reefs and Outer Shelf IMMA	N				N
	Hervey Bay and Great Sandy Strait IMMA	N				N
	Hikurangi Trench IMMA	N				N

Marine Area Region	*IMMA Name*	*Criterion 1: Geography*	*Criterion 2: LF-Hearing Cetaceans*	*Relevant Marine Mammal(s)*	*Important Biological Activity*	*Carried Forward for Criterion 3 Review: Biological Importance*
	Hinchinbrook to Round Hill Network IMMA	N				N
	Houtman Abrolhos to Rottnest Shelf Waters IMMA	N				N
	Kaikoura IMMA	N				N
	Mapoon to Aurukun IMMA	N				N
	Marlborough Sounds and Cook Strait IMMA	N				N
	Moreton Bay IMMA	N				N
	Ningaloo Reef to Montebello Islands IMMA	N				N
	Northern Great Barrier Reef IMMA	N				N
	Northwestern Australian Coastal Waters and Inlets IMMA	N				N
	Rakiura Stewart Island and Te Ara a Kiwa IMMA	N				N
	Rangitahua Kermadec IMMA	N				N
	Shark Bay IMMA	N/A (included in existing OBIA)				N
	South Australian Gulfs and Adjacent Waters IMMA	N				N
	South Taranaki Bight IMMA	N				N
	Southeastern Australian and Tasmanian Shelf Waters IMMA	N				N
	Southern Australian Coastal and Shelf Region IMMA	N				N
	Southern Great Barrier Reef Lagoon and Coast IMMA	N				N
	Southern Gulf of Carpentaria IMMA	N				N
	Tikapa Moana Te Moananui a Toi Hauraki IMMA	N				N
	Western Australian Humpback Whale Migration Route IMMA	N/A (included in existing OBIA)				N
Central Indian Ocean	Coastal Northern Bay of Bengal IMMA	Y	Y	Bryde's whale	None (insufficient data)	Y
	Lakshadweep Archipelago IMMA	Y	Y	Blue (pygmy), fin, sperm, Bryde's, and minke whales	None (insufficient data)	Y

Marine Area Region	*IMMA Name*	*Criterion 1: Geography*	*Criterion 2: LF-Hearing Cetaceans*	*Relevant Marine Mammal(s)*	*Important Biological Activity*	*Carried Forward for Criterion 3 Review: Biological Importance*
	Maldives Archipelago and Adjacent Oceanic Waters IMMA	Y	Y	Blue (pygmy), HBW, Bryde's, and sperm whales	Breeding/calving, foraging, high densities, and migration	Y
East Africa	Aldabra Atoll IMMA	N				N
	Bazaruto Archipelago to Inhambane Bay IMMA	N				N
	Cape Coastal Waters IMMA	N				N
	Central Mozambique Channel and Western Madagascar IMMA	N				N
	Comoros Island Chain and Adjacent Reef Banks IMMA	N				N
	Greater Pemba Channel IMMA	N				N
	Kisite-Shimoni IMMA	N				N
	Lamu Offshore IMMA	N				N
	Madagascar Central East Coast IMMA	N				N
	Madagascar Ridge IMMA	N				N
	Mascarene Islands and Associated Oceanic Features IMMA	N				N
	Menai Bay IMMA	N				N
	Mozambique Coastal Breeding Grounds IMMA	N				N
	Northern Red Sea Islands IMMA	N				N
	Northwest Madagascar and Northeast Mozambique Channel IMMA	N				N
	Seychelles Plateau and Adjacent Oceanic Waters IMMA	N				N
	Shelf Waters of Southern Madagascar IMMA	N				N
	South East African Coastal Migration Corridor IMMA	N				N
	South West Madagascar and Mozambique Channel IMMA	N				N
	Southern Coastal and Shelf Waters of South Africa IMMA	N				N
	Southern Egyptian Red Sea Bays, Offshore Reefs and Islands IMMA	N				N
	Toliara, St. Augustine Canyon and Anakao IMMA	N				N
	Watamu-Malindi and Watamu Banks IMMA	N				N
East Asian Seas	Kien Giang and Kep Archipelago IMMA	Y	Y	Bryde's whale	None (insufficient data)	Y

Marine Area Region	*IMMA Name*	*Criterion 1: Geography*	*Criterion 2: LF-Hearing Cetaceans*	*Relevant Marine Mammal(s)*	*Important Biological Activity*	*Carried Forward for Criterion 3 Review: Biological Importance*
	The Upper Gulf of Thailand	N/A (included in existing OBIA)				N
East Indian Ocean	Babuyan Marine Corridor IMMA	N/A (included in existing OBIA)				N
	Balikpapan, Adang and Apar Bays IMMA	N				N
	Berau and East Kutai District, Kalimantan IMMA	N				N
	Bintuni Bay, West Papua IMMA	N				N
	Bohol Sea IMMA	N				N
	Buleleng IMMA	N				N
	Chilika Lagoon IMMA	N				N
	Con Dao IMMA	N				N
	Eastern Indian Ocean Blue Whale Migratory Route IMMA	Y	Y	Blue (pygmy) whale	High densities and migration	Y
	Eastern Lesser Sunda Islands and Timor Coastal Area IMMA	N				N
	Gulf of Mannar and Palk Bay IMMA	Y	Y	Minke, blue, HBW, and sperm whales	Migration	Y
	Iloilo and Guimaras Straits IMMA	N				N
	Kaimana, West Papua IMMA	N				N
	Kuching Bay IMMA	N				N
	Malampaya Sound IMMA	N				N
	Matang Mangroves and Coastal Waters IMMA	Y	N			N
	Mersing Archipelago IMMA	N				N
	Satun-Langkawi Archipelago IMMA	Y	Y	Bryde's whale	None (insufficient data)	Y
	Savu Sea and Surrounding Areas IMMA	N/A (included in existing OBIA)				N
	Similajau-Kuala Nyalau Coastline IMMA	N				N

Marine Area Region	*IMMA Name*	*Criterion 1: Geography*	*Criterion 2: LF-Hearing Cetaceans*	*Relevant Marine Mammal(s)*	*Important Biological Activity*	*Carried Forward for Criterion 3 Review: Biological Importance*
	South West to Eastern Sri Lanka IMMA	N/A (included in existing OBIA)				N
	Southern Andaman Islands IMMA	Y	Y	Bryde's, Omura's, and sperm whales	None (insufficient data)	Y
	Southern Bali Peninsula and Adjacent Slope IMMA	N/A (included in existing OBIA)				N
	Sundarbans IMMA					N
	Swatch-of-No-Ground IMMA	N/A (included in existing OBIA)				N
	Tañon Strait IMMA	N				N
	Tolitoli IMMA	N				N
	Wakatobi and Adjacent Waters IMMA	N				N
	Western Lesser Sunda Islands and Sumba Coastal Area IMMA[1]	Y	Y	Blue (pygmy) whale	Breeding, foraging, high densities, and migration	Y
North Central Pacific	Kona Coast of Hawaii IMMA	N				N
	Main Hawaiian Archipelago IMMA	N/A (included in existing OBIA)				N
	Main Hawaiian Islands IMMA	N/A (included in existing OBIA)				N
	Northwestern Hawaiian Islands IMMA	N/A (included in existing OBIA)				N
	Palmyra Atoll IMMA	N				N
South West Pacific	Austral Archipelago IMMA	N				N
	Bismarck Sea IMMA	N				N

Marine Area Region	*IMMA Name*	*Criterion 1: Geography*	*Criterion 2: LF-Hearing Cetaceans*	*Relevant Marine Mammal(s)*	*Important Biological Activity*	*Carried Forward for Criterion 3 Review: Biological Importance*
	Chesterfield-Bellona Coral Reef Complex and Seamounts IMMA	N				N
	Cook Islands Southern Group IMMA	N				N
	Kikori Delta IMMA	N				N
	Main Solomon Islands IMMA	N				N
	Marquesas Archipelago IMMA	N				N
	New Caledonia Southern Seamounts and Banks IMMA	N				N
	New Caledonian Lagoons and Shelf Waters IMMA	N				N
	Samoan Archipelago IMMA	N				N
	Society Archipelago IMMA	N				N
	Southern Shelf Waters and Reef Edge of Palau IMMA	N				N
	Tongan Archipelago IMMA	N				N
	Vatu-i-Ra IMMA	N				N
	Wallis and Futuna IMMA	N				N
	Waters of New Caledonia and Loyalty Islands IMMA	N				N

CSR = Coastal Standoff Range; HBW = Humpback whale; IMMA = Important Marine Mammal Area; N = No; N/A = Not Applicable; OBIA = Offshore Biologically Important Area; Y = Yes; [1]Although Western Lesser Sunda Islands and Sumba Coastal Area IMMA is within the 12-mile CSR, it was analyzed as part of a larger OBIA Watch List area (Southern Java/Sumbawa Islands; Western Lesser Sunda Islands and Sumba Coastal Area IMMA). After analysis for the present document, this larger area was renamed and redrawn as South of Lombok and Sumbawa Islands for proposed OBIA designation.

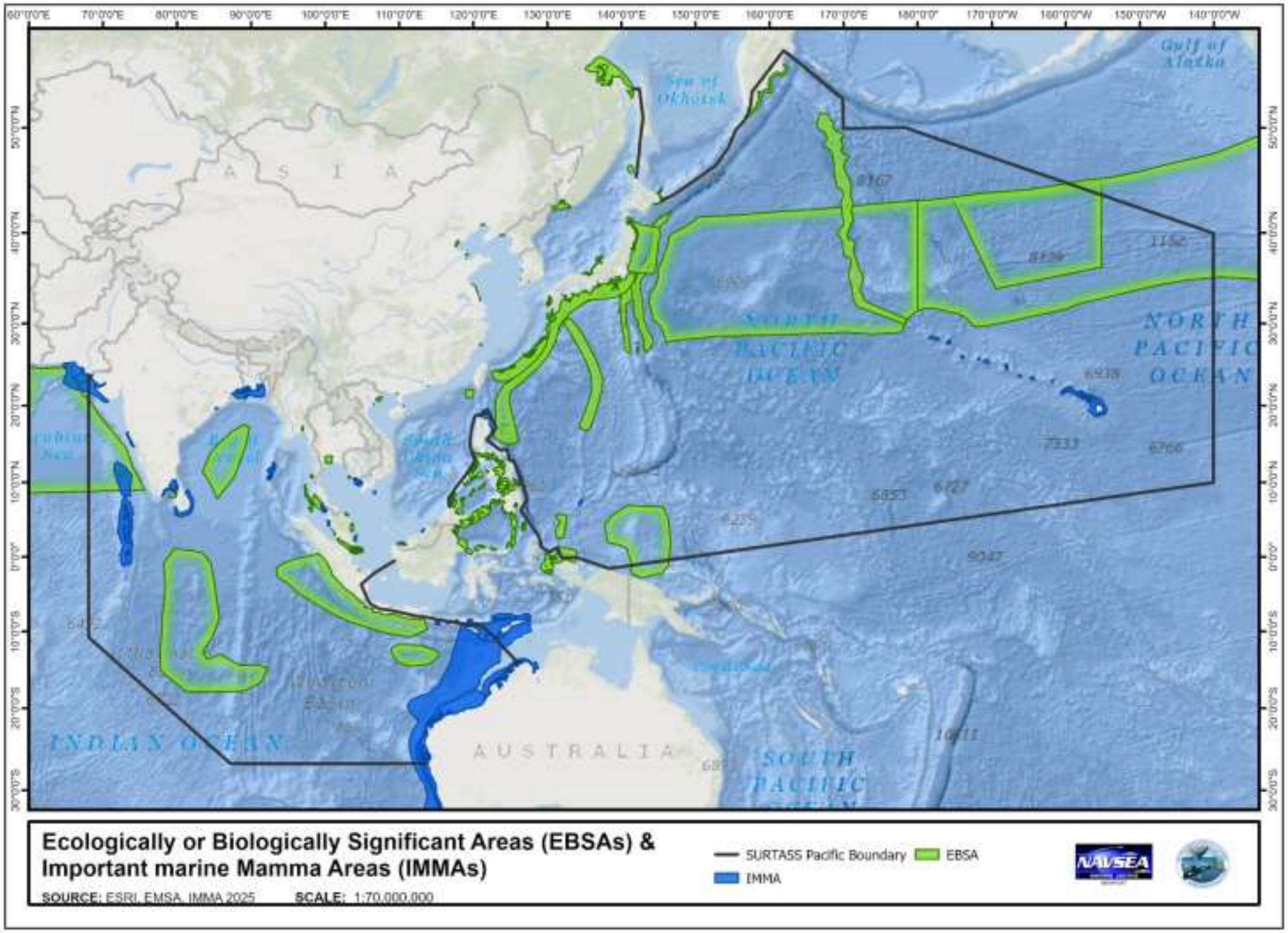

Figure F-2. Locations of Important Marine Mammal Areas (IMMAs) and Ecologically and Biologically Significant Areas (EBSAs) in the Pacific Study Area for SURTASS LFA Sonar (IUCN MMPATF 2024; UNEP CBD 2024)

F.1.3.5 Ecologically or Biologically Significant Areas (EBSAs)

EBSAs are an effort of the Convention on Biological Diversity (CBD), which is an international agreement of the United Nations first signed at the Rio Earth Summit in 1992. The CBD focuses on biodiversity conservation, sustainable use, and fair and equitable benefits sharing from genetic resources. The designation of EBSAs is a key facet of the CBD’s efforts on marine and coastal biodiversity. EBSAs are marine areas that have special biological or ecological importance that support the healthy functioning of oceans. Like IMMAs, EBSAs are not themselves protected areas, but function as a designation intended to inform other conservation and protection measures. EBSAs are designated through a rigorous process that includes regional experts, governments, and stakeholders.

As of April 2025, the CBD has developed 338 EBSAs across 15 geographic regions of the world’s oceans (as categorized by the CBD); six of these regions overlap with the SURTASS LFA Study Area: the East Asian Seas, North Pacific, North-East Indian Ocean, North-West Indian Ocean and Adjacent Gulf Areas, Southern Indian Ocean, and the Western South Pacific. These regions hold 180 EBSAs that are potentially relevant to the SURTASS LFA Study Area and were consequently included in the OBIA marine area analysis (Table F-8 and Figure F-2). Most of the 180 EBSAs are located either outside the Study Area (e.g., near the eastern African coastline), within the 12-NM CSR (e.g., designated primarily for coastal and non-LF species, such as dugongs and delphinids), or in areas already designated as OBIAs. As a result, 35 of the 180 EBSAs analyzed met Criterion 1 (Geography). As a result, 35 of the 180 EBSAs analyzed met Criterion 1 (Geography). Of these, 14 EBSAs met Criterion 2 (LF-Hearing) and were subsequently carried forward for full assessment against Criterion 3 (Biological Importance) and consideration for OBIA designation.

Table F-8. Ecologically or Biologically Significant Areas (EBSAs) Reviewed as Potential Marine Mammals Offshore Biologically Important Areas (OBIAs) for SURTASS LFA Sonar

Marine Area Region	*EBSA Name*	*Criterion 1: Geography*	*Criterion 2: LF-Hearing Cetaceans*	*Relevant Marine Mammal(s)*	*Important Biological Activity*	*Carried Forward for Criterion 3 Review: Biological Importance*
Arabian Sea	Arabian Basin	N				N
	Arabian Sea Oxygen Minimum Zone	Y	Y		Non (insufficient data)	Y
	Churna-Kaio Island Complex	N				N
	Daymaniyat Islands	N				N
	Dungonab Bay/Mukawar Island Area	N				N
	Îles des Sept Frères et Godorya (Seven Brothers Islands and Godorya)	N				N
	Indus Estuarine Area and Associated Creeks	N				N
	Jabal Ali	N				N
	Khor Kalba	N				N
	Khori Great Bank	N				N
	Makran/Daran-Jiwani Area	N				N
	Malan-Gwader Bank	N				N
	Marawah	N				N
	Miani Hor	N				N
	Nayband Bay	N				N
	Oman Arabian Sea	N				N
	Qaro and Umm Al-Maradem	N				N
	Qeshm Island and adjacent marine and coastal areas	N				N
	Sandspit/Hawks Bay and the Adjoining Backwaters	N				N
	Sanganeb Atoll/Sha'ab Rumi	N				N
	Shatt Al-Arab Delta	N				N
	Sir Bu Na'air Island	N				N
	Socotra Archipelago	N				N
	Southern Red Sea Islands	N				N

Marine Area Region	*EBSA Name*	*Criterion 1: Geography*	*Criterion 2: LF-Hearing Cetaceans*	*Relevant Marine Mammal(s)*	*Important Biological Activity*	*Carried Forward for Criterion 3 Review: Biological Importance*
	Southern Red Sea Pelagic Ecosystems	N				N
	South-west Waters of Abu Dhabi	N				N
	Suakin Archipelago and Sudanese Southern Red Sea	N				N
	Sulaibikhat Bay	N				N
	The Great Whirl and Gulf of Aden Upwelling Ecosystem	N				N
	Wadi El-Gemal Elba	N				N
Australia-New Zealand	Due South of Great Australian Bight	N				N
	East Broken Ridge Guyot	N				N
	Fool’s Flat	N				N
	Monowai Seamount	N				N
	Northern Lord Howe Ridge Petrel Foraging Area	N				N
	Northern New Zealand/South Fiji Basin	N				N
	Rusky	Y	N			N
	Seamounts of West Norfolk Ridge	N				N
	South Tasman Sea	N				N
Central Indian Ocean	Baa Atoll	N				N
	Coastal/Offshore Gulf of Mannar EBSA	Y	Y	Blue (pygmy), HBW, and sperm whales	Foraging	Y
	Olive Ridley Sea Turtle Migratory Corridor in the Bay of Bengal	Y	N			N
	Rasdhoo Atoll Reef	N				N
	Sri Lankan Side of Gulf of Mannar	N				N
	The Southern Coastal and Offshore Waters between Galle and Yala National Park	N/A (included in existing OBIA)				N

Marine Area Region	***EBSA Name***	***Criterion 1: Geography***	***Criterion 2: LF-Hearing Cetaceans***	***Relevant Marine Mammal(s)***	***Important Biological Activity***	***Carried Forward for Criterion 3 Review: Biological Importance***
	Trincomalee Canyon and Associated Ecosystems	N/A (included in existing OBIA)				N
East Africa	Agulhas Front	N				N
	Atlantis Seamount	N				N
	Baixo Pinda – Pebane (Primeiras and Segundas Islands)	N				N
	Blue Bay Marine Park	N				N
	Central Indian Ocean Basin	N				N
	Coral Seamount and Fracture Zone Feature	N				N
	Delagoa Shelf Edge, Canyons and Slope	N				N
	Incomati River to Ponta do Ouro (Southern Mozambique)	N				N
	Lamu-Kiunga Area	N				N
	Mahe, Alphonse and Amirantes Plateau	N				N
	Moheli Marine Park	N				N
	Morrumbene to Zavora Bay (Southern Mozambique)	N				N
	Mozambique Channel	N				N
	Natal Bight	N				N
	Northern Mozambique Channel	N				N
	Pemba Bay - Mtwara (part of the Mozambique Channel)	N				N
	Pemba-Shimoni-Kisite	N				N
	Protea Banks and Sardine Route	N				N
	Quelimane to Zuni River (Zambezi River Delta)	N				N
	Rufiji – Mafia- Kilwa	N				N

Marine Area Region	*EBSA Name*	*Criterion 1: Geography*	*Criterion 2: LF-Hearing Cetaceans*	*Relevant Marine Mammal(s)*	*Important Biological Activity*	*Carried Forward for Criterion 3 Review: Biological Importance*
	Save River to San Sebastian (Central Mozambique)	N				N
	Saya de Malha Bank	N				N
	Southern Madagascar (part of the Mozambique Channel)	N				N
	Tanga Coelacanth Marine Park	N				N
	The Iles Éparses (part of the Mozambique Channel)	N				N
	Tromelin Island	N				N
	Walters Shoals	N				N
	Watamu Area	N				N
	Zanzibar (Unguja) – Saadani	N				N
East Asian Seas	Atauro Island	N				N
	Benham Rise	Y	Y		None (insufficient data)	Y
	Bluefin Spawning Area	N/A (included in existing OBIA)				N
	Cold Seeps	Y	N			N
	Convection Zone East of Honshu	N/A (included in existing OBIA)				N
	Eastern Hokkaido	N				N
	Hainan Dongzhaigang Mangrove National Natural Reserve	N				N
	Halong Bay-Catba Limestone Island Cluster	N				N
	Hydrothermal Vent Community on the Slope of the South West Islands	N/A (included in existing OBIA)				N

Marine Area Region	*EBSA Name*	*Criterion 1: Geography*	*Criterion 2: LF-Hearing Cetaceans*	*Relevant Marine Mammal(s)*	*Important Biological Activity*	*Carried Forward for Criterion 3 Review: Biological Importance*
	Inland Sea Areas of Western Kyushu	N				N
	Intertidal Areas of East Asian Shallow Seas	N				N
	Koh Rong Marine National Park	N				N
	Kuroshio Current South of Honshu	Y	Y	HBW	Migration	Y
	Lampi Marine National Park	N				N
	Muan Tidal Flat	N				N
	Nanji Islands Marine Reserve	N				N
	Nankai Trough	Y	Y		None (insufficient data)	Y
	Nino Konis Santana National Park	N				N
	Northeastern Honshu	N				N
	Northern Coast of Hyogo, Kyoto, Fukui, Ishikawa and Toyama Prefectures	N				N
	Ogasawara Islands	N/A (included in existing OBIA)				N
	Raja Ampat/Northern Bird's Head EBSA	Y	Y	Bryde’s and sperm whales	None (insufficient data)	Y
	Redang Island Archipelago and Adjacent Area	N				N
	Ryukyu Trench Area	Y	Y		None (insufficient data)	Y
	Sagami Trough and Island and Seamount Chain of Izu-Ogasawara	Y	Y		None (insufficient data)	Y
	Shankou Mangrove National Nature Reserve	N				N
	South Kyushu including Yakushima and Tanegashima Islands	N				N
	Southern Coastal Areas of Shikoku and Honshu Islands	N				N
	Southern Straits of Malacca	N				N

Marine Area Region	EBSA Name	Criterion 1: Geography	Criterion 2: LF-Hearing Cetaceans	Relevant Marine Mammal(s)	Important Biological Activity	Carried Forward for Criterion 3 Review: Biological Importance
	Southwest Islands	N				N
	Sulu-Sulawesi Marine Ecoregion	N				N
	The Upper Gulf of Thailand	N/A (included in existing OBIA)				N
	Tioman Marine Park	N				N
	West Kuril Trench, Japan Trench, Izu-Ogasawara Trench and North of Mariana Trench	Y	Y		None (insufficient data)	Y
East Indian Ocean	Lower Western Coastal Sea	Y	N			N
	Shelf Break Front	Y	N			N
	South of Java Island	Y	Y	Blue (pygmy) whale	Breeding, foraging, high densities, and migration	Y
	Trang, Home of the Dugongs	N				N
	Upwelling Zone of the Sumatra-Java Coast	Y	Y		None (insufficient data)	Y
North and South Pacific	Central Louisville Seamount Chain	N				N
	Clipperton Fracture Zone Petrel Foraging Area	N				N
	Equatorial High-Productivity Zone	N				N
	Focal Foraging Areas for Hawaiian Albatrosses During Egg-Laying and Incubation	Y	N			N
	Juan de Fuca Ridge Hydrothermal Vents	Y	N			N
	Kyushu Palau Ridge	Y	N			N
	Manihiki Plateau	N				N
	Phoenix Islands	N				N
	Rarotonga Outer Reef Slopes	N				N
	Suwarrow National Park	N				N
	Ua Puakaoa Seamounts	N				N

