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

May 2025

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Draft Supplemental Environmental Impact Statement DSEIS/OEIS
SURTASS LFA Sonar Training and Testing

SEIS-007-17-USN-1727716941

Abstract

Lead Agency:	United States Department of the Navy
Cooperating Agency:	National Marine Fisheries Service
Title of Proposed Action:	Surveillance Towed Array Sensor System Low Frequency Active Sonar Training and Testing in the Western North Pacific and Indian Oceans
Designation:	Supplemental Environmental Impact Statement

The United States Department of the Navy (Navy), along with the National Marine Fisheries Service as a cooperating agency, prepared this Supplemental Environmental Impact Statement/Overseas Environmental Impact Statement (SEIS/OEIS) to comply with the National Environmental Policy Act and Executive Order 12114. This SEIS/OEIS evaluates the potential environmental impacts associated with conducting the training and testing of the Surveillance Towed Array Sensor System (SURTASS) Low-Frequency Active (LFA) sonar in the western and central North Pacific and eastern Indian Oceans (Study Area) beyond 2026 and into the reasonably foreseeable future. Multiple proposed action alternatives were analyzed in this SEIS/OEIS:

- Under the No Action Alternative, the Proposed Action would not occur, and therefore the SURTASS LFA sonar training and testing activities would be discontinued in August 2026 and no further activities would occur.
- Under Alternative 1, the Preferred Alternative, 1,100 hours of LFA sonar transmissions are planned per year for training activities, pooled across all SURTASS LFA sonar equipped vessels stationed in the Pacific. This would cover training activities for four operational vessels.
- Under Alternative 2, a maximum of 2,490 hours of LFA sonar transmission are planned per year for training and testing activities, pooled across all SURTASS LFA sonar equipped vessels stationed in the Pacific; this would represent an increased number of active LFA sonar training hours above the baseline provided in Alternative 1 as well as hours needed for testing of one new SURTASS LFA-equipped vessel per year. This increase assumes a need for additional SURTASS LFA sonar equipped vessels to be operational in the Study Area, based on training requirements or a change in geopolitics. It is possible that two of the new vessels being tested annually could be added to the fleet as opposed to replacing existing vessels, meaning the total number of vessels in the Study Area would be a maximum of six.

The resources evaluated include acoustic marine environment, fish, sea turtles, marine mammals, marine protected habitats, and economic resources.

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EXECUTIVE SUMMARY

ES.1 Introduction