Marine Area Region	*EBSA Name*	*Criterion 1: Geography*	*Criterion 2: LF-Hearing Cetaceans*	*Relevant Marine Mammal(s)*	*Important Biological Activity*	*Carried Forward for Criterion 3 Review: Biological Importance*
	Western South Pacific High Aragonite Saturation State Zone	N				N
North Central Pacific	Emperor Seamount Chain and Northern Hawaiian Ridge	Y	Y	Sei whale	High densities	Y
	North Pacific Transition Zone	Y	Y	Northern elephant seal	Foraging	Y
North East Pacific	Alijos Islands	N				N
	Clipperton Atoll	N				N
	Coastal Waters Off Baja California	N				N
	Coronado Islands	N				N
	Guadalupe Island	N				N
	Midriff Islands Region	N				N
	North-East Pacific Ocean Seamounts	Y	N			N
	North-East Pacific White Shark Aggregation Area	N				N
	Santuario Ventilas Hidrotermales de la Cuenca De Guaymas (Guaymas Basin Hydrothermal Vents Sanctuary)	N				N
	Upper Gulf of California Region	N				N
North West Pacific	Commander Islands Shelf and Slope	N				N
	East and South Chukotka Coast	N				N
	Eastern Shelf of Sakhalin Island	N/A (included in existing OBIA)				N
	Moneron Island Shelf	Y	N			N
	Peter the Great Bay	Y	N			N
	Shantary Islands Shelf, Amur and Tugur Bays	N				N

Marine Area Region	*EBSA Name*	*Criterion 1: Geography*	*Criterion 2: LF-Hearing Cetaceans*	*Relevant Marine Mammal(s)*	*Important Biological Activity*	*Carried Forward for Criterion 3 Review: Biological Importance*
	Southeast Kamchatka Coastal Waters	N/A (included in existing OBIA)				N
	West Kamchatka Shelf	N				N
	Yamskie Islands and Western Shelikhov Bay	N				N
South East Pacific	Archipiélago de Galápagos y Prolongación Occidental	N				N
	Área de Alimentación del Petrel Gris en la Sur del Dorsal del Pacífico Este (Grey Petrel Feeding Area in the South-East Pacific Rise)	N				N
	Centros de Surgencia Mayor y Aves Marinas Asociadas a la Corriente de Humboldt en Perú	N				N
	Convergencia de la Deriva del Oeste (West Wind Drift Convergence)	N				N
	Cordillera de Carnegie – Frente Ecuatorial	N				N
	Corredor Marino del Pacífico Oriental tropical	N				N
	Dorsal de Nazca y de Salas y Gómez (Salas y Gómez and Nazca Ridges)	N				N
	Dorsal Submarina de Malpelo	N				N
	Ecosistema Marino Sipacate-Cañón, San José	N				N
	Equatorial High-Productivity Zone	N				N
	Golfo de Fonseca	N				N
	Golfo de Guayaquil	N				N
	Montes submarinos en el Cordón de Juan Fernández	N				N

Marine Area Region	*EBSA Name*	*Criterion 1: Geography*	*Criterion 2: LF-Hearing Cetaceans*	*Relevant Marine Mammal(s)*	*Important Biological Activity*	*Carried Forward for Criterion 3 Review: Biological Importance*
	Sistema de Surgencia de la Corriente de Humboldt en Chile Central (Central Chile Humboldt Current Upwelling System)	N				N
	Sistema de Surgencia de la Corriente de Humboldt en el Norte de Chile (Northern Chile Humboldt Current Upwelling System)	N				N
	Sistema de Surgencia de la Corriente de Humboldt en el Sur de Chile (Southern Chile Humboldt Current Upwelling System)	N				N
	Sistema de Surgencia de la Corriente Humboldt en el Perú	N				N
	Upwelling System of Papagayo and adjacent areas	N				N
South West Pacific	Kadavu and the Southern Lau Region	N				N
	Kermadec-Tonga-Louisville Junction	N				N
	New Britain Trench Region	N				N
	New Hebrides Trench Region	N				N
	Niue Island and Beveridge Reef	N				N
	Palau Southwest	Y				N
	Remetau Group: South-West Caroline Islands and Northern New Guinea	Y	Y	Sperm and Bryde's whales	None (insufficient data)	Y
	Samoan Archipelago	N				N
	South of Tuvalu/Wallis and Fortuna/North of Fiji Plateau	N				N
	Taveuni and Ringgold Islands	N				N
	Tongan Archipelago	N				N
	Vatu-i-Ra/Lomaiviti, Fiji	N				N
West Africa	Agulhas Bank Nursery Area	N				N

Marine Area Region	*EBSA Name*	*Criterion 1: Geography*	*Criterion 2: LF-Hearing Cetaceans*	*Relevant Marine Mammal(s)*	*Important Biological Activity*	*Carried Forward for Criterion 3 Review: Biological Importance*
	Agulhas Slope and Seamounts	N				N
	Offshore of Port Elizabeth	N				N

CSR = Coastal Standoff Range; EBSA = Ecologically or Biologically Significant Area; HBW = Humpback whale; N = No; N/A = Not Applicable; OBIA = Offshore Biologically Important Area; Y = Yes

F.1.3.6 Other Marine Area Designations

In addition to Watch List Areas, NMSs, Critical Habitat areas, IMMAs, and EBSAs, the OBIA marine area analysis included areas identified and/or designated from other sources, including, but not limited to: Mission Blue Hope Spots (3 marine areas assessed), Pew Bertarelli Ocean Legacy Sites (4 areas), High Seas Alliance Hot Spots (1 area), areas catalogued in the World Database of Protected Areas (WDPA; 102 areas), and areas that were previously analyzed for OBIA designation but not added to the Watch List (4 areas). Some of these additional marine areas had multiple designations; particularly those catalogued in the WDPA, which is comprehensive of nearly all global protected areas.

A total of 114 marine areas that held other designations were potentially relevant to the SURTASS LFA Study Area and were consequently included in the OBIA marine area analysis. Most of these 114 marine areas were located either outside the Study Area, within the 12-NM CSR (e.g., designated primarily for coastal and non-LF species, such as dugongs and delphinids), or in areas already designated as OBIAs. As a result, 39 of the 114 marine areas analyzed met Criterion 1 (Geography). Of these, 17 marine areas met Criterion 2 (LF-Hearing) and were subsequently carried forward for full assessment against Criterion 3 (Biological Importance) and consideration for OBIA designation.

Marine Area Summaries

Included in this appendix are summaries of all the marine areas that were designated as OBIAs or added to the OBIA Watch List. These marine areas meet Criterion 1 (Geographic) and Criterion 2 (LF-Hearing). Those designated as OBIAs met Criterion 3 (Biological Importance) and Criterion 4 (Navy Practicability). Those instead added to the OBIA Watch List did not meet Criterion 3 but may do so in the future if new information becomes available for analysis.

Navy and NMFS did not differentiate the marine areas for relevance to LF-sensitive marine mammal species until all available information and data were gathered and reviewed. Even if the designation purpose of an area was for a specific marine mammal species, such as shallow water, inshore/coastal odontocetes or dugongs, the Navy and NMFS reviewed all available information about potentially occurring marine mammals in each marine area.

After concluding the evaluation of all available data and information for all considered marine areas, the Navy and NMFS made determinations on which areas met all OBIA criteria except the Navy operational practicability criterion. Some considered marine areas were located adjacent spatially to one another. In circumstances where cetaceans may be moving through these adjacent areas seasonally, it was logical to combine the adjacent areas to create larger OBIAs that encompassed the seasonal movements. Additionally, some marine areas included more than one type of assessed marine area. In those cases, both types of marine areas were assessed separately or together based on overlap and available data.

The marine area summaries in this appendix are listed in two sections: (1) marine areas that meet the geographic and biological criteria and LF-sensitivity, and accordingly, are considered candidate OBIAs that underwent Navy operational practicability review (Section F.2); and (2) marine areas that are not further considered as OBIAs for SURTASS LFA sonar because they do not meet the OBIA selection criteria, and were instead included on the OBIA Watch List (Section F.3).

F.2 Part 1: Candidate OBIAs: Marine Areas Meeting OBIA Designation Criteria

This section details the candidate OBIAs that meet designation criteria laid out in Section F.1.

F.2.1 Western Australia—Blue Whale (Expansion)

Determination

Recommended for OBIA designation.

Ocean

Indian

Region

East Indian Ocean

Country

International

Summary

The Eastern Indian Ocean Blue Whale Migratory Route IMMA is largely coincident with existing OBIAs for blue and HBW in Western Australia, however this IMMA is slightly larger, encompassing areas known or likely to contain migrating whales based on recent research (see, e.g., IUCN-MMPATF 2024, Thums et al. 2022, Möller et al. 2020, Sahri et al. 2022). Möller et al. (2020), for example, provide evidence of important areas south of Java, Bali, and Lombok, which suggest an OBIA between the existing Western Australia and Southern Bali OBIAs would be warranted. Similarly, Double et al. (2014) and Sahri et al. (2022) draw on telemetry data to show that parts of pygmy blue whale home and migration ranges extend into parts of this marine area that are not already designated an OBIA. Much of the relevant pygmy blue whale range is already encompassed by the existing Western Australia Blue Whale OBIA; however, this evidence suggests important biological activity west of that, as well. Consequently, we recommend expanding the existing Western Australia – Blue Whale OBIA to include the extent of this IMMA.

In future analyses, we further recommend consideration of combining this proposed OBIA, the South of Lombok and Sumbawa Islands proposed OBIA, and the existing Southern Bali OBIA to encompass a larger area extending along Western Australia into Southern Indonesia. See references from South of Lombok and Sumbawa Islands proposed OBIA for further information.

Criterion 1: Geography ***2***

Criterion 2: LF Hearing ***1***

LF-Hearing Species Present:	Blue (pygmy)
Seasonality:	May to November

Criterion 3: Biological Importance

C3: Breeding	1
C3: Crit Hab	0
C3: Foraging	1
C3: High Density	2
C3: Migration	4
C3: Small Pop	0

Total C3 Score: ***8***

Designation(s):

Hope Spot	False	☐
Pew Legacy	False	☐
EBSA	False	☐
IMMA	True	☑
NOAA NMS	False	☐
ESA Crit Hab	False	☐
High Seas Alliance	False	☐
WDPA	False	☐
Watch List	False	☐
Previously Analyzed	False	☐

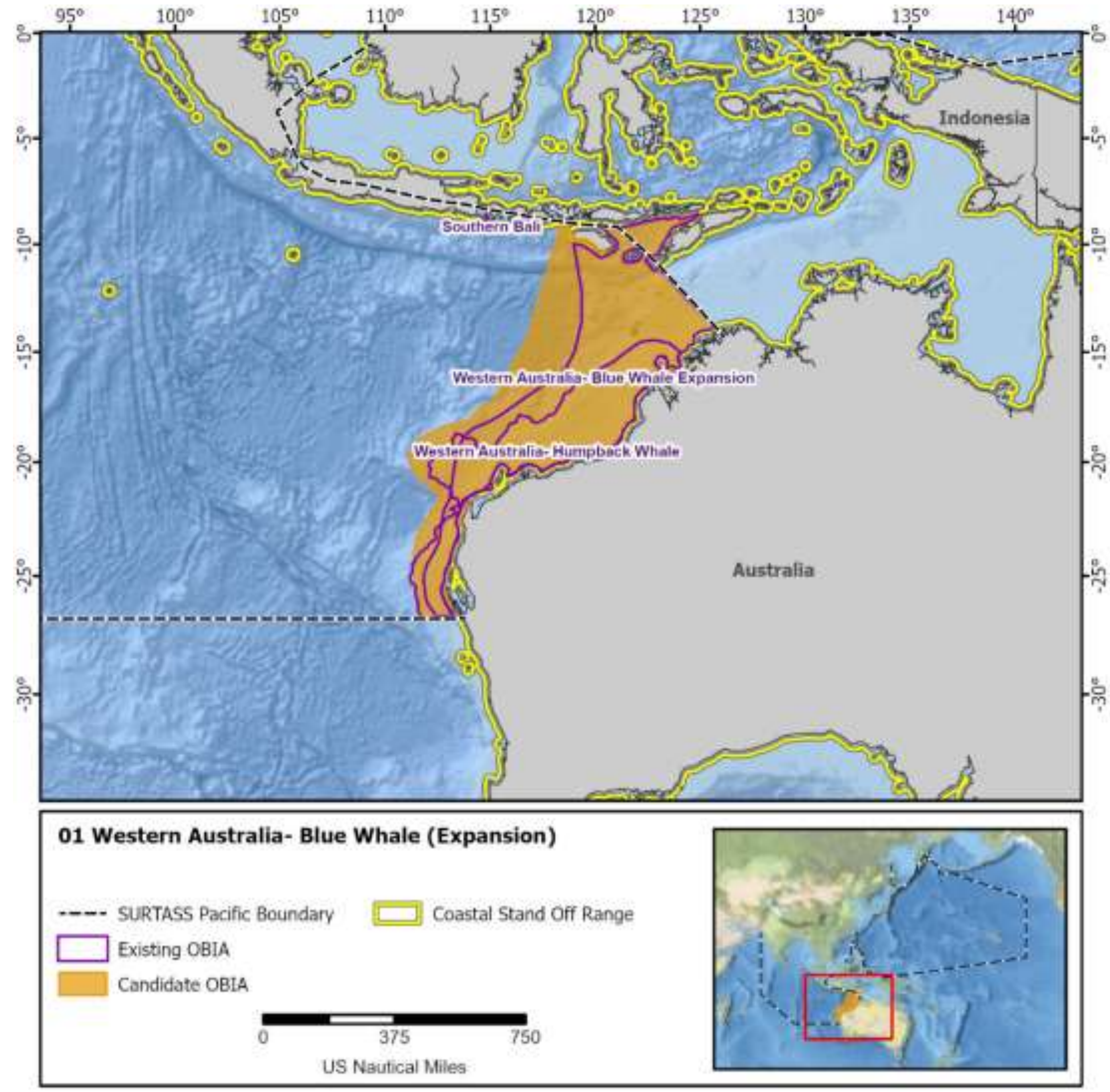

Figure F-3. Western Australia—Blue Whale (Expansion) (Eastern Indian Ocean Blue Whale Migratory Route IMMA)

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F.2.2 Maldives Archipelago

Determination

Recommended for OBIA designation.

Ocean

Indian

Region

Central Indian Ocean

Country

Maldives

Summary

The area west of the Maldives was analyzed for the 2019 SEIS/SOEIS in response to a Natural Resources Defense Council (NRDC) comment on the Draft Environmental Impact Statement (DEIS). The previous analysis found limited evidence of important biological activity for LF-hearing cetaceans in the region. However, newer evidence supports the designation of an OBIA in the region.

The Maldives are dominated by the seasonal monsoons. During the northeast monsoon, from about December to March, the winds die down and the intense upwelling ceases. In these months, whales disperse more widely to regions with seasonally high productivity, such as the waters west of the Maldives (Anderson et al., 2012). A wide diversity of cetacean species has been documented around the Maldives (Balance et al., 2001; Branch et al., 2007; Anderson et al., 2012b). Anderson et al. (2012b) compiled whaling information, visual and acoustic survey results, and stranding records for their review paper of cetaceans around the Maldives. Spinner dolphins were the mostly commonly sighted species, while the one acoustic survey most commonly detected sperm whales. There were no passive acoustic detections of blue whales, and one detection of humpback whales, though this region was targeted by Soviet whalers in the 1960s for blue, Bryde’s, humpback, and sperm whales (Anderson et al., 2012b). Clark et al. (2012) reported that the most commonly sighted species were Risso’s dolphin, pantropical spotted dolphin, spinner dolphin, and sperm whale. Clark et al. (2012) only documented sightings of two sperm whale calves during their survey; no other species were observed to have calves with them. Anderson et al. (2012a) compiled catches, sightings, strandings, and acoustic detections of pygmy blue whales and correlated the distribution with ocean color data indicative of higher chlorophyll a concentrations. While there is a peak in chlorophyll a west of the Maldives in December to March, the Maldives have much lower chlorophyll values overall. The observations suggest that most blue whales pass by the Maldives as they migrate east-west between monsoon seasons, though some animals do loiter (Anderson et al., 2012a).

Anderson et al. (2022) compiled and analyzed available records on the occurrence of Humpback Whales (HBWs) in the Maldives, Sri Lanka, and Chagos Archipelago region and found that records of HBW in the Maldives were steadily increasing over recent decades, including observations of mother-calf pairs in both the northern and southern winter seasons. This is echoed by the Maldives' IMMA listing, where the Marine Mammal Protected Areas Task Force (2024) notes that the proportion of HBW sightings in Sept-Oct that includes calves increases dramatically relative to the rest of the year. Anderson et al. (2022) also found there have also been increasing reports of northern winter and spring blue whale in the Maldives. Similarly, Letessier et al. (2022) analyzed historical and modern records of sperm whale distributions in the Indian Ocean, and found that whales were more commonly recorded in and near the Maldives in modern records. While this may be due to higher survey effort in the region in more recent decades, it shows presence of the whales, particularly in the southern portions of the archipelago, where their habitat suitability model shows the highest suitability predictions (from southern Maldives south into the Chagos Archipelago). Recent work by Panicker (2022) and Panicker et al. (2020, 2021) also provides support for cetacean presence in the northern portions of the Maldives, closer to Lakshadweep Archipelago, while early work by Ballance et al. (2001) encountered blue whales and other cetacean species in the region.

Data sources for this area are emerging and typically general or include broad-ranging geographies. However, there is growing and compelling evidence of regular baleen whale presence throughout the broader region, from W Sri Lanka to W of Maldives, for foraging, and including regular occurrences of calves. The Maldives Archipelago is designated an IMMA for species including HBW, blue, and sperm whales, for both reproductive importance (HBW calves) and the presence of vulnerable species (Arabian Sea HBW) (IUCN-MMPATF 2024). We recommend adding new candidate area of Maldives Archipelago as potential OBIA site given emerging research and evidence of baleen species throughout the archipelago. See also Lakshadweep Marine Area for more references and support.

Criterion 1: Geography ***3***

Criterion 2: LF Hearing ***1***

LF-Hearing Species Present:	Blue (pygmy); HBW; Bryde's; Sperm
Seasonality:	October to May

Criterion 3: Biological Importance

C3: Breeding	2
C3: Crit Hab	0
C3: Foraging	3
C3: High Density	2
C3: Migration	2
C3: Small Pop	0

Total C3 Score: ***9***

Designation(s):

Hope Spot	False	☐
Pew Legacy	False	☐
EBSA	False	☐
IMMA	True	☑
NOAA NMS	False	☐
ESA Crit Hab	False	☐
High Seas Alliance	False	☐
WDPA	False	☐
Watch List	True	☑
Previously Analyzed	False	☐

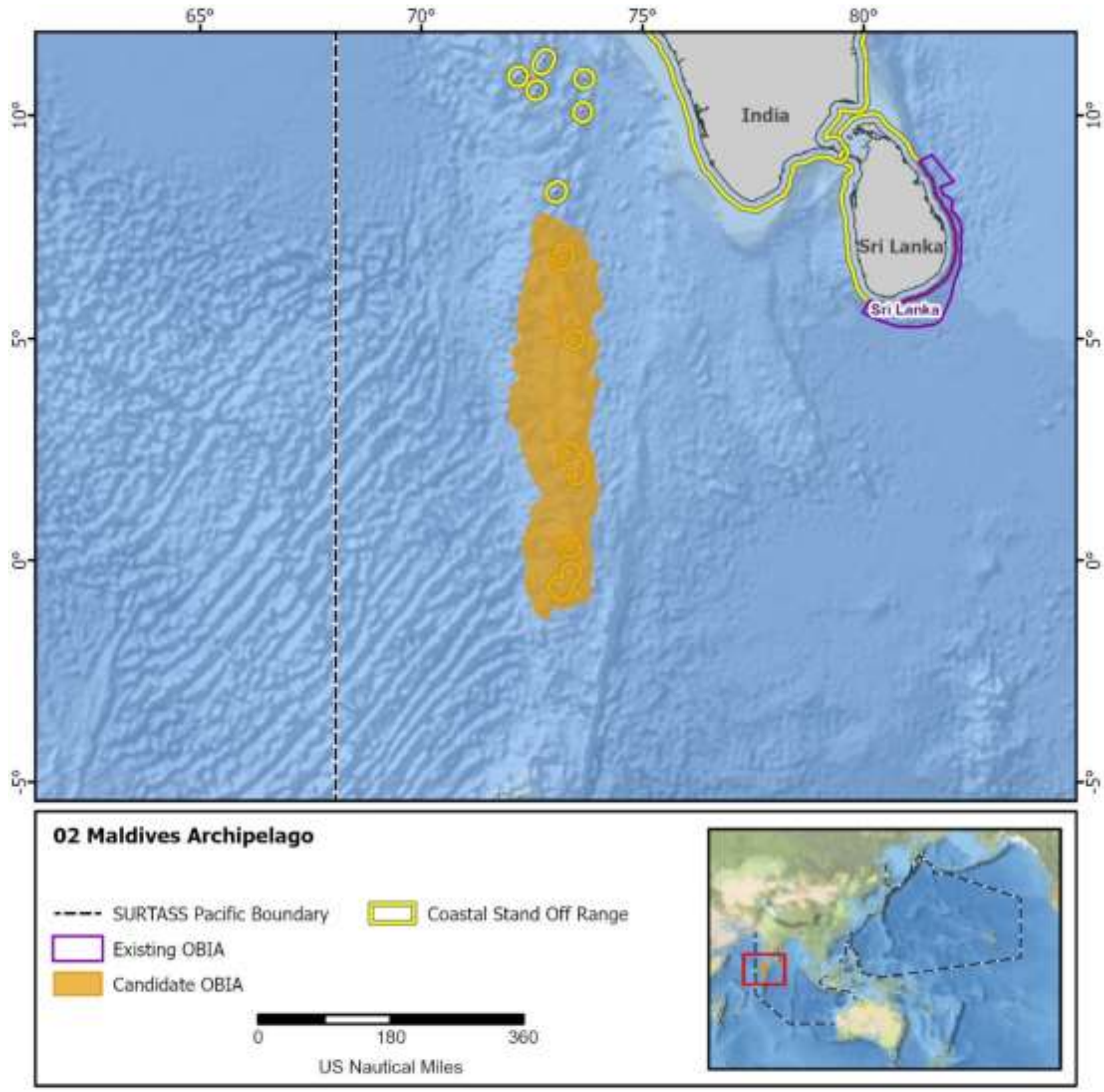

Figure F-4. Maldives Archipelago

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F.2.3 Northeast Arabian Sea

Determination

Recommended for OBIA designation.

Ocean Indian

Region

Arabian Sea

Country

India

Summary

Evidence is growing that this area is particularly biologically important for the genetically distinct Arabian Sea HBW (ASHBW) (IUCN-MMPATF 2024; Pomilla et al. 2014). Generally, in the central west Indian Coast, evidence of baleen species is very limited. However, the south Indian coast and the Eastern Arabian Sea (i.e., Northwest Indian coast) have greater presence of LF cetaceans. There are whales throughout this area (including west to Lakshadweep and southwest to Maldives), however data deficiencies and uncertainty of biologically important behaviors (e.g., calving, foraging, migrations) remain. Despite this, due to emerging evidence of the marine area's importance to the small and distinct ASHBW population, this area should be strongly considered for OBIA designation. At the least, this area and adjacent areas, especially to the northwest through southwest, should remain on watchlist as research is growing throughout the region. The NE Arabian Sea is designated an IMMA, largely for HBW, blue, and Bryde's whales.

While Anderson et al. (2022) reported limited evidence of HBW along the northwest coast of India, other emerging research provides support for OBIA designation. Chandrasekar et al. (2021), for instance, provide an observation of a blue whale off Gujarat, and note that the northern Arabian Sea may function as a potential hot spot for the species. D'Souza et al. (2023) analyzed HBW singing activity in the region and noted that “"information on humpback whales off the Indian coast has largely been limited to stranding records, local ecological knowledge, and opportunistic visual sighting data. These data […] suggest that humpback whales migrate across the Arabian Sea into Indian territorial waters from October to March (p. 223)." More generally, in its IMMA designation, the IUCN-MMPATF (2024) refers to surveys by WWF-Pakistan (Moazzam and Nawaz 2018, 2019) that observed a number of whales, including 55 ASHBW, in the area during surveys in 2017 and 2018. Aggregations of ASHBW were similarly observed along the Indian coast within this area in the same time period (Sutaria et al. 2017; Sutaria 2018a), while Sutaria 2018b utilized secondary information from fisher surveys and stranding reports to provide evidence of HBWs within the marine area. This information is consistent with Wilson et al (2015) modeling outputs suggested ASHBW presence in different portions of the Arabian Sea, including within this marine area. This follows historical analyses, such as Mikhalev (1997), who found that HBW and other cetaceans were taken by Soviet whalers throughout the Arabian sea in the 1960s, including off the coasts of Pakistan and NW India. Consequently, given existing and emerging evidence, and the small and genetically distinct nature of the ASHBW, we recommend this area for OBIA designation.

Criterion 1: Geography ***2***

Criterion 2: LF Hearing ***1***

LF-Hearing Species Present:	HBW (Arabian Sea); Blue; Bryde's
Seasonality:	Year-round

Criterion 3: Biological Importance

C3: Breeding	1
C3: Crit Hab	0
C3: Foraging	2
C3: High Density	1
C3: Migration	2
C3: Small Pop	4

Total C3 Score: ***10***

Designation(s):

Hope Spot	False	☐
Pew Legacy	False	☐
EBSA	False	☐
IMMA	True	☑
NOAA NMS	False	☐
ESA Crit Hab	False	☐
High Seas Alliance	False	☐
WDPA	False	☐
Watch List	True	☑
Previously Analyzed	False	☐

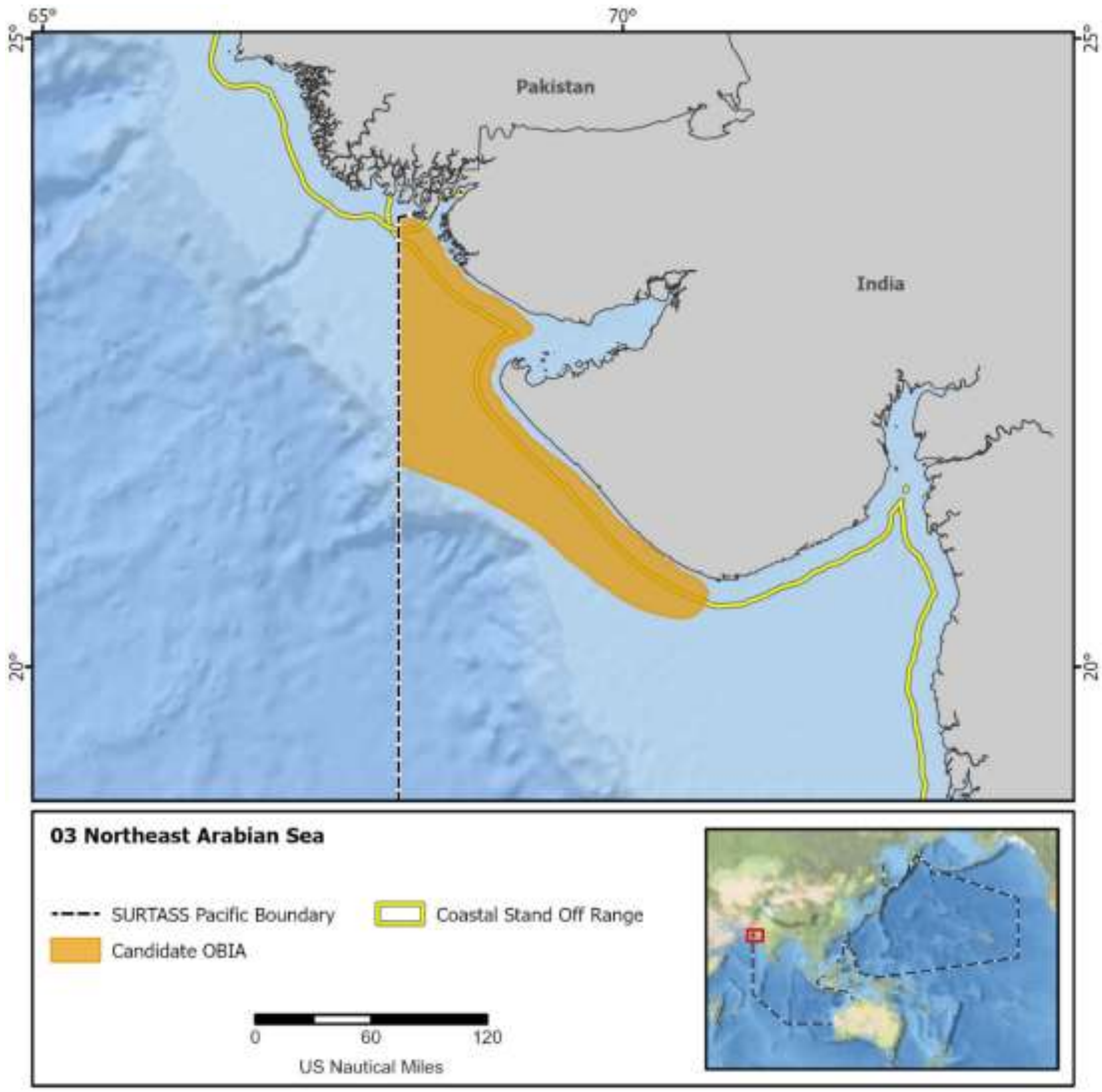

Figure F-5. Northeast Arabian Sea

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F.2.4 South of Java Island

Determination

Recommended for OBIA designation.

Ocean

Indian

Region

East Indian Ocean

Country

Indonesia

Summary

This area, south of Java, is a designated EBSA. The primary rationale for EBSA designation is that the area is the only known spawning area for Southern Bluefin Tuna. However, cetaceans are also known to migrate through the area. Although this area lies further offshore Java and less data exist on cetaceans in the region, it borders known migratory routes and an existing OBIA (Western Australia—Blue Whale). Thums et al. (2021, 2022) and Sahiri et al. (2022) provide evidence for pygmy blue whale migration in and near this marine area. Telemetry data shows whales largely east of the area, but in conjunction with emerging data, confirmed records of whales in the area, other nearby marine areas, and existing OBIAs, this area is recommended for OBIA designation. Double et al. (2014) provide further justification, including telemetry records of migratory pygmy blue whale movements through this area in the spring season. Möller et al. (2020) provide data consistent with this finding, drawing on tagging data to conclude the presence of a presumed breeding ground for eastern Indian Ocean pygmy blue whales in this region, including possibly south of Java, Bali, and Lombok.

In future analyses, we further recommend consideration of connecting this OBIA with the recommended Western Australia—Blue Whale (Expansion) OBIA. For further justification, discussion, and references, see the Western Australia—Blue Whale (Expansion) marine area entry.

Criterion 1: Geography ***2***

Criterion 2: LF Hearing ***1***

LF-Hearing Species Present:	Blue (pygmy)
Seasonality:	May to November

Criterion 3: Biological Importance

C3: Breeding	2
C3: Crit Hab	0
C3: Foraging	2
C3: High Density	2
C3: Migration	3
C3: Small Pop	0

Total C3 Score: ***9***

Designation(s):

Hope Spot	False	☐
Pew Legacy	False	☐
EBSA	True	☑
IMMA	False	☐
NOAA NMS	False	☐
ESA Crit Hab	False	☐
High Seas Alliance	False	☐
WDPA	False	☐
Watch List	False	☐
Previously Analyzed	False	☐

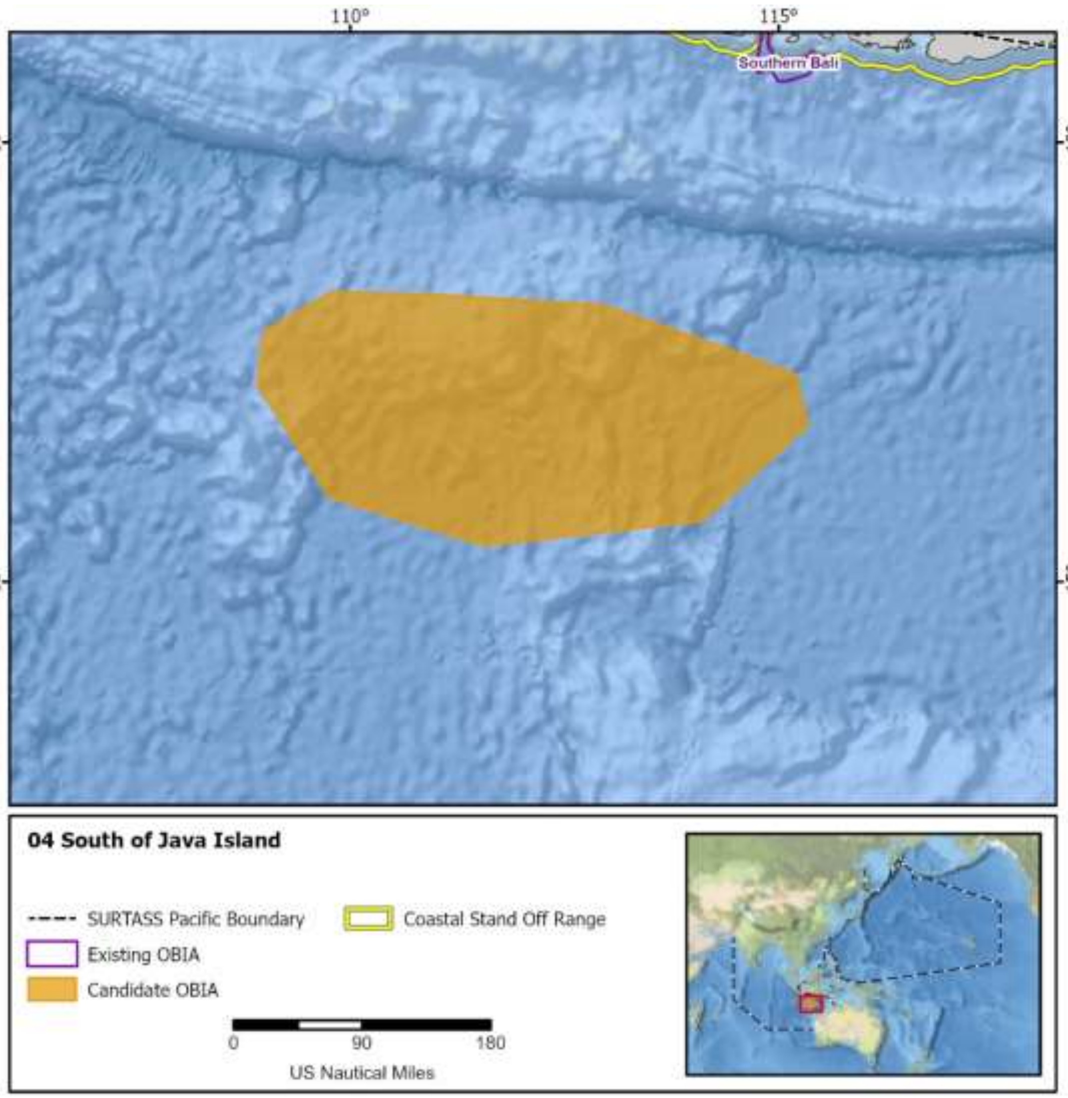

Figure F-6. South of Java Island

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F.2.5 South of Lombok and Sumbawa Islands

Determination

Recommended for OBIA designation.

Ocean

Indian

Region

East Indian Ocean

Country

Indonesia

Summary

This area was previously assessed in the 2019 SEIS/SOEIS due to NRDC comment N1-21 on the DSEIS, stating the area is a foraging site for pygmy blue whales. At the time, evidence was lacking to support the designation of this area as an OBIA. However, since the 2019 SEIS/SOEIS, new evidence suggests this area should be considered due to pygmy blue whale activity in the region.

The area falls directly between two sets of existing OBIAs, both designated in part for blue whales. Areas immediately east-southeast are already designated OBIAs for blue whale migration, and current evidence shows that some of these blue whales likely migrate through this marine area as well. Thums et al. (2021, 2022) and Sahiri et al. (2022) provide evidence of pygmy blue whale migration in and near this marine area. Telemetry data shows whales east of marine area, but in conjunction emerging data, recorded whales in the area, other nearby marine areas, and existing OBIAs, this should be strongly considered for designation. Double et al. (2014) provides further supporting evidence, while Thums et al. (2020) tracked tagged pygmy blue whales through the area during migration season, showing high occupancy rates for waters in and near this marine area. They note the possibility the area may provide for previously unknown foraging or breeding activity.

In future analyses, we further recommend consideration of combining this proposed OBIA, the Western Australia—Blue Whale OBIA, and the existing Southern Bali OBIA to encompass a larger area extending along Western Australia into Southern Indonesia. See references from Western Australia—Blue Whale (Expansion) proposed OBIA for further information.

A portion of this area is designated as Western Lesser Sunda Islands and Sumba Coastal Area IMMA, which, alongside prior Watch List inclusion (Southern Java\Sumbawa Islands; Western Lesser Sunda Islands and Sumba Coastal Area IMMA), prompted the re-analysis of this area (later renamed/redrawn to South of Lombok and Sumbawa Islands for proposed OBIA designation) in the 2025 SEIS/SOEIS process.

Criterion 1: Geography ***2***

Criterion 2: LF Hearing ***1***

LF-Hearing Species Present:	Blue (pygmy)
Seasonality:	May to November

Criterion 3: Biological Importance

C3: Breeding	2
C3: Crit Hab	0
C3: Foraging	2
C3: High Density	2
C3: Migration	3
C3: Small Pop	0

Total C3 Score: ***9***

Designation(s):

Hope Spot	False	☐
Pew Legacy	False	☐
EBSA	False	☐
IMMA	False	☐
NOAA NMS	False	☐
ESA Crit Hab	False	☐
High Seas Alliance	False	☐
WDPA	False	☐
Watch List	True	☑
Previously Analyzed	False	☐

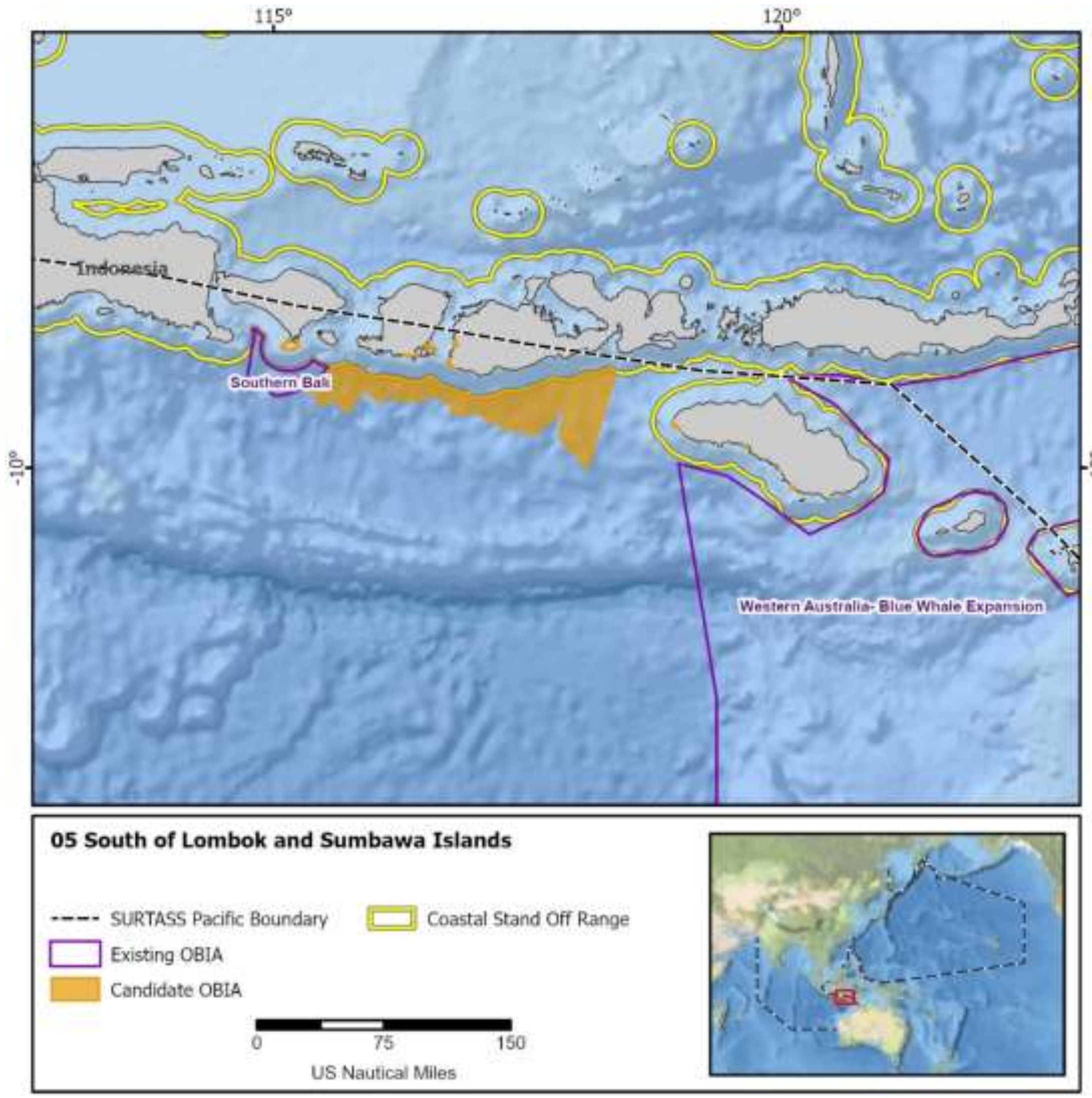

Figure F-7. South of Lombok and Sumbawa Islands

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F.3 Part 2: OBIA Watch List: Marine Areas that Do Not Meet OBIA Designation Criteria but Were Added to the OBIA Watch List

This section describes those areas that have been considered for OBIA designation, but did not meet the criteria described in Section F.1.

F.3.1 Micronesian Islands

Determination

Not recommended for OBIA designation, but recommended for inclusion on Watch List.

Ocean

Pacific

Region

South West Pacific

Country

Micronesia, Federated States Of

Summary

The Micronesian Islands have been reviewed in previous SURTASS documents, including 2012, for OBIA designation. This Mission Blue Hope Spot encompasses virtually all of Micronesia, stretching across the Federated States of Micronesia as well as other nations that comprise the region. Consequently, it is too large and unwieldy for appropriate analysis. Wiles (2005) notes a variety of whales (including Sperm and baleen whales) that have been recorded historically and more recently, including via vocalizations, however these observations stretch substantially across time and space and it is not clear if they are related to any important biological activity.

New research by Konishi et al. (2024) provides evidence that sei whale breeding grounds may be found between 20 and 7 degrees North latitude in the waters of the Marshall Islands and north of Micronesia. Their evidence shows that sei whales do not follow clear migratory pathways south for breeding season, but move over a widely distributed area southwards. They appear to stay largely at depth for around a month during this breeding period, near the Marshall Islands. More information is needed about the details of migration to these areas. While this article provides important new evidence about sei whale behavior, there is still significant uncertainty. Particularly given the large areas in question, it is difficult to justify OBIA designation. However, this area should remain on the Watch List and new research should be monitored that could provide more specificity regarding important biological activities to inform future OBIA assessments.

Criterion 1: Geography ***2***

Criterion 2: LF Hearing ***1***

LF-Hearing Species Present:	Blue; Bryde's; Sperm
Seasonality:	

Criterion 3: Biological Importance

C3: Breeding	1
C3: Crit Hab	0
C3: Foraging	1
C3: High Density	1
C3: Migration	1
C3: Small Pop	1

Total C3 Score: ***5***

Designation(s):

Hope Spot	True	☑
Pew Legacy	False	☐
EBSA	False	☐
IMMA	False	☐
NOAA NMS	False	☐
ESA Crit Hab	False	☐
High Seas Alliance	False	☐
WDPA	False	☐
Watch List	True	☑
Previously Analyzed	False	☐

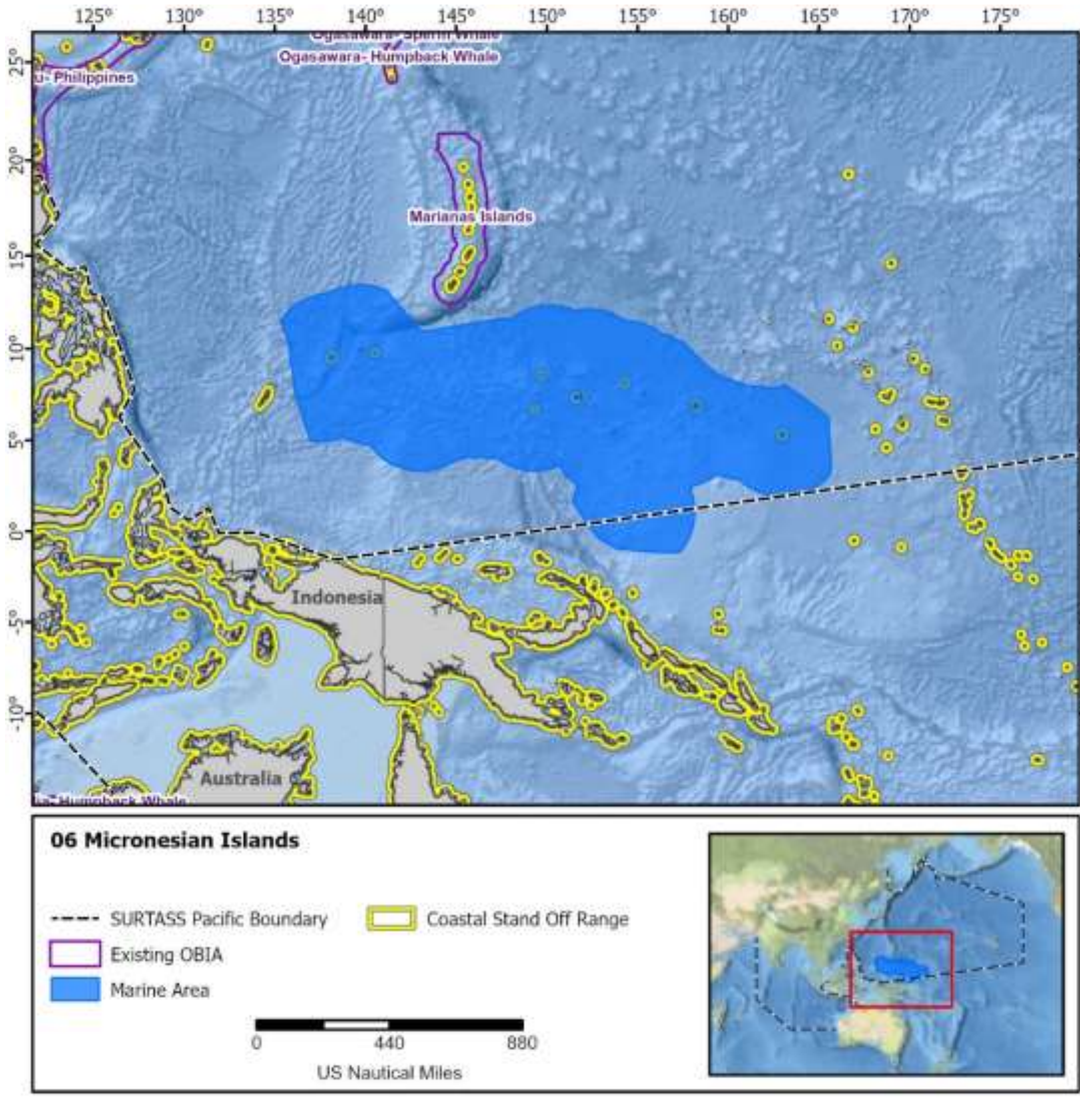

Figure F-8. Micronesian Islands

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F.3.2 Pacific Islands Heritage Marine National Monument - Palmyra and Johnston Atolls and Kingman Reef

Determination

Not recommended for OBIA designation, but recommended for inclusion on Watch List.

Ocean

Pacific

Region

South West Pacific

Country

United States

Summary

Palmyra Atoll, Johnston Atoll, and Kingman Reef were analyzed in previous SEIS/SOEIS processes as part of the Pacific Remote Islands MNM and are analyzed here under their new name as of 2025, the Pacific Islands Heritage MNM. Generally, there is very limited information on LF-hearing cetaceans in this marine area. Rather, other species such as dolphins, sea turtles, fish, and corals are typically found in and around these atolls and reefs (NOAA 2025; Morgan et al. 2010). Barlow et al. (2008) documented the first comprehensive cetacean survey in the U.S. EEZ around Palmyra and Kingman, and while they observed at least 22 cetacean species, there was no discussion of important biological activity for any detected species. Morgan et al. (2010) increased the known cetacean count for this region to 27 species. Recently, there is new evidence of HBW presence at Johnston Atoll and Kingman Reef, however the data are scant and limited. Pitman et al. (2022) describe the presence of mother-calf pair at Johnston, which, they argue, suggests a nearby breeding area (or breeding at Johnston). However, this sighting was in 1992, and although there are additional lay accounts of HBW presence, scientific surveys have generally not observed HBW in the area. Using passive acoustics and machine learning, Allen et al. (2021) characterized the first known HBW song recorded at Kingman Reef, which they deemed unprecedented as there are no historical records of HBW in this region of the world. They found no recorded songs at Palmyra Atoll. Overall, information on baleen whales throughout this region in the central Pacific is scant. Instead, data often demonstrate the presence of other cetacean species such as beaked whales (e.g., Baumann-Pickering et al. (2014, 2016). As a result, inclusion on the Watch List is warranted but no OBIA designation at this time given data deficiencies.

We suggest that future analyses may consider Johnston Atoll separately from Kingman Reef and Palmyra Atoll given the distance between them.

Criterion 1: Geography 2

Criterion 2: LF Hearing 1

LF-Hearing Species Present:	Bryde's; HBW; Sperm
Seasonality:	

Criterion 3: Biological Importance

C3: Breeding	2
C3: Crit Hab	0
C3: Foraging	1
C3: High Density	1
C3: Migration	1
C3: Small Pop	1

Total C3 Score: 6

Designation(s):

Hope Spot	False	☐
Pew Legacy	False	☐
EBSA	False	☐
IMMA	False	☐
NOAA NMS	False	☐
ESA Crit Hab	False	☐
High Seas Alliance	False	☐
WDPA	False	☐
Watch List	True	☑
Previously Analyzed	False	☐

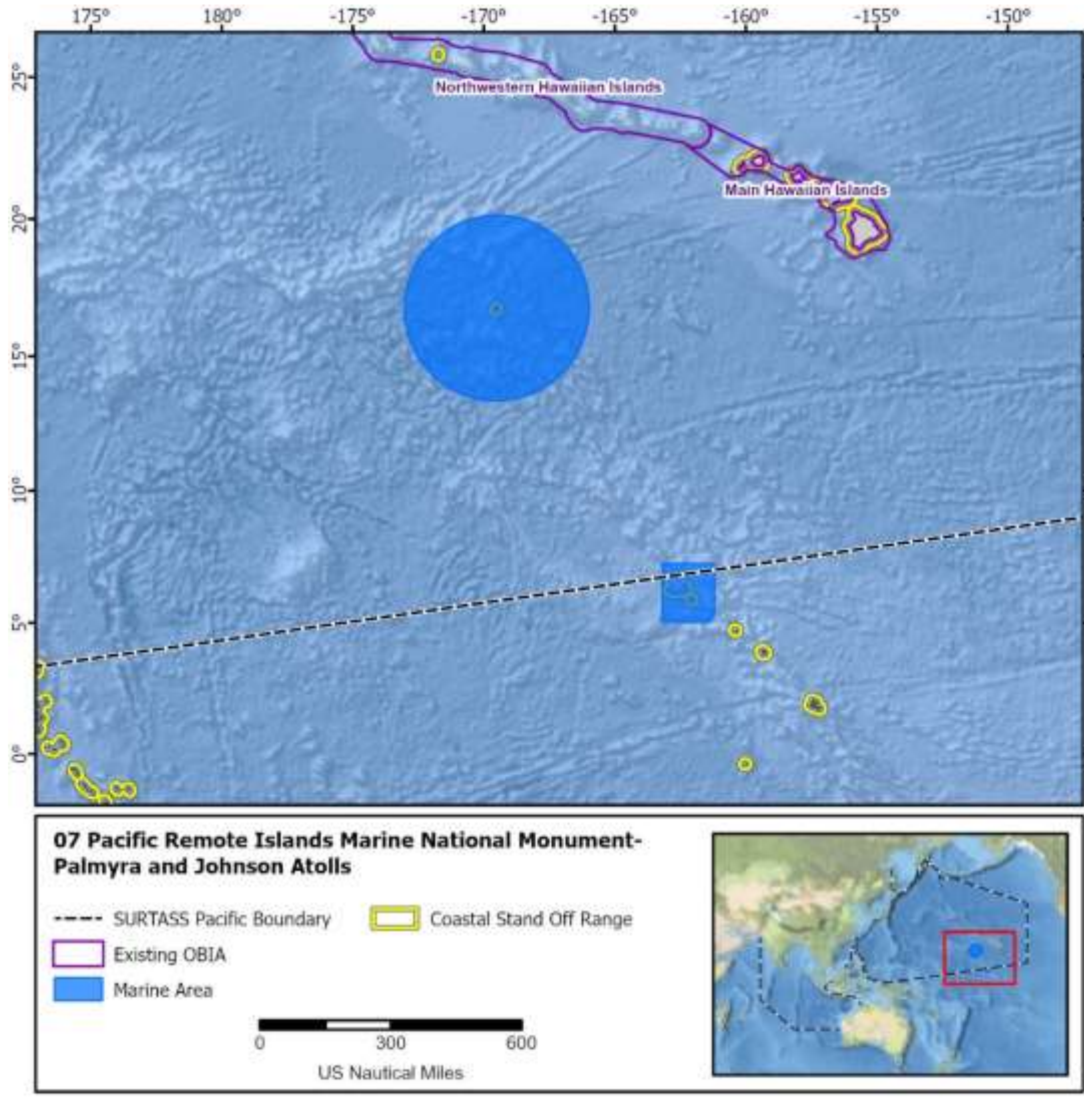

Figure F-9. Pacific Islands Heritage Marine National Monument—Palmyra and Johnston Atolls and Kingman Reef

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F.3.3 Pacific Islands Heritage Marine National Monument - Wake Island

Determination

Not recommended for OBIA designation, but recommended for inclusion on Watch List.

Ocean

Pacific

Region

North West Pacific

Country

United States

Summary

Wake Island was analyzed in previous SEIS/SOEIS processes as part of the Pacific Remote Islands MNM and is analyzed here under its new name as of 2025, the Pacific Islands Heritage MNM. Following in part from the review of the Palmyra and Johnston Atolls and Kingman Reef marine area analyzed above, information on LF-hearing cetaceans in this marine area is extremely limited. Allen et al. (2021) note that acoustic evidence suggests HBW are uncommon at Wake Island, and any acoustic detections are likely from whales passing by the island rather than engaging in important biological activity. Watkins et al. (2000), Stafford et al. (2001), and McDonald et al. (2006) noted blue whale calls recorded near Wake Island. However, these data are limited and not linked to any important biological activity; overall, the area around Wake Island is data deficient with limited knowledge about whale presence (Brownell and Ralls, 2008). More recently, Wade et al. (2021) suggest that the Allen et al. (2021) data may mean HBWs recorded near Wake Island are part of the Hawaiian Island Distinct Population Segment (DPS), however detections were extremely limited. Moreover, this presents little justification for OBIA designation, as the detection presents no evidence of important biological activity in the marine area. Lammers et al. (2011) postulated the Wake Island area could be considered a candidate for unknown HBW wintering habitat but concluded that the NWHI were the nearest and most likely habitat for those animals. Consequently, with little and limited data about baleen whales in the marine area, Wake Island is not recommended for OBIA designation.

We suggest including the area on the Watch List as new data may emerge in the future; however, we do not recommend OBIA designation at this time.

Criterion 1: Geography ***2***

Criterion 2: LF Hearing ***1***

LF-Hearing Species Present:	Blue; Fin; HBW; Sperm
Seasonality:	

Criterion 3: Biological Importance

C3: Breeding	1
C3: Crit Hab	0
C3: Foraging	1
C3: High Density	1
C3: Migration	1
C3: Small Pop	2

Total C3 Score: ***6***

Designation(s):

Hope Spot	False	☐
Pew Legacy	False	☐
EBSA	False	☐
IMMA	False	☐
NOAA NMS	False	☐
ESA Crit Hab	False	☐
High Seas Alliance	False	☐
WDPA	False	☐
Watch List	True	☑
Previously Analyzed	False	☐

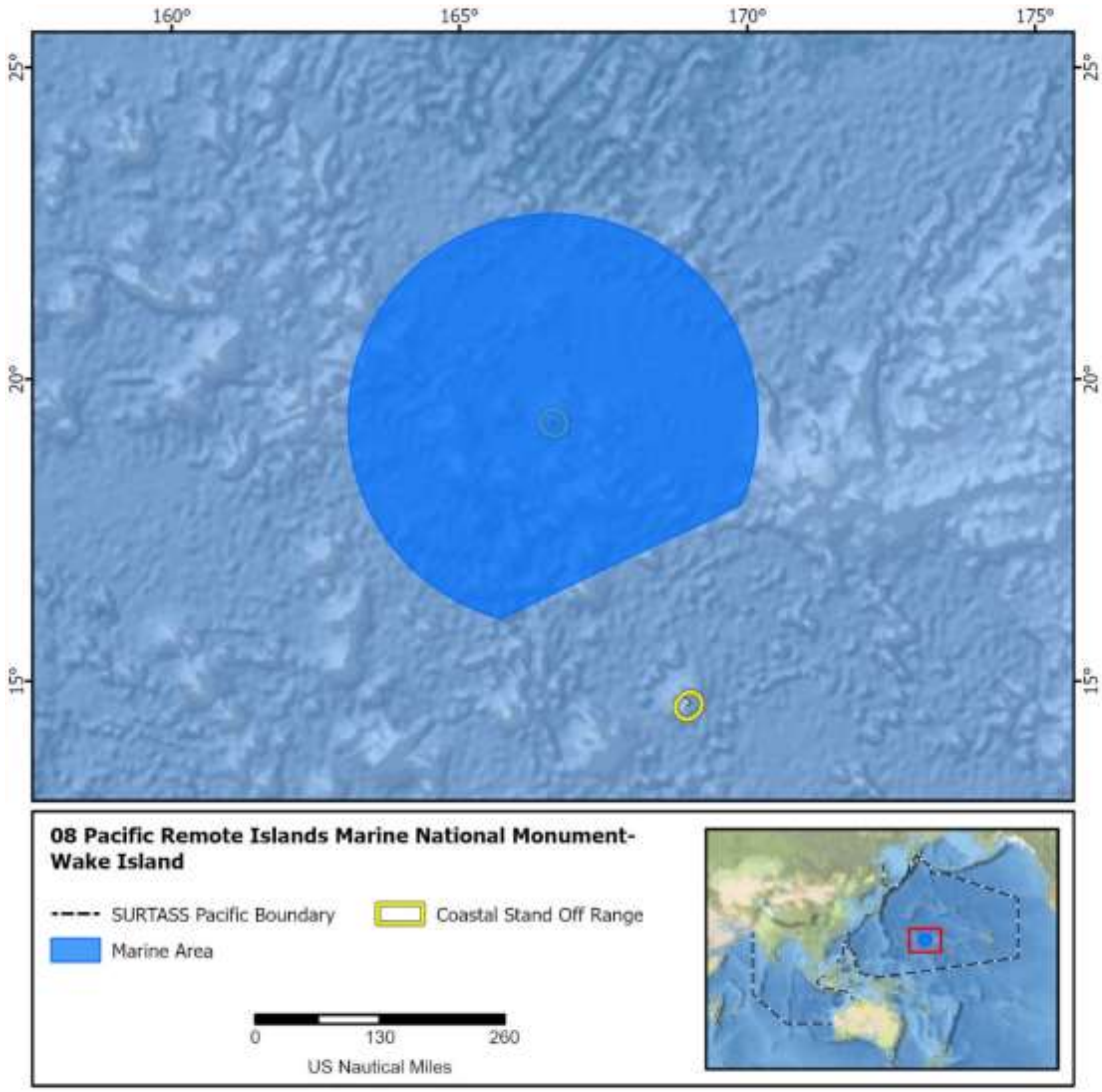

Figure F-10. Pacific Islands Heritage Marine National Monument—Wake Island

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F.3.4 Polar Front/Kuroshio Extension Front

Determination

Not recommended for OBIA designation, but recommended for inclusion on Watch List.

Ocean

Pacific

Region

North West Pacific

Country

International

Summary

This marine area was examined in the 2019 SEIS/SOEIS process in response to NRDC comments received. It was not designated an OBIA at the time, and no new evidence supports its designation. Consequently, it will remain on the Watch List. More specifically, existing and new research provides little evidence of distinct sei or Bryde's whale populations in western North Pacific feeding grounds around this marine area, consistent with past literature.

Research efforts in and near this marine area have focused on sei whales to identify environmental factors that define habitat features. Sighting survey data from July in the years 2000 to 2007 were analyzed in relation to the distances from the Polar Front, Subarctic Front, and Kuroshio Extension Front (Murase et al., 2014). Sei whales were found in higher densities from 135 to 189 NM (250 to 350 km) north and from 54 to 108 NM (100 to 200 km) south of the Subarctic Front. The authors suggest that the bimodal distribution of higher abundances might reflect annual changes in their environment at varying spatial scales. This study focused on macro scale (months and 1,000s of km) to meso scale (days to weeks over 100s of km) distributions; the authors suggest that macro to nano-scale studies are needed to understand the spatial distribution of sei whales. To investigate sei whale diving behavior at smaller spatial scales, Ishii et al. (2017) attached acoustic time-depth recorders to two sei whales in the western North Pacific. The sei whales were found to dive to depths of approximately 40 m (131 ft) during the day. The authors suggest that sei whales use oceanographic features such as sea surface temperature (SST) to find mesoscale regions (100s km) (Sasaki et al., 2013), then search within those regions for microscale (10s km), high-density prey fields.

Similar heterogeneity in sei whale distribution has been found in the North Atlantic (Skov et al., 2008). It appears that sei whale utilize fine-scale frontal processes that interact with the seafloor topography, where consistent flow gradients result in patterns of increased primary and secondary productivity. The persistence of such features, as well as the association of sei whales, needs to be investigated further. Furthermore, Sasaki et al. (2013) found distinct and separate habitats for sei and Bryde’s whales in the western North Pacific, which both appear to migrate seasonally with SST. Takahashi et al. (2022) similarly found differences in the feeding habits of sei and Bryde's whales in the region, including both temporal differences and prey species. This results from spatial segregation and the availability of different prey species as the two whale species migrate into the North Pacific feeding grounds. In a population genetic study of Bryde’s whales in the region, Taguchi et al. (2022) found little evidence of distinct populations in western north Pacific feeding grounds, consistent with other literature.

Although available information is demonstrates whale presence in the marine area, currently the scientific evidence to support this area's biological importance to the sei or Bryde's whale is insufficient to designate the area as an OBIA. This is in part because the recommended marine area comprises a large geography, and there is limited information on finer spatial scales. We recommend the area remain on the Watch List and be re-evaluated for OBIA designation in the future. We further recommend evaluating future research to reduce the marine area size for better small-scale geographic evaluation, if those data become available.

Criterion 1: Geography **2**

Criterion 2: LF Hearing **1**

LF-Hearing Species Present:	Sei; Bryde's
Seasonality:	

Criterion 3: Biological Importance

C3: Breeding	1
C3: Crit Hab	0
C3: Foraging	1
C3: High Density	1
C3: Migration	1
C3: Small Pop	1

Total C3 Score: **5**

Designation(s):

Hope Spot	False	☐
Pew Legacy	False	☐
EBSA	False	☐
IMMA	False	☐
NOAA NMS	False	☐
ESA Crit Hab	False	☐
High Seas Alliance	False	☐
WDPA	False	☐
Watch List	True	☑
Previously Analyzed	False	☐

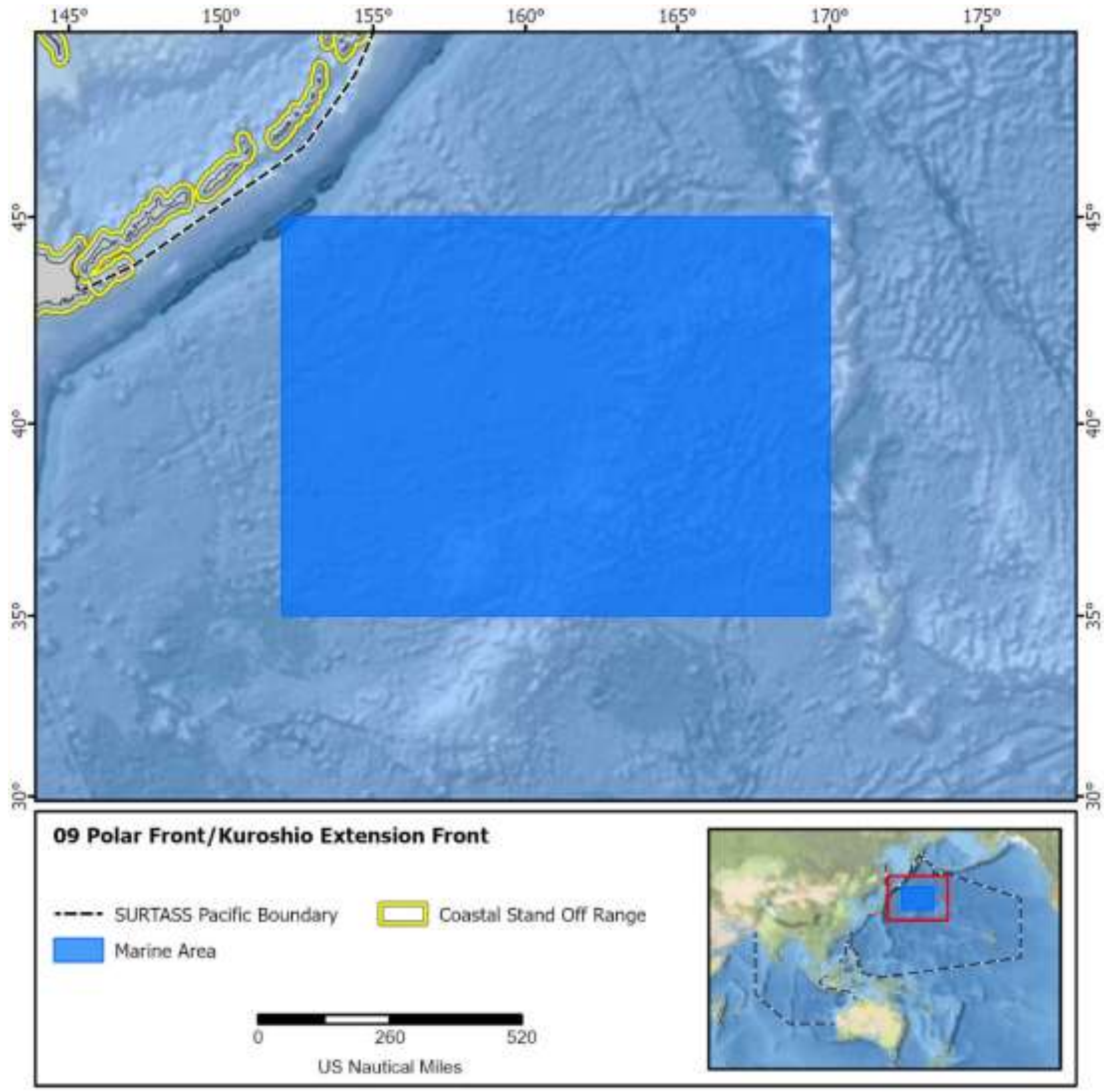

Figure F-11. Polar Front/Kuroshio Extension Front

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F.3.5 Coastal Northern Bay of Bengal IMMA

Determination

Not recommended for OBIA designation, but recommended for inclusion on Watch List.

Ocean

Indian

Region

Central Indian Ocean

Country

Bangladesh

Summary

This coastal IMMA was assessed for the 2019 SEIS/SOEIS, but the area was not designated as an OBIA as data only indicate coastal odontocetes in the IMMA with no records of baleen whales in the nearshore waters. Also, only a portion of this IMMA is outside the CSR. OBIA #38, Swatch-of-No-Ground (SoNG), is located just south of this area in the northern Bay of Bengal. The Irrawaddy dolphin, Indo-Pac finless dolphin, & Indo-Pac humpback dolphin occur in the waters of this IMMA; 11 species of marine mammals are found in the North Bay of Bengal.

There is a slowly growing knowledge base of megafauna and cetaceans in this area (e.g., Begum et al. 2020), however current evidence is still limited to support an OBIA designation. New research does show or suggest cetaceans do occur in the area; however, these data are limited and it is difficult to draw conclusions about the ecological importance of the area, especially as related to OBIA criteria. In a review of marine megafauna in the Northern Bay of Bengal, Begum et al. (2020), for instance, note that there are only four whale species present in the area, and data collected from local stakeholders recounted few bycatch encounters with whales and no comprehensive or up-to-date status of whales in the region. The IMMA listing includes the Bryde's whale as a secondary species in the area, noting one sighting of a mother-young pair in unpublished 2017-2018 survey data (IUCN-MMPATF, 2024). However, this data point alone, even in conjunction with other recent information, does not provide enough justification for the presence of important biological activity by baleen species in the area.

We suggest keeping this marine area on the Watch List and re-evaluate for OBIA criteria in the future if more comprehensive and definitive information about cetaceans (especially baleen species) is published.

Criterion 1: Geography **2**

Criterion 2: LF Hearing **1**

LF-Hearing Species Present:	Bryde's
Seasonality:	

Criterion 3: Biological Importance

C3: Breeding	1
C3: Crit Hab	0
C3: Foraging	1
C3: High Density	1
C3: Migration	1
C3: Small Pop	1

Total C3 Score: **5**

Designation(s):

Hope Spot	False	☐
Pew Legacy	False	☐
EBSA	False	☐
IMMA	True	☑
NOAA NMS	False	☐
ESA Crit Hab	False	☐
High Seas Alliance	False	☐
WDPA	False	☐
Watch List	True	☑
Previously Analyzed	False	☐

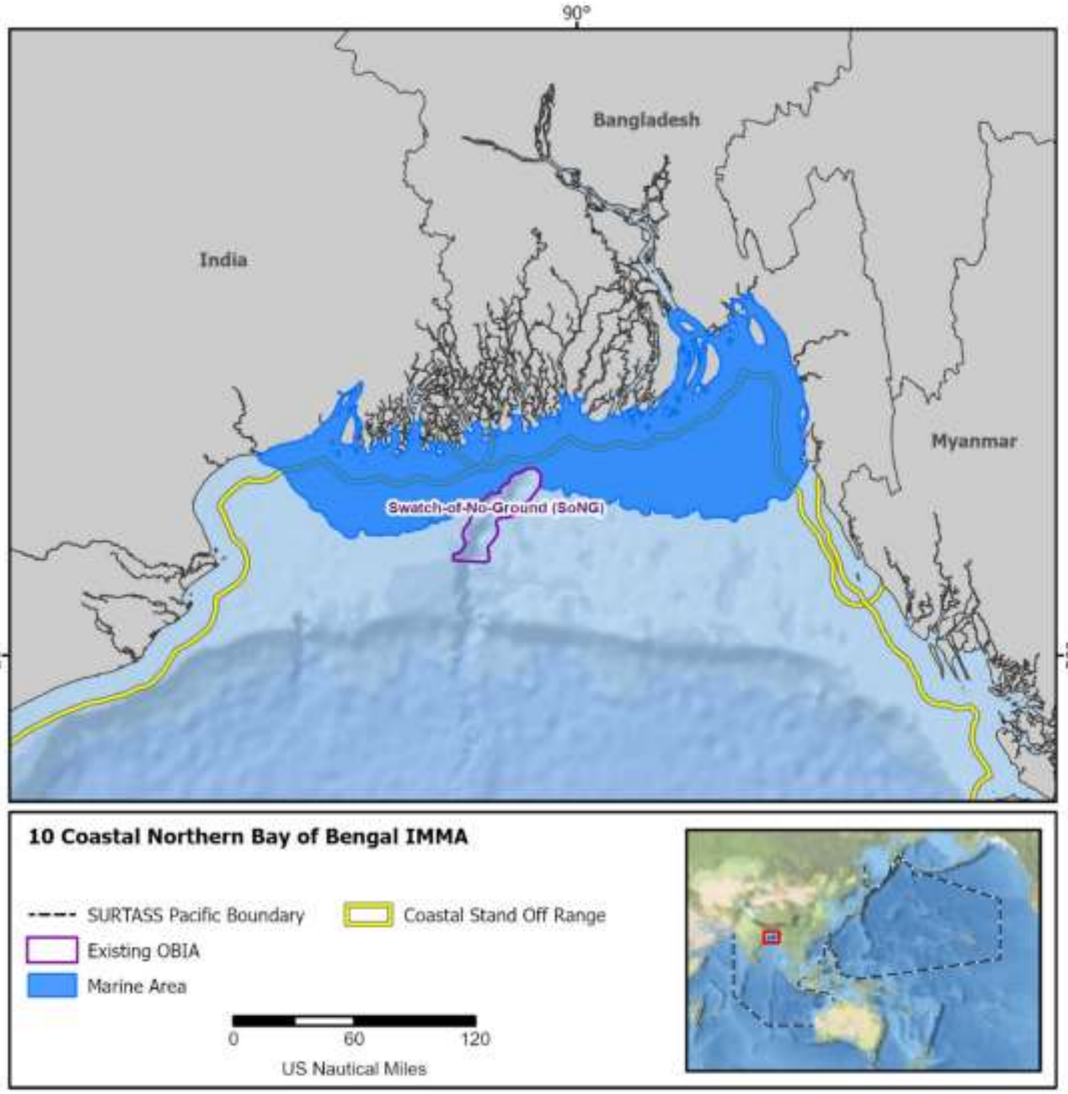

Figure F-12. Coastal Northern Bay of Bengal IMMA

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F.3.6 Kien Giang and Kep Archipelago IMMA

Determination

Not recommended for OBIA designation, but recommended for inclusion on Watch List.

Ocean

Indian

Region

East Asian Seas

Country

Vietnam

Summary

This marine area is almost entirely within the CSR. Only a very small pocket of the area is outside the CSR in the Gulf of Thailand. The area was previously reviewed as part of 2019 SEIS/SOEIS but not carried forward as OBIA because insufficient evidence of relevance to LF cetaceans or other large whales.

The IMMA designated principally for Irrawaddy dolphin & dugong (IUCN-MMPATF, 2024). The Kien Giang and Kep Archipelago IMMA covers the coastal waters of Kien Giang province in Vietnam and Kep province in Cambodia. Sightings of Indo-Pacific finless porpoises, Indo-Pacific humpback dolphins, pantropical spotted dolphins, false killer whales, and Bryde's whales have also been recorded in these waters. Bryde's whales only appear to be sighted by fishermen and are the only confirmed baleen species, and no new evidence of Bryde's whale (or other whale) important biological activity warrants OBIA designation.

We recommend this area remain on the Watch List; however, in future reviews we suggest re-evaluating the geographic extent of the area given its general overlap with the CSR. Specifically, re-evaluate if more information on Bryde's and other baleen whales become available.

Criterion 1: Geography ***2***

Criterion 2: LF Hearing ***1***

LF-Hearing Species Present:	Bryde's
Seasonality:	

Criterion 3: Biological Importance

C3: Breeding	1
C3: Crit Hab	0
C3: Foraging	1
C3: High Density	1
C3: Migration	1
C3: Small Pop	1

Total C3 Score: ***5***

Designation(s):

Hope Spot	False	☐
Pew Legacy	False	☐
EBSA	False	☐
IMMA	True	☑
NOAA NMS	False	☐
ESA Crit Hab	False	☐
High Seas Alliance	False	☐
WDPA	True	☑
Watch List	True	☑
Previously Analyzed	False	☐

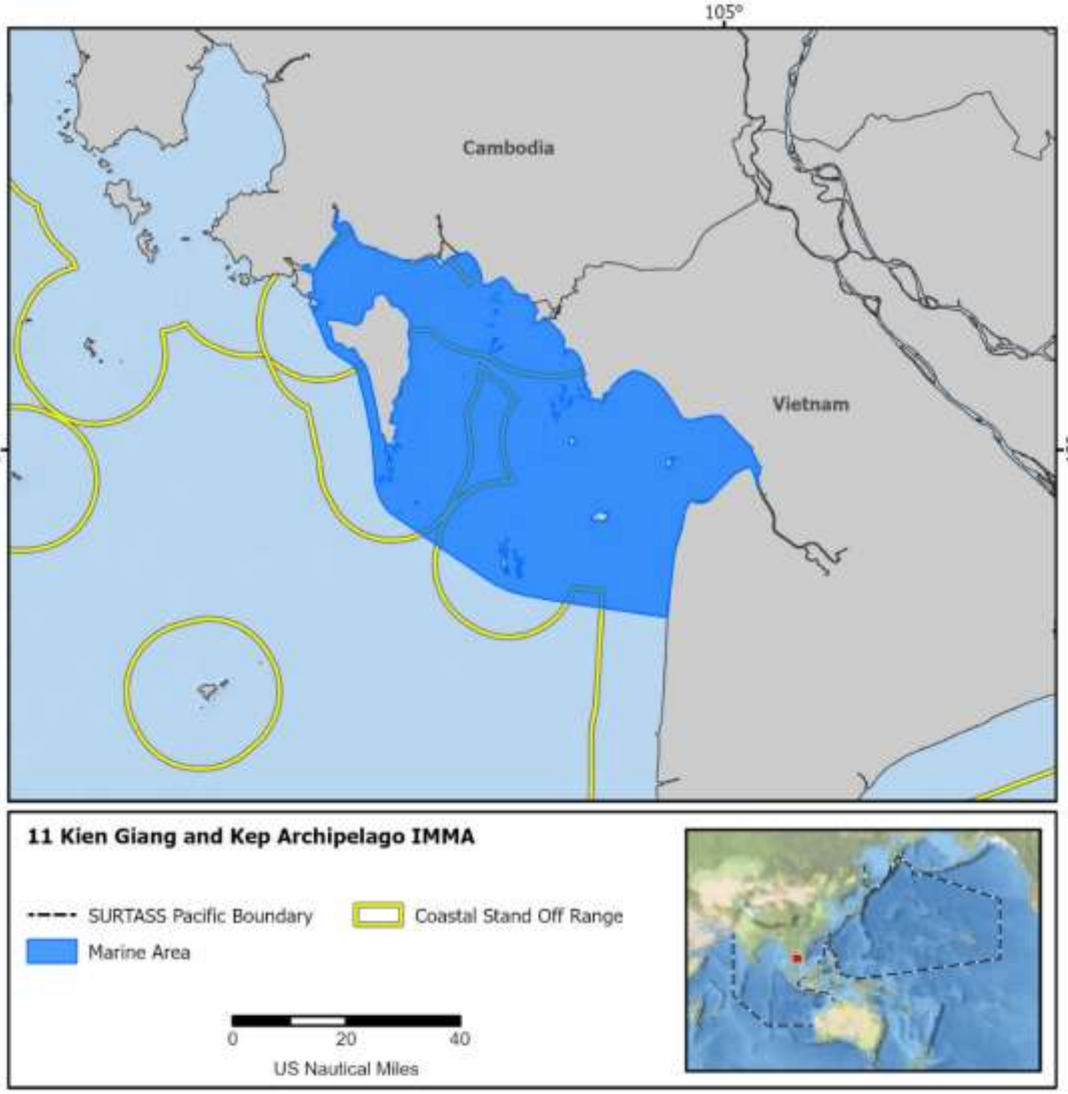

Figure F-13. Kien Giang and Kep Archipelago IMMA

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F.3.7 Lakshadweep Archipelago

Determination

Not recommended for OBIA designation, but recommended for inclusion on Watch List.

Ocean

Indian

Region

Central Indian Ocean

Country

India

Summary

Despite emerging research (largely from Panicker and colleagues), the Northern Indian Ocean (NIO) region generally and Lakshadweep area specifically is data-poor, particularly for cetaceans. Panicker et al. (2017) conducted platform-of-opportunity, line-transect surveys in which eight toothed whales and one baleen whale (Balaenoptera sp., considered most likely to be a pygmy blue or fin whale) were sighted. The most abundant species were, in descending order, spinner dolphins and short-finned pilot whales. During both on- and off-efforts, 65 unidentified cetaceans were detected. More recent work by Panicker and colleagues (2020, 2021) detected limited counts of pygmy blue whales and other cetaceans in the region. Kumar et al. (2018) presented the first confirmed record of the stranding of a dwarf sperm whale (Kogia sima) in Indian waters, which occurred on the Lakshadweep Archipelago. The Marine Mammals of India Database has confirmed sightings and strandings of Bryde's, blue, HBW, sperm, and unidentified baleen whales in recent years (Marine Mammal Conservation network of India, 2024). However, the greatest number of observations was only 2, for both Bryde’s and HBW, in 2022).

Overall, evidence shows that pygmy blue whales other baleen species are present in the area during some seasons, however it is not possible to discern if they are carrying out behaviors that meet OBIA criteria. Furthermore, the number of cetaceans detected in the area thus far remains extremely low and sparse. While the archipelago is designated an IMMA (IUCN-MMPATF, 2024), this designation is for species other than baleen whales.

For these reasons, we do not recommend Lakshadweep Archipelago be designated an OBIA, however the area should remain on the Watch List and re-assessed in the future as new research is published.

Criterion 1: Geography ***3***

Criterion 2: LF Hearing ***1***

LF-Hearing Species Present:	Pygmy blue; Fin; Sperm; Bryde's; Minke
Seasonality:	

Criterion 3: Biological Importance

C3: Breeding	1
C3: Crit Hab	0
C3: Foraging	1
C3: High Density	1
C3: Migration	1
C3: Small Pop	1

Total C3 Score: ***5***

Designation(s):

Hope Spot	False	☐
Pew Legacy	False	☐
EBSA	False	☐
IMMA	True	☑
NOAA NMS	False	☐
ESA Crit Hab	False	☐
High Seas Alliance	False	☐
WDPA	False	☐
Watch List	True	☑
Previously Analyzed	False	☐

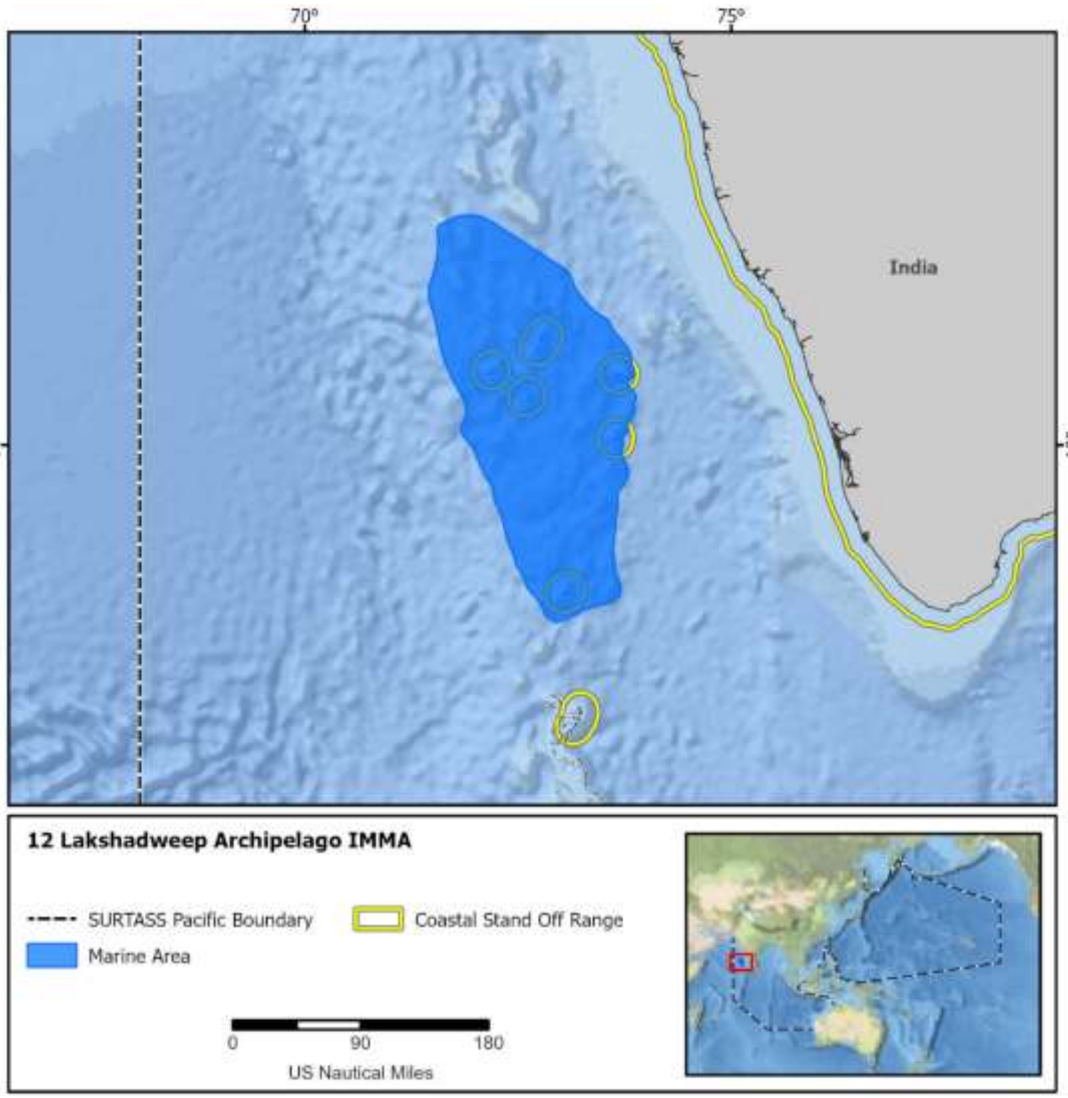

Figure F-14. Lakshadweep Archipelago

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F.3.8 Raja Ampat/Northern Bird's Head EBSA

Determination

Not recommended for OBIA designation, but recommended for inclusion on Watch List.

Ocean

Indian

Region

East Asian Seas

Country

Indonesia

Summary

The Raja Ampat and Northern Bird’s Head marine area is part of the Bismarck Solomon Seas Ecoregion and contains a high diversity of coral, reef fishes, and habitat types. The Bird’s Head Seascape Region is a large area of West Papua, Indonesia. Raja Ampat consists of four main islands and hundreds of other small islands, located at the western this area includes critical nesting and feeding habitats and migration routes for various threatened species, including sea turtles and cetaceans (CBD, 2017).

Sixteen species of marine mammals, including 15 cetaceans and the dugong, have been reported in the waters of the Bird’s Head Seascape (Borsa and Nugroho, 2010; Mangubhai et al., 2012, Kahn, 2015; Rudolph et al., 1997). Enders et al. (2014) reported only 13 species of cetaceans in Raja Ampat waters, based on 2006 to 2011 aerial and boat surveys, not including the blue whale or dugong. Mustika et al. (2022) noted that Raja Ampat appeared to be a cetacean stranding hotspot in the period of 1995-2011, but has experienced relatively fewer stranding since; those strandings in and near Raja Ampat included Bryde’s and sperm whales. Kahn (2015) noted that the dugong and blue whale occurred only rarely in the waters of Raja Ampat during his 2011 to 2016 sighting surveys, with the blue whale having been observed only once in five field seasons and the dugong observed in only three field seasons. The January and September 2006 aerial survey observations of marine mammals in the Raja Ampat region were all reported in the waters of the straits (>1,640 ft [500 m]) between the closely grouped islands or clustered in the insular shelf waters (Ender et al, 2014; Wilson et al., 2010). Ender et al. (2014) noted that highest cetacean diversity occurred in January to February, May, and October to November. Ender et al. (2014) and Wilson et al. (2010) suggested that Dampier and Sagewin straits may function as migratory corridors for cetaceans migrating between the western Pacific and eastern Indian oceans.

None of the areas surveyed in any of the cited literature herein occur within the Study Area for SURTASS LFA sonar (though Mustika et al. 2022 did note one sperm whale stranding offshore Raja Ampat in the Study Area). Furthermore, those portions of the marine area within the Study Area are largely contained within the CSR. Consequently, there very little of the extent of this marine area is eligible for OBIA designation. Furthermore, since there is no data supporting important biological activities by LF-hearing cetaceans being carried out in the part of this marine area that lies within the Study Area for SURTASS LFA sonar, this area does not meet the biological criteria for OBIA designation and is thus not considered further as an OBIA. We recommend it remain on the Watch List.

Criterion 1: Geography ***2***

Criterion 2: LF Hearing ***1***

LF-Hearing Species Present:	Bryde's; Sperm
Seasonality:	

Criterion 3: Biological Importance

C3: Breeding	1
C3: Crit Hab	0
C3: Foraging	1
C3: High Density	1
C3: Migration	1
C3: Small Pop	1

Total C3 Score: ***5***

Designation(s):

Hope Spot	False	☐
Pew Legacy	False	☐
EBSA	True	☑
IMMA	False	☐
NOAA NMS	False	☐
ESA Crit Hab	False	☐
High Seas Alliance	False	☐
WDPA	False	☐
Watch List	True	☑
Previously Analyzed	False	☐

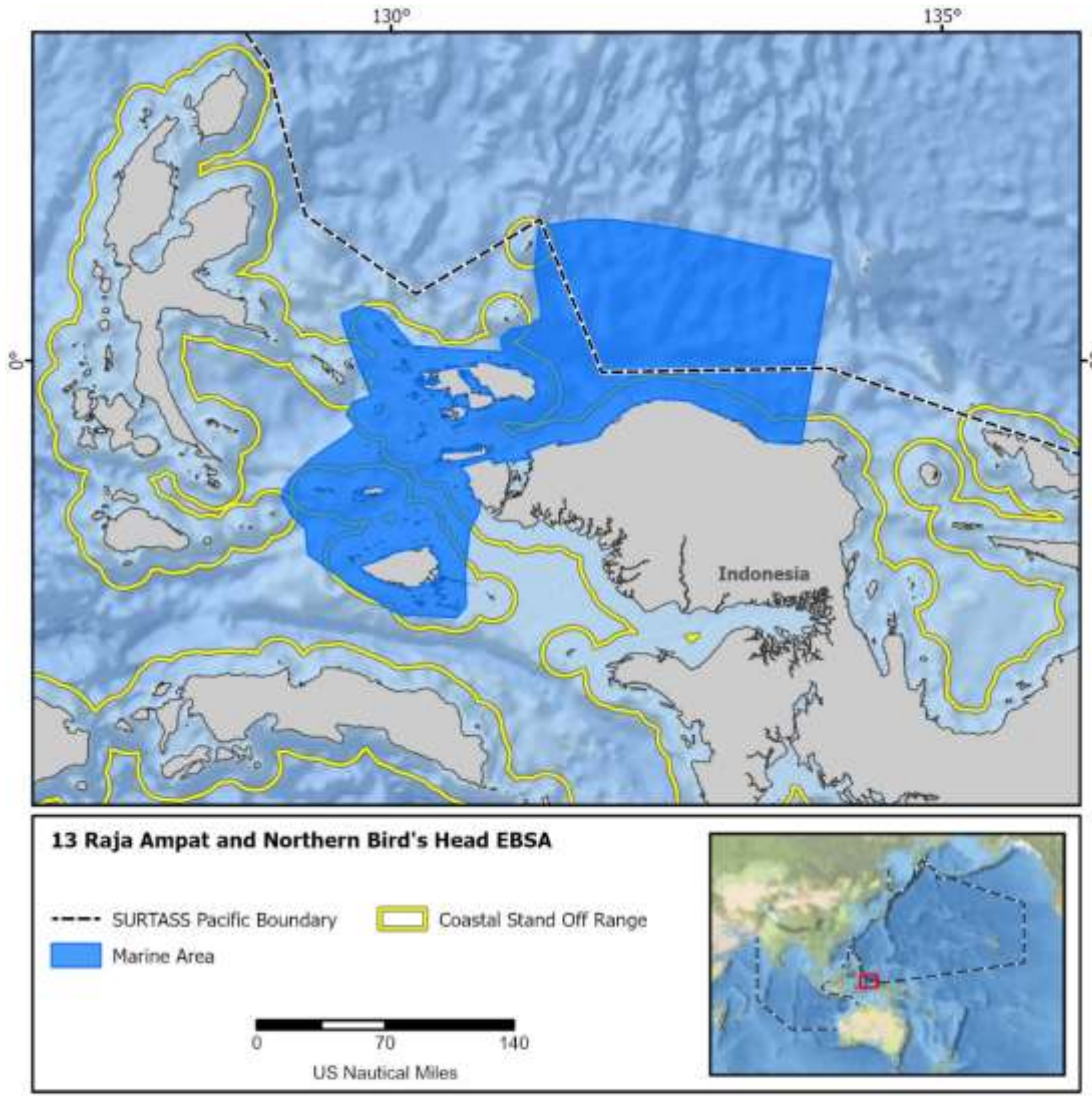

Figure F-15. Raja Ampat/Northern Bird's Head EBSA

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F.3.9 Southern Andaman Islands IMMA

Determination

Not recommended for OBIA designation, but recommended for inclusion on Watch List.

Ocean

Indian

Region

East Indian Ocean

Country

India

Summary

This IMMA is designated primarily for coastal dolphins and dugongs. Although whales are present, there are very few and limited records of LF-hearing cetaceans in the area, and limited to no evidence of important biological activity.

The Andaman and Nicobar Islands are a group of volcanic island systems in the North-eastern Indian Ocean with complex bathymetry, characterized by fringing coral reefs, seagrass beds and mangroves. The IMMA of southern Andaman Islands has 16 species of marine mammals consisting of 15 cetacean species and the dugong (IUCN-MMPATF, 20024). Although the Southern Andaman Islands IMMA was designated for the resident dugong and Indo-Pacific bottlenose dolphin, sperm whales and the recently observed Bryde's and Omura's whales have been documented in these waters. Of the 16 species of marine mammals recorded from systematic vessel-based surveys, ferry-based sighting surveys, opportunistic sightings by network members and past records, only the Indo-Pacific bottlenose dolphin and dugong are resident in the nearshore waters of the southern islands but the pantropical spotted, spinner, and Risso's dolphins are commonly observed (Malakar et al., 2015; IUCN-MMPATF, 2024). Surveys of nearshore waters only observed bottlenose dolphins and one dugong (Malakar et al., 2015). An Omura's whale was observed for the first time in the southern coastal waters of the Andaman Islands in 2015 with a second observed in 2018 (MMCNI, 2019; Cerchio et al., 2019).

Mohan and Sojitra (2018) compiled all known records of marine mammals in the waters of the Andaman Islands, including interviewing fishermen, and reported seven species of marine mammals, including the sperm, killer, false killer, Bryde's, short-finned pilot, and Blainville's beaked whales in addition to the dugong. A mass stranding of 30 pilot whales occurred in the Andaman Islands in May 2010 (Mohan and Sojitra, 2018). Mankeshwar (2018) reported similar information, noting that 10 cetacean species have been opportunistically reported in regional waters, and 15 species were identified in their study. More recently, Purkayastha et al. (2025) conducted a vessel-based cetacean survey in eastern Andaman waters from November 2022 to March 2023 and identified 5 cetacean species, including 65 sightings and 469 individuals. Notably, however, no baleen whale species were observed; spinner dolphins were the dominant species observed.

Although cetacean observations are not uncommon, information on baleen species remains limited and it appears these animals are unusual within the waters of the marine area. Since information on the occurrence of Bryde's and Omura's whales is so recent and limited, no scientific evidence exists on the importance of the waters of the Andaman Islands to these baleen whale species. Furthermore, only small portions of the IMMA are outside the SURTASS CSR; as a result, it is difficult to discern if these offshore portions are important for biological activities. Thus, the IMMA does not meet the biological importance criteria. We recommend inclusion on Watch List given the region is data-poor and future research may provide more useful information, particularly for the areas beyond the CSR around the Anadman and Nicobar Islands.

Criterion 1: Geography ***2***

Criterion 2: LF Hearing ***1***

LF-Hearing Species Present:	Bryde's; Omura's; Sperm
Seasonality:	

Criterion 3: Biological Importance

C3: Breeding	1
C3: Crit Hab	0
C3: Foraging	1
C3: High Density	1
C3: Migration	1
C3: Small Pop	1

Total C3 Score: ***5***

Designation(s):

Hope Spot	False	☐
Pew Legacy	False	☐
EBSA	False	☐
IMMA	True	☑
NOAA NMS	False	☐
ESA Crit Hab	False	☐
High Seas Alliance	False	☐
WDPA	False	☐
Watch List	True	☑
Previously Analyzed	False	☐

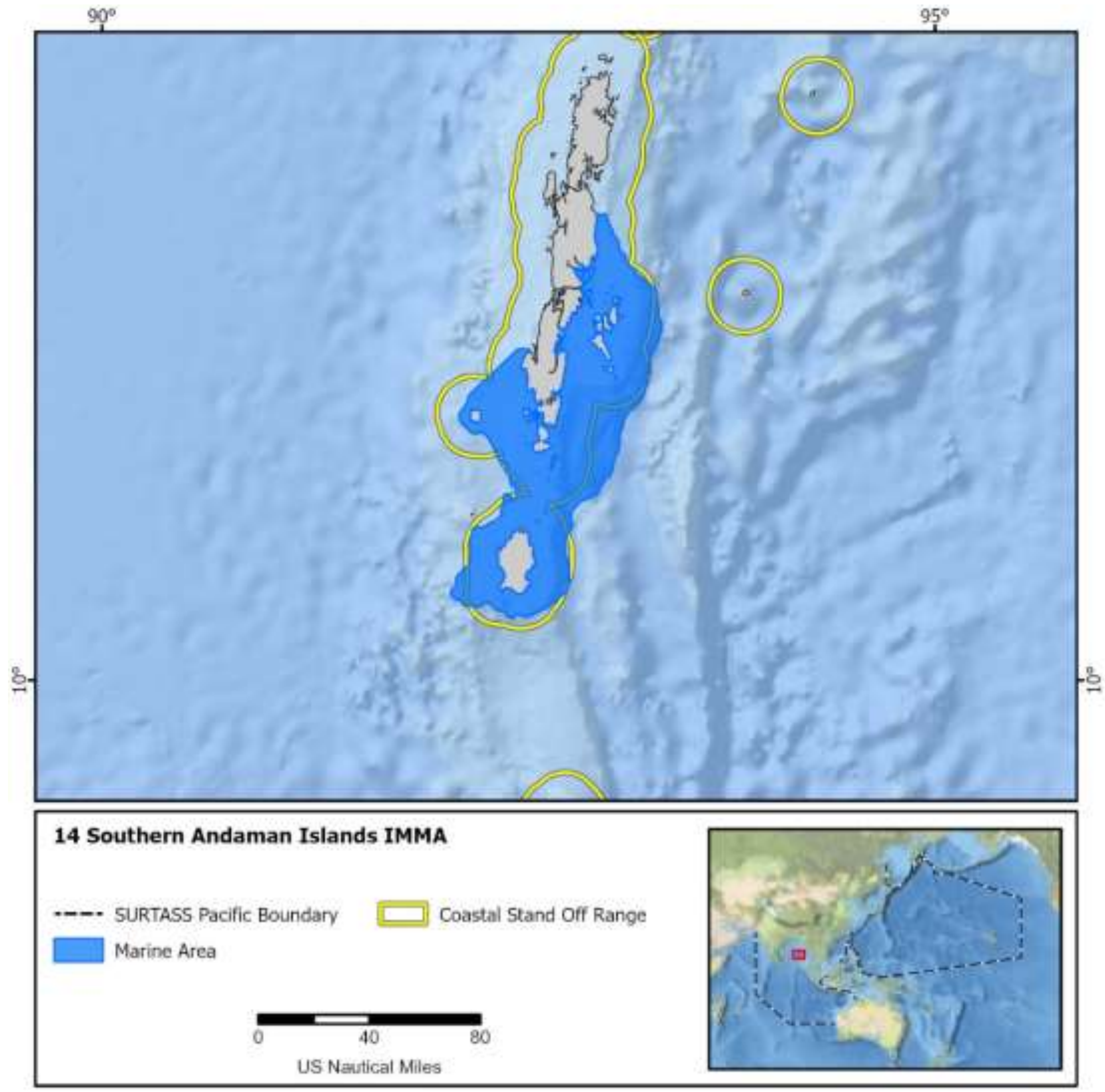

Figure F-16. Southern Andaman Islands IMMA

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F.3.10 West of Sri Lanka (3°to 12°N, 74° to 80°E)

Determination

Not recommended for OBIA designation, but recommended for inclusion on Watch List.

Ocean

Indian

Region

Central Indian Ocean

Country

Sri Lanka

Summary

This marine area was previously assessed for the 2019 SEIS/SOEIS based on an NRDC comment suggesting this area important to blue and perhaps sperm whales based on Anderson et al. 2012 paper. While Anderson et al. (2012) hypothesized whale activity in this area, direct evidence of biological importance is uncertain.

Anderson et al. (2012) describes the distinct population of blue whales in Northern Indian Ocean (NIO). The authors reviewed catch, sightings, strandings, and acoustic detection data and used ocean color data to estimate seasonality of primary productivity in different areas of the northern Indian Ocean together to develop a migration hypothesis for the NIO blue whales. The hypothesis is that most of the NIO blue whales feed in the Arabian Sea off the coasts of Somalia and the Arabian peninsula during the period of intense upwelling associated with the southwest monsoon (from about May to October) while at the same time some blue whales also feed in the area of upwelling off the southwest coast of India and west coast of Sri Lanka. When the southwest monsoon dies down in about October–November these upwellings cease, and the blue whales then disperse more widely (during about December to March) in other localized areas with seasonally high productivity, including the east coast of Sri Lanka, the waters west of the Maldives, the vicinity of the Indus Canyon (at least historically), and some parts of the southern Indian Ocean.

More recent research by Panicker and colleagues (e.g., 2020, 2021) examining cetacean presence in and around Lakshadweep provides some evidence for the Anderson et al. (2012) hypothesis. However, data and observations in the area remain extremely limited, and information on biological importance is even further limited. While data west near the Maldives provides support for an OBIA recommendation in that area, and data east near Sri Lanka supports existing OBIAs in that region, information about cetacean activity and importance in the open ocean between these areas remain limited and do not support OBIA designation. Further information discussing the western portion of this marine area may be found in the entries on Lakshadweep Archipelago and the Maldives Archipelago; however, data suggests cetacean presence is higher near the islands of the Maldives rather than the open ocean east of the archipelago. We suggest keeping this marine area on the Watch List and reevaluating as new research on cetaceans in the NIO continues to be published.

Criterion 1: Geography 2

Criterion 2: LF Hearing 1

LF-Hearing Species Present:	Blue; Sperm
Seasonality:	

Criterion 3: Biological Importance

C3: Breeding	1
C3: Crit Hab	0
C3: Foraging	1
C3: High Density	1
C3: Migration	1
C3: Small Pop	1

Total C3 Score: 5

Designation(s):

Hope Spot	False	☐
Pew Legacy	False	☐
EBSA	False	☐
IMMA	False	☐
NOAA NMS	False	☐
ESA Crit Hab	False	☐
High Seas Alliance	False	☐
WDPA	True	☑
Watch List	True	☑
Previously Analyzed	False	☐

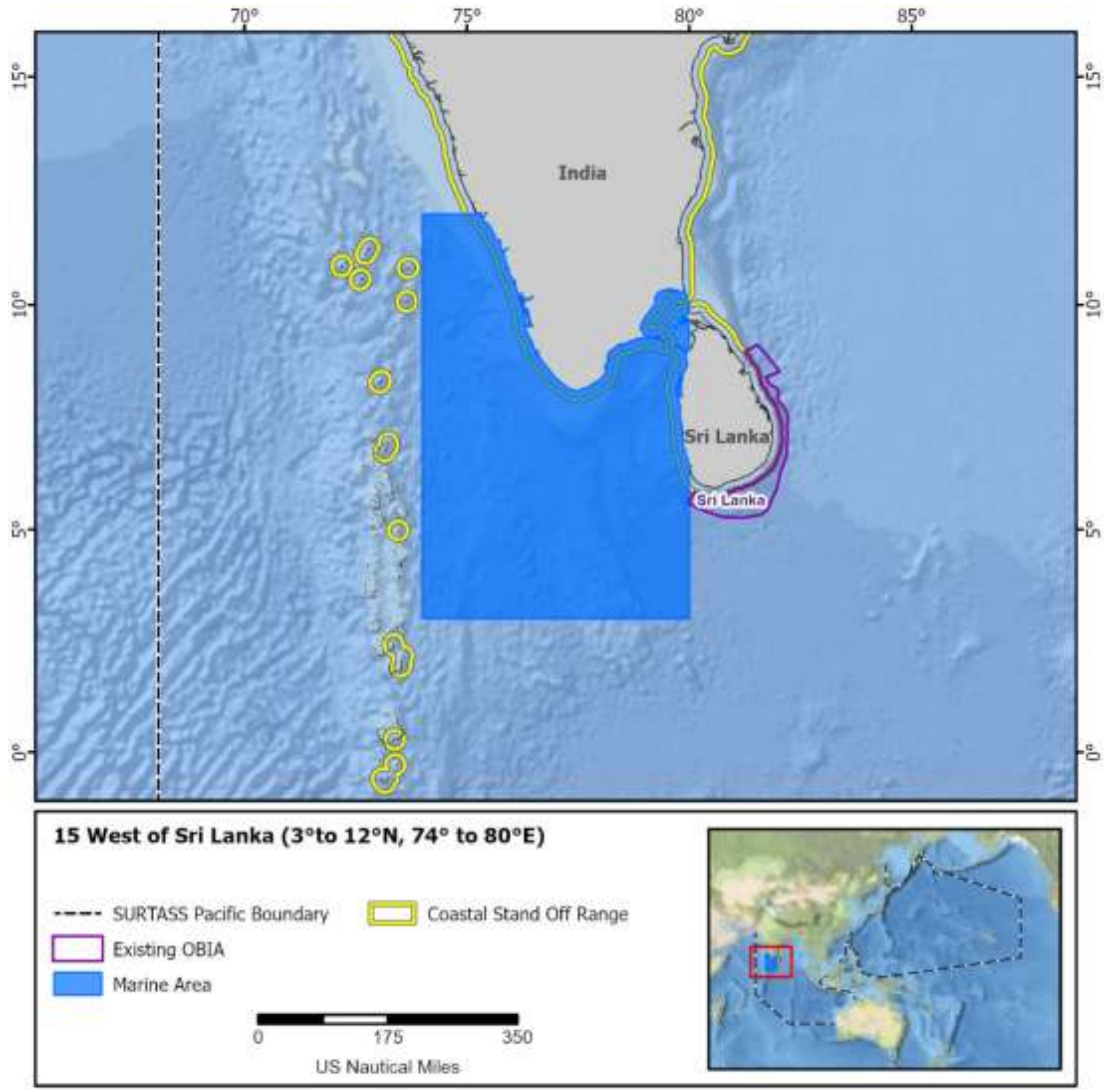

Figure F-17. West of Sri Lanka (3 ° to 12 °N, 74 ° to 80 °E)

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F.3.11 Coastal/Offshore Gulf of Mannar EBSA

Determination

Not recommended for OBIA designation, but recommended for inclusion on Watch List.

Ocean

Indian

Region

Central Indian Ocean

Country

Sri Lanka

Summary

In the 2019 SEIS/SOEIS process, NRDC asked Navy/NMFS to consider this area for pygmy blue whale; however, there is limited evidence that blue whales use these waters or migrate through them. There have been confirmed observations of other LF-hearing whales in the Gulf of Mannar, including fin, HBW, minke, sperm, and sei whales, however current evidence suggests whales generally prefer the northern portions of the gulf, and it is unclear if any biologically important activity occurs in the EBSA for LF-hearing species (jayasiri and Haputhantri, 2015; Sutaria et al., 2017). Nanayakkara et al. (2020) provided the first known observation of a pod of killer whales preying on a pod of sperm whales in the Gulf of Mannar, while an opportunistic blue whale survey by Kirumbara et al. (2022) in the area found few observations of blue whales in or near the gulf. The EBSA was not designated for cetacean species, but rather for the local population of dugongs.

The marine area is not recommended for OBIA designation, but should be retained on the Watch List for future reanalysis.

Criterion 1: Geography 2

Criterion 2: LF Hearing 1

LF-Hearing Species Present:	Pygmy blue; HBW; Sperm
Seasonality:	

Criterion 3: Biological Importance

C3: Breeding	1
C3: Crit Hab	0
C3: Foraging	2
C3: High Density	1
C3: Migration	1
C3: Small Pop	1

Total C3 Score: 6

Designation(s):

Hope Spot	False	☐
Pew Legacy	False	☐
EBSA	True	☑
IMMA	False	☐
NOAA NMS	False	☐
ESA Crit Hab	False	☐
High Seas Alliance	False	☐
WDPA	False	☐
Watch List	True	☑
Previously Analyzed	False	☐

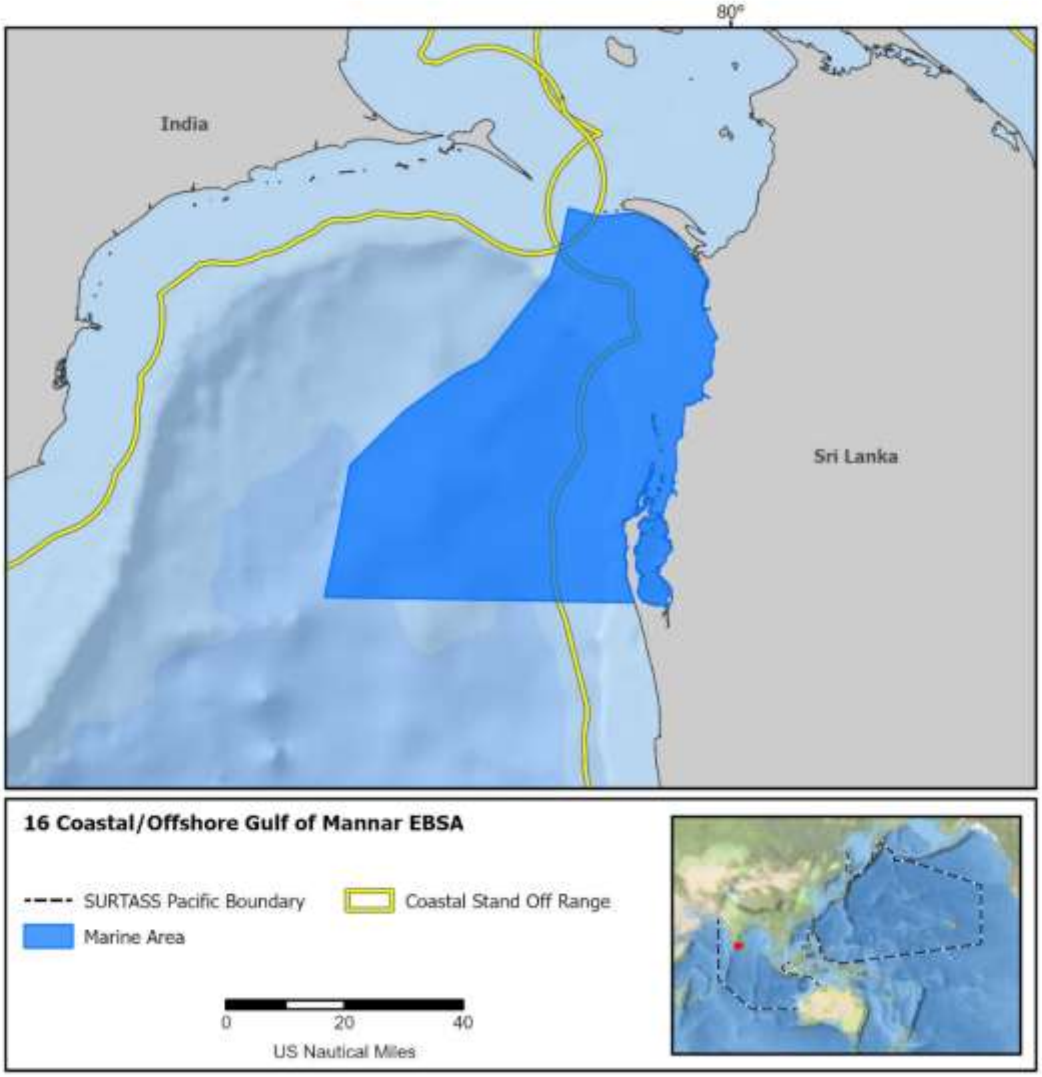

Figure F-18. Coastal/Offshore Gulf of Mannar EBSA

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F.3.12 Southern Australia—Southern Right Whale Calving Areas

Determination

Not recommended for OBIA designation, but recommended for inclusion on Watch List.

Ocean

Indian

Region

Australia-New Zealand

Country

Australia

Summary

This marine area lies outside the SURTASS Study Area boundaries. It was analyzed and is included on the Watch List because of its importance to HBW and blue whales that migrate (and breed) through this area to and from other designated OBIAs and Watch List areas that are contained with the Study Area (e.g., Western Australia—Blue Whale and HBW). In 2012, the Australian Government established a South-west Commonwealth Marine Reserve Network designating a marine sanctuary for biologically important seasonal calving habitat and calving buffer zones for southern right whales. Southern right whales are large whales that are known to occur on a seasonal basis within the coastal waters of Australia. Major calving areas are generally restricted to nearshore coastal waters off the southern coastline of Western Australia (east of Albany), South Australia, and Victoria. The IFAW (2015) has identified core calving grounds for the southwestern population of endangered southern right whales from Doubtful Bay eastward to Israelite Bay and the Head of Bight.

Although the marine area is outside the Study Area, it is recommended to remain on the Watch List given its importance and connection to other OBIAs and Watch List areas.

Criterion 1: Geography ***2***

Criterion 2: LF Hearing ***1***

LF-Hearing Species Present:	Southern right whale
Seasonality:	June through October

Criterion 3: Biological Importance

C3: Breeding	3
C3: Crit Hab	0
C3: Foraging	1
C3: High Density	1
C3: Migration	1
C3: Small Pop	1

Total C3 Score: ***7***

Designation(s):

Hope Spot	False	☐
Pew Legacy	False	☐
EBSA	False	☐
IMMA	False	☐
NOAA NMS	False	☐
ESA Crit Hab	False	☐
High Seas Alliance	False	☐
WDPA	False	☐
Watch List	True	☑
Previously Analyzed	False	☐

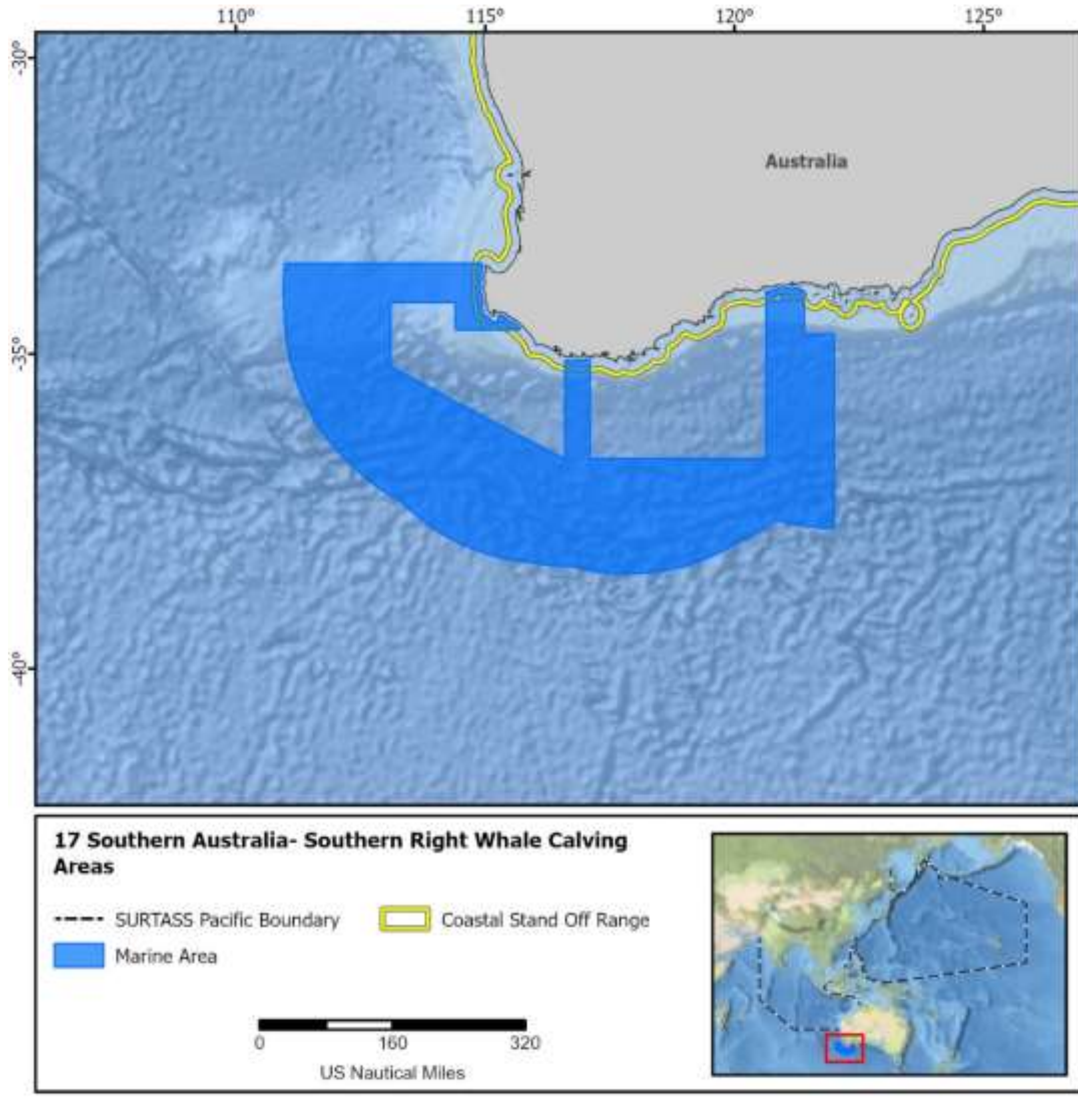

Figure F-19. Southern Australia—Southern Right Whale Calving Areas

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F.3.13 Gulf of Mannar and Palk Bay IMMA

Determination

Not recommended for OBIA designation, but recommended for inclusion on Watch List.

Ocean

Indian

Region

East Indian Ocean

Country

India

Summary

This marine area was previously considered in the 2019 SEIS/SOEIS. The Gulf of Mannar, located between India and Sri Lanka, is a biologically and ecologically diverse coastal region that supports a large, remnant population of dugongs. Although both the EBSA for the Gulf of Mannar as well as the IMMA for the gulf and adjacent Palk Bay were both designated to protect the population of dugongs, 15 other species of marine mammals have been reported from the Gulf of Mannar, including minke, blue, sei, and sperm whales, although some of these species are only known from strandings.

The dugong and the Indo-Pacific finless porpoise are the most commonly occurring marine mammals in the waters of the northern gulf, including both the IMMA and EBSA. Sighting surveys and stranding records from the waters of Bar Reef Marine Sanctuary, Gulf of Mannar Biosphere Reserve, and the northern gulf document the occurrence of minke, blue, humpback, and sperm whales, with these whales having been described as migrating, and blue and sperm whales only observed in the inter-monsoonal periods (Ilangakoon, 2006 and 2012; Jayasiri and Haputhantri, 2015). Strandings of at least one blue, minke, sei, and sperm whales have been reported from the northern gulf (Ilangakoon, 2012; Kannaiyan and Venkataraman, 2008; Sutaria et al., 2017).

Though cetaceans, including LF-hearing whales, have been observed in the Gulf of Mannar and Palk Bay, the IMMA is not recommended for OBIA designation as the presence of biologically important activities is unclear. Furthermore, much of the area is contained with the SURTASS CSR. The area is retained on the OBIA Watch List for future reevaluation as additional information on the biological important behaviors occurring in the area becomes available.

Criterion 1: Geography ***2***

Criterion 2: LF Hearing ***1***

LF-Hearing Species Present:	Minke; blue; HBW; sperm
Seasonality:	

Criterion 3: Biological Importance

C3: Breeding	1
C3: Crit Hab	0
C3: Foraging	1
C3: High Density	1
C3: Migration	2
C3: Small Pop	1

Total C3 Score: ***6***

Designation(s):

Hope Spot	False	☐
Pew Legacy	False	☐
EBSA	False	☐
IMMA	True	☑
NOAA NMS	False	☐
ESA Crit Hab	False	☐
High Seas Alliance	False	☐
WDPA	False	☐
Watch List	False	☐
Previously Analyzed	False	☐

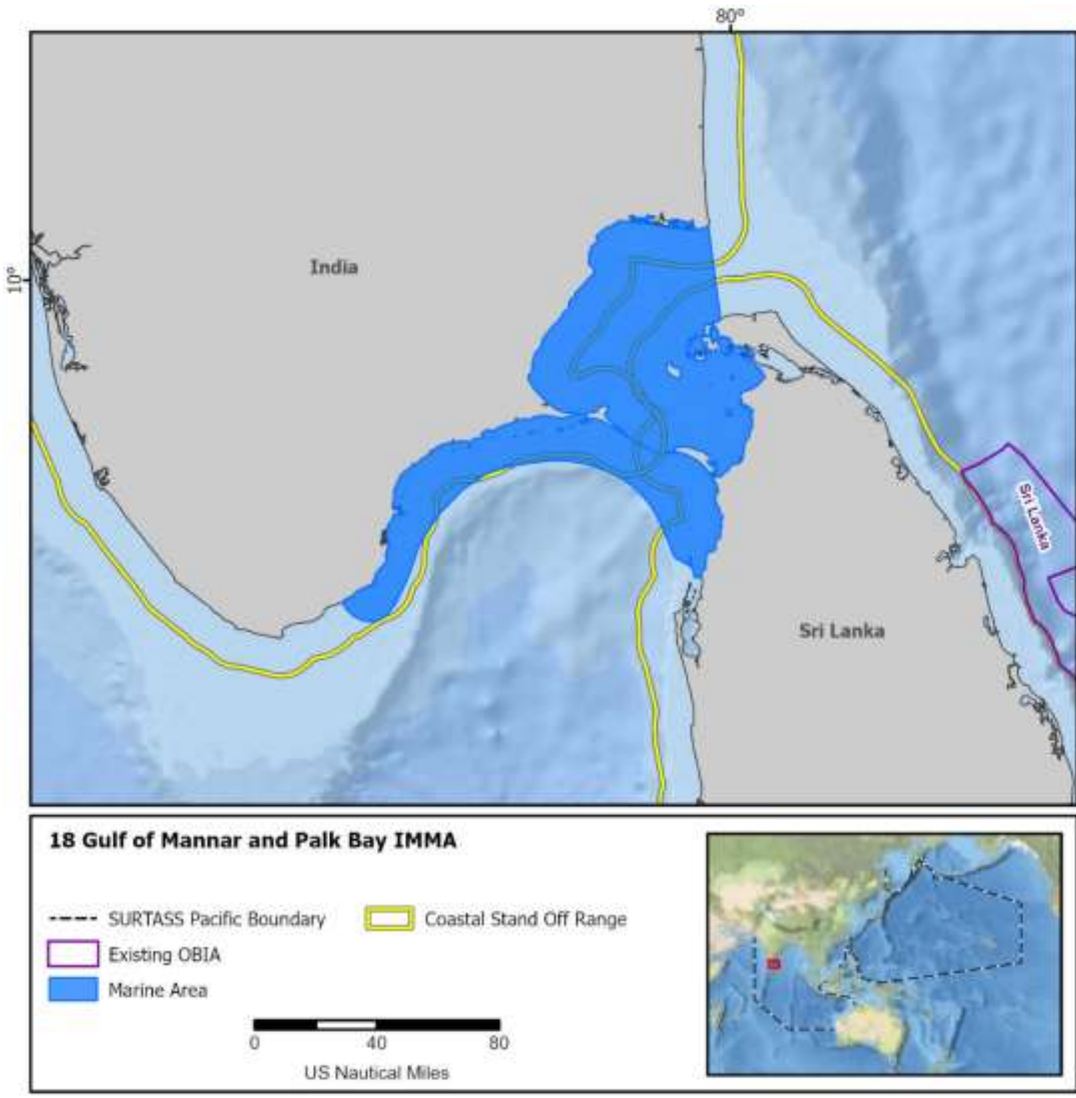

Figure F-20. Gulf of Mannar and Palk Bay IMMA

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F.3.14 Nijhum Dwip Marine Reserve/Marine Protected Area

Determination

Not recommended for OBIA designation, but recommended for inclusion on Watch List.

Ocean

Indian

Region

Central Indian Ocean

Country

Bangladesh

Summary

The Nijhum Dwip Marine Protected Area is located in the coastal northern Bay of Bengal. Portions of the overlap with the Coastal Northern Bay of Bengal IMMA. Analysis of the IMMA revealed that there is limited information and no justification for OBIA designation; consequently, Nijhum Dwip MPA is also not recommended for OBIA designation. Furthermore, much of this marine area falls inside the SURTASS CSR. Nahiduzzaman (2021) and WCS (2019) note that the MPA was declared primarily for the protection of important fish species, dolphins, sea turtles, and other organisms. Whales, while present in the northern Bay of Bengal, are not species of concern in the MPA. No research or literature was identified that supported consistent use of this area by LF-hearing whales or important biological activities. For further discussion and justification, refer to the entry for the Coastal Northern Bay of Bengal IMMA.

We suggest maintaining this area on the Watch List due to its proximity to the Swatch-of-No-Ground OBIA, the Coastal Northern Bay of Bengal IMMA, and because research on cetaceans and marine mammals in the Northern Indian Ocean and Bay of Bengal is emerging.

Criterion 1: Geography ***2***

Criterion 2: LF Hearing ***1***

LF-Hearing Species Present: Seasonality:

Criterion 3: Biological Importance

C3: Breeding	1
C3: Crit Hab	0
C3: Foraging	1
C3: High Density	1
C3: Migration	1
C3: Small Pop	1

Total C3 Score: ***5***

Designation(s):

Hope Spot	False	☐
Pew Legacy	False	☐
EBSA	False	☐
IMMA	False	☐
NOAA NMS	False	☐
ESA Crit Hab	False	☐
High Seas Alliance	False	☐
WDPA	True	☑
Watch List	False	☐
Previously Analyzed	False	☐

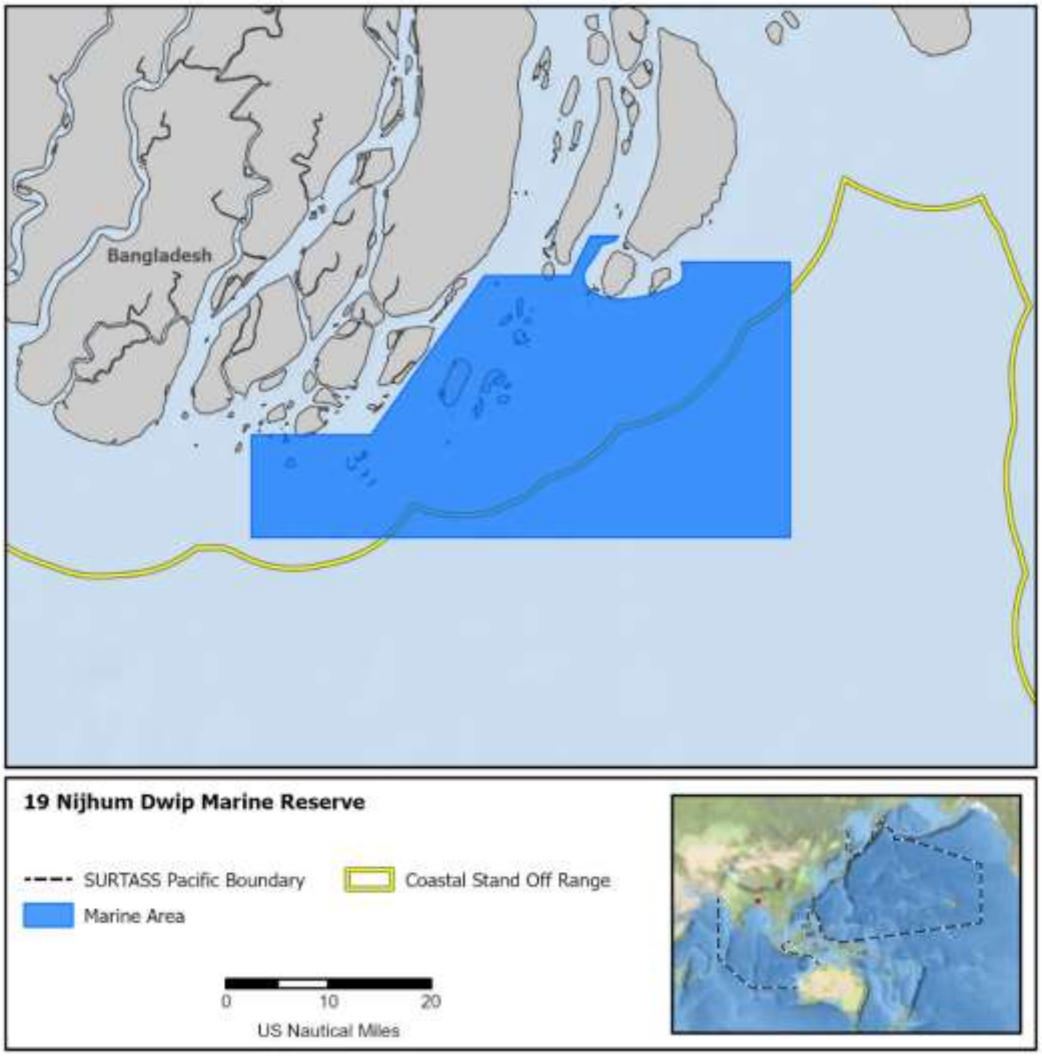

Figure F-21. Nijhum Dwip Marine Reserve/Marine Protected Area

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F.3.15 Kuroshio Current South of Honshu

Determination

Not recommended for OBIA designation, but recommended for inclusion on Watch List.

Ocean

Pacific

Region

East Asian Seas

Country

Japan

Summary

Although designated an EBSA, the EBSA record for this marine area includes little discussion of cetaceans, with the exception of the finless porpoise (CBD, 2017). There is no mention of baleen whales in the EBSA. The area was previously analyzed for OBIA consideration but not designated. It is dominated by the subtropical waters of the Kuroshio Current as it sweeps along the southern reaches of the Ryukyu Islands and roughly parallel to coasts of Kyushu, Shikoku, and Honshu Islands, Japan until it is deflected eastward from land off Honshu to become the Kuroshio Extension Current. The EBSA record notes that the area includes the reproductive area for the finless porpoise, but this species typically only occurs in coastal waters <164 ft (50 m) in depth and is not an LF-hearing specialist (Wang and Reeves, 2017). No occurrence data of baleen whales coincides with this EBSA, and only rare historical whaling records of sperm whales coincide with the EBSA, but not in sufficient density to suggest a correlation (Halpin et al., 2009). Kishiro (2018) observed and tagged Bryde's whales in the near-coastal portion of this marine area during the summer and found that those whales remained in coastal waters and did not move long distances (although the tracking periods were short). These observations generally occurred inside the CSR for SURTASS activities.

Research suggests there is exchange and movement of HBWs across the broader region, including from Ryukyu-Philippines OBIA, Honshu OBIA, and the Ogasawara OBIAs, which would imply that LF- hearing cetaceans do occur within the marine area, particularly as animals in the Ogasawara region move north to feeding grounds. However, other work on Bryde's whales, such as Kishiro (2018) demonstrate that the Kuroshio current functions as a barrier between western Pacific Bryde's whale stocks, with little to no exchange across the current. Despite these data, however, information specific to this marine area is limited. Therefore, no conclusions can be made about biological importance in the Kuroshio Current South of Honshu. We suggest adding this area to the Watch List and continuing to monitor new research on baleen species in the region, including the Northwest Pacific HBW. Southwestern portion of this area tracks very closely to Ryukyu-Phillipines OBIA, but is slightly further offshore. Consequently, it may be prudent to analyze smaller portions of this marine area separately in future OBIA processes.

Criterion 1: Geography 3

Criterion 2: LF Hearing 1

LF-Hearing Species Present:	HBW
Seasonality:	

Criterion 3: Biological Importance

C3: Breeding	1
C3: Crit Hab	0
C3: Foraging	1
C3: High Density	1
C3: Migration	2
C3: Small Pop	1

Total C3 Score: 6

Designation(s):

Hope Spot	False	☐
Pew Legacy	False	☐
EBSA	True	☑
IMMA	False	☐
NOAA NMS	False	☐
ESA Crit Hab	False	☐
High Seas Alliance	False	☐
WDPA	False	☐
Watch List	False	☐
Previously Analyzed	True	☑

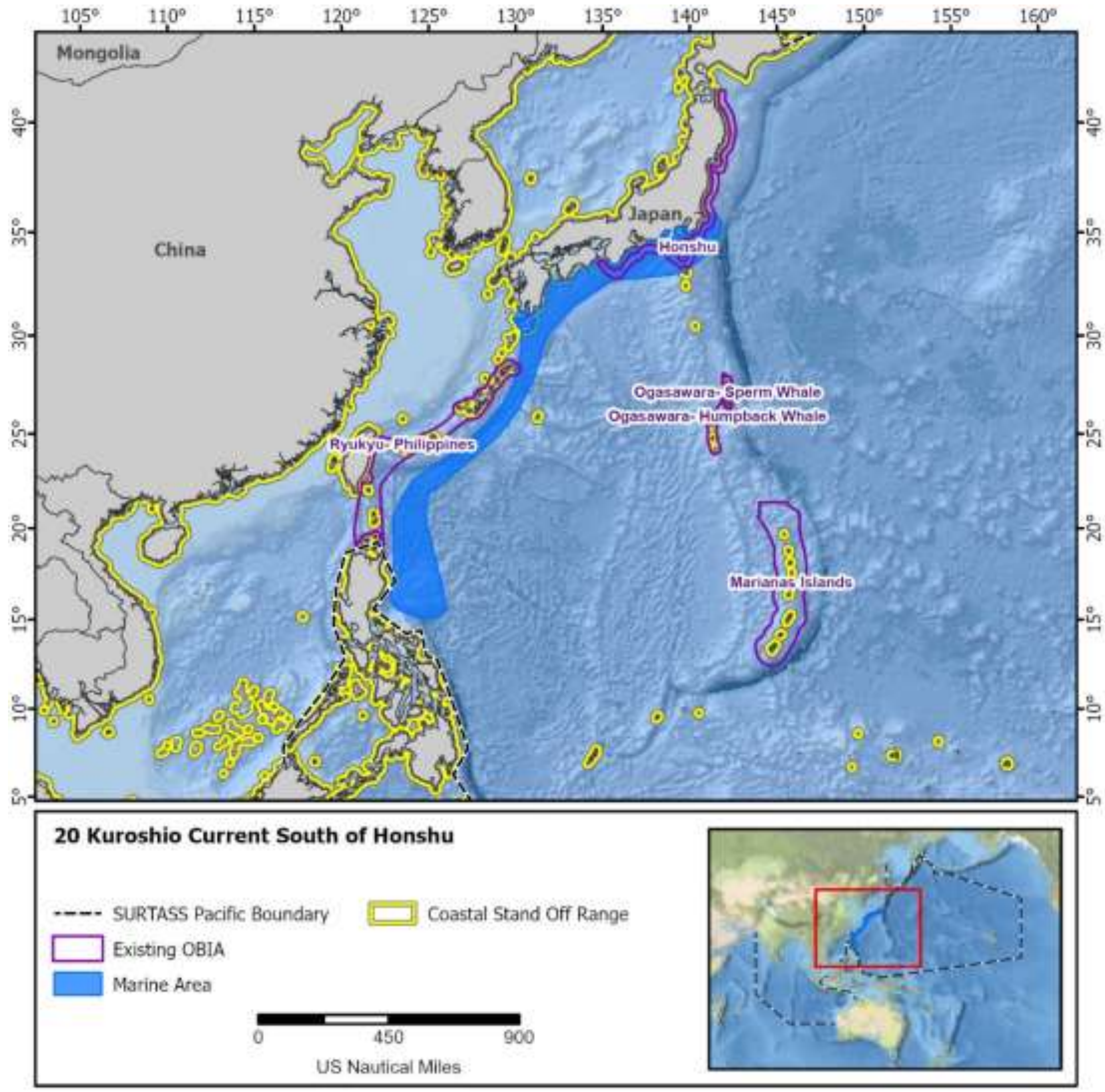

Figure F-22. Kuroshio Current South of Honshu

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F.3.16 Emperor Seamount Chain and Northern Hawaiian Ridge

Determination

Not recommended for OBIA designation, but recommended for inclusion on Watch List.

Ocean

Pacific

Region

North Central Pacific

Country

International

Summary

This marine area extends northwest of the NWHI Islands along the Northern Hawaiian Ridge and Emperor Seamount Chain towards the Aleutian Islands, spanning a large area of the North Pacific Ocean including portions of the North Pacific Transition Zone. The area is designated an EBSA primarily to highlight the need for protections from commercial fishing and other activities to conserve fish and benthic species (CBD, 2016). Although the area is not designated for cetacean species, Sasaki et al. (2013) note higher observed densities of sei whales at the Emperor Seamount than other nearby areas or features, suggesting aggregations at this seamount within the chain.

Despite this, there is limited evidence linking this area to important biological functions. The marine area will be retained on the Watch List for future reassessment.

Criterion 1: Geography 3

Criterion 2: LF Hearing 1

LF-Hearing Species Present:	Sei
Seasonality:	

Criterion 3: Biological Importance

C3: Breeding	1
C3: Crit Hab	0
C3: Foraging	1
C3: High Density	2
C3: Migration	1
C3: Small Pop	1

Total C3 Score: 6

Designation(s):

Hope Spot	False	☐
Pew Legacy	False	☐
EBSA	True	☑
IMMA	False	☐
NOAA NMS	False	☐
ESA Crit Hab	False	☐
High Seas Alliance	True	☑
WDPA	False	☐
Watch List	False	☐
Previously Analyzed	False	☐

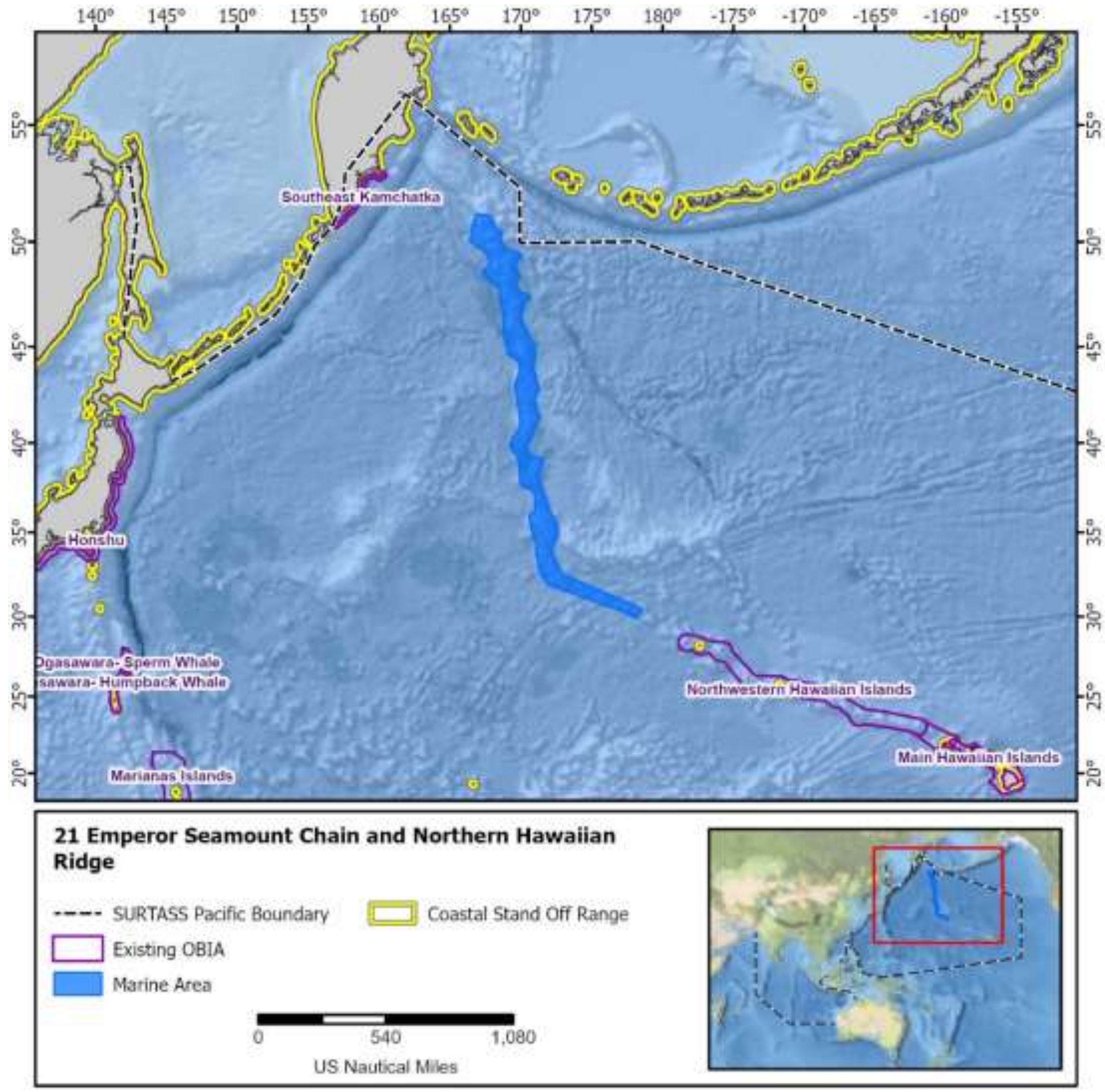

Figure F-23. Emperor Seamount Chain and Northern Hawaiian Ridge

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F.3.17 Upwelling Zone of the Sumatra-Java Coast

Determination

Not recommended for OBIA designation, but recommended for inclusion on Watch List.

Ocean

Indian

Region

East Indian Ocean

Country

Indonesia

Summary

This marine area lies directly west/northwest of existing and candidate OBIAs including the Southern Bali OBIA, South of Java Island candidate OBIA, South of Lombok and Sumbawa Islands candidate OBIA, and the Western Australia whale OBIAs. Despite its proximity, however, the research supporting other OBIA designations suggests that blue and HBW migrations do not occur this far northwest into this marine area. Furthermore, the region itself has extremely limited data about cetaceans in the area. As noted in the entries for South of Java Island and South of Lombok and Sumbawa Islands, observations of cetaceans engaging in migratory or breeding behavior typically occur along the northwest coast of Australia into the Indonesia islands, but the animals generally do not travel as far northwest as this marine area (see, e.g., Double et al., 2014; Möller et al., 2020; Sahri et al., 2022; Thums et al., 2021, 2022).

As a result, this area is not recommended for OBIA designation, but will be retained on the Watch List as more data emerges about this region, particularly regarding pygmy blue whale migration and breeding patterns. For more information, see entries for Western Australia—Blue Whale (Expansion), South of Java Island, and South of Lombok and Sumbawa Islands.

Criterion 1: Geography ***2***

Criterion 2: LF Hearing ***1***

LF-Hearing Species Present: Seasonality:

Criterion 3: Biological Importance

C3: Breeding	1
C3: Crit Hab	0
C3: Foraging	1
C3: High Density	1
C3: Migration	1
C3: Small Pop	1

Total C3 Score: ***5***

Designation(s):

Hope Spot	False	☐
Pew Legacy	False	☐
EBSA	True	☑
IMMA	False	☐
NOAA NMS	False	☐
ESA Crit Hab	False	☐
High Seas Alliance	False	☐
WDPA	False	☐
Watch List	False	☐
Previously Analyzed	False	☐

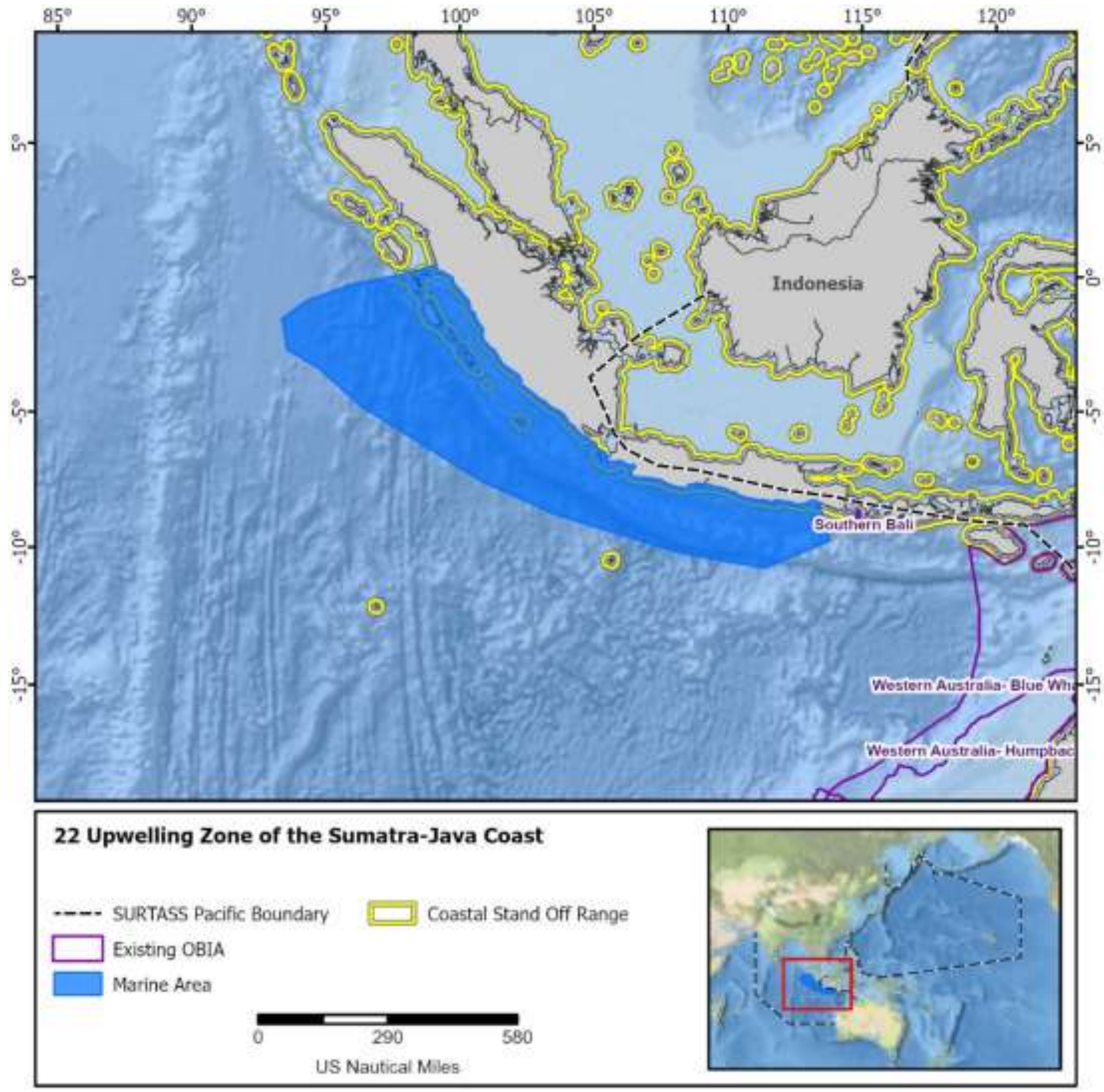

Figure F-24. Upwelling Zone of the Sumatra-Java Coast

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F.3.18 Mariana Trench Marine National Monument—Trench Unit

Determination

Not recommended for OBIA designation, but recommended for inclusion on Watch List.

Ocean

Pacific

Region

South West Pacific

Country

Northern Mariana Islands

Summary

The existing Marianas Islands OBIA contains only the Islands Unit of Mariana Trench Marine National Monument. The Trench Unit is not part of the OBIA. The 2019 SEIS Appendix C description of the OBIA notes that it is a conservative boundary, and humpback and other whales may move beyond the OBIA boundary elsewhere in the monument.

The Northern Part of the Mariana Trench is protected for seabed, not cetaceans. The MNM Management Plan notes that cetaceans are typically observed in the Islands unit, rather than the Trench unit, though whales such as the blue and HBW may travel through the Trench unit when migrating to the archipelago most often during the winter (MTMNM, 2024). The northern trench is also adjacent to EBSAs (with Izu-Ogasawara and others) that were reviewed elsewhere in the 2019 SEIS/SOEIS or in the present analysis (and did not meet criteria for full analysis). The entire Mariana Archipelago, including the trench area, is an IMMA Area of Interest (though not yet designated an IMMA), and HBW is a supporting species for the classification (IUCN-MMPATF, 2025). However, the region requires more data about whale behavior and biology and does not yet meet the criteria for IMMA designation.

Consequently, evidence of important biological importance for LF-hearing cetaceans in this marine area is extremely limited. As such, there is not enough evidence to warrant designation as OBIA. The area will be retained on the Watch List for future reassessment.

Criterion 1: Geography ***2***

Criterion 2: LF Hearing ***1***

LF-Hearing Species Present:	HBW
Seasonality:	

Criterion 3: Biological Importance

C3: Breeding	1
C3: Crit Hab	0
C3: Foraging	2
C3: High Density	1
C3: Migration	2
C3: Small Pop	1

Total C3 Score: ***7***

Designation(s):

Hope Spot	False	☐
Pew Legacy	True	☑
EBSA	False	☐
IMMA	False	☐
NOAA NMS	False	☐
ESA Crit Hab	False	☐
High Seas Alliance	False	☐
WDPA	False	☐
Watch List	False	☐
Previously Analyzed	False	☐

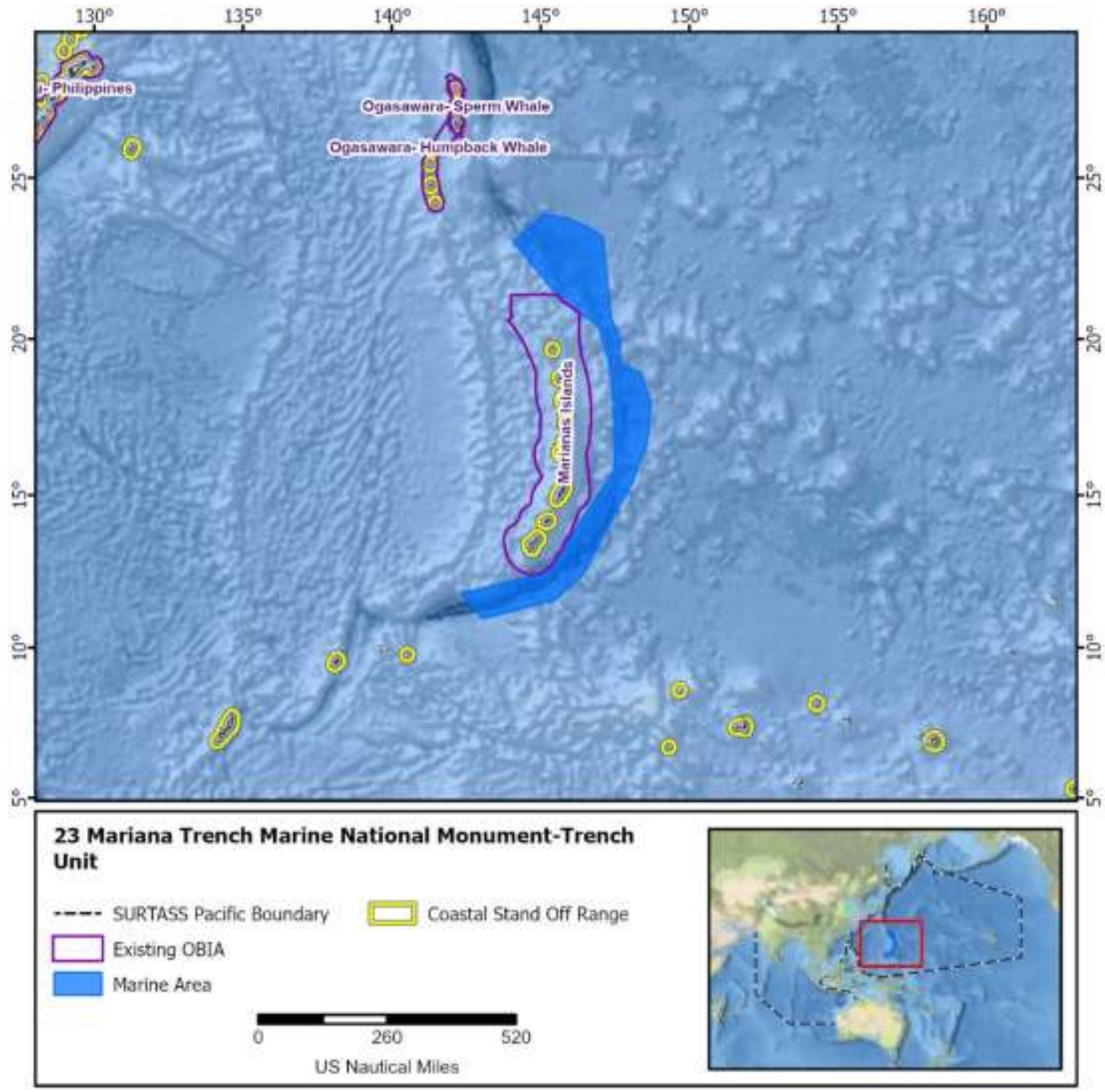

Figure F-25. Mariana Trench Marine National Monument—Trench Unit

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F.3.19 Papahānaumokuākea National Marine Sanctuary

Determination

Not recommended for OBIA designation, but recommended for inclusion on Watch List.

Ocean

Pacific

Region

North Central Pacific

Country

United States

Summary

Previously, as Papahānaumokuākea MNM, the coastal portion (12-30 NM offshore) of what is now also Papahānaumokuākea NMS was designated as part of existing OBIA #27 Northwestern Hawaiian Islands. The marine portion of Papahānaumokuākea MNM was designated as Papahānaumokuākea NMS in 2025 and assessed for OBIA designation in the present SEIS/SOEIS. This assessment focused on the offshore portion of Papahānaumokuākea MNM/NMS (30-200 NM) that was not previously designated an OBIA. The designation of Papahānaumokuākea NMS did not remove its MNM designation; rather, the NMS is coextensive with the marine portion of the MNM and includes all waters and submerged lands of the approximately 582,570 square mile (1,508,850 square kilometer) area.

Predominantly in the coastal waters of PNMS, visual and acoustic observations of humpback whales justified designation of the NWHI OBIA. Observations during winter in the NWHI indicate that these whales occur in these waters seasonally and may be relatively common (Johnston et al., 2007; Lammers et al., 2011, 2016). Johnston et al. (2007) modeled the available habitat in the NWHI and determined that the amount of shallow, warm-water habitat in the NWHI is almost double that available in the MHI. The sighting and acoustic data as well as the habitat suitability modeling indicate to researchers that the NWHI may be an important winter habitat for humpback whales and potentially may represent an unidentified breeding site. Current information and data are insufficient to determine whether the humpback whales occurring in the NWHI and MHI represent the same breeding stock (Bettridge et al., 2015; Lammers et al., 2011). Bettridge et al. (2015) proposed an alternative theory for the presence of HBWs in the NWHI during winter, that the breeding populations in the MHI have simply expanded their range to include the NWHI.

While current information justifies the existing NWHI OBIA in coastal waters of PNMS, overall, the occurrence of HBW throughout the NWHI remains poorly understood (Lammers et al. 2023). This is even more so in the offshore waters of PNMS, where information remains extremely limited as most research occurs around the islands of the archipelago. While HBW transit or migration could be inferred from other observations and research closer to shore, specificity regarding important biological activity in the offshore portions of PNMS remain limited. The lack of data cannot justify the designation of an OBIA in those waters, however PNMS will remain on the Watch List and re-analyzed as further information is collected about the region.

Criterion 1: Geography ***2***

Criterion 2: LF Hearing ***1***

LF-Hearing Species Present:	HBW
Seasonality:	Year-round

Criterion 3: Biological Importance

C3: Breeding	1
C3: Crit Hab	0
C3: Foraging	3
C3: High Density	1
C3: Migration	3
C3: Small Pop	0

Total C3 Score: ***8***

Designation(s):

Hope Spot	False	☐
Pew Legacy	False	☐
EBSA	False	☐
IMMA	False	☐
NOAA NMS	True	☑
ESA Crit Hab	False	☐
High Seas Alliance	False	☐
WDPA	False	☐
Watch List	False	☐
Previously Analyzed	False	☐

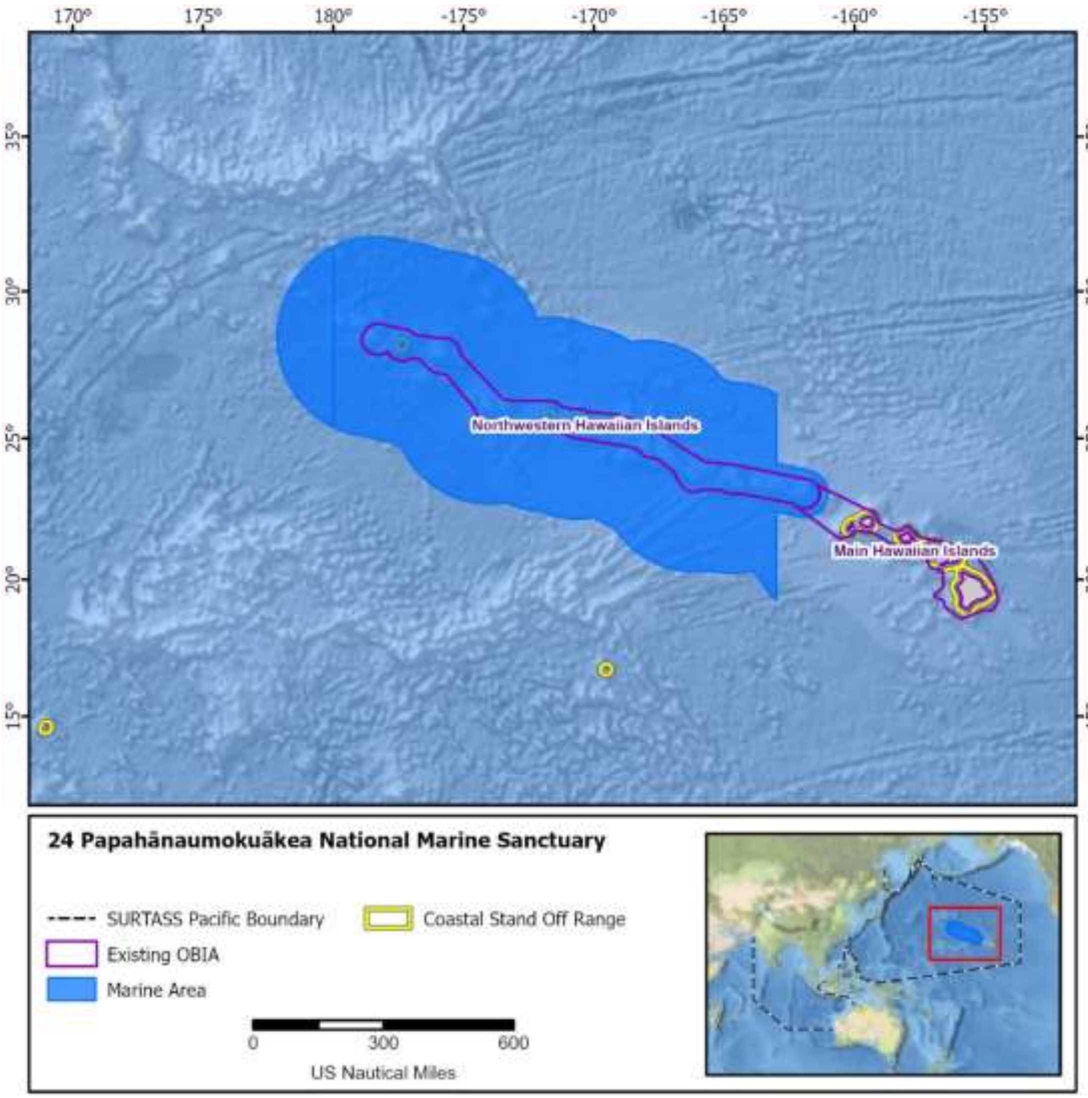

Figure F-26. Papahānaumokuākea National Marine Sanctuary

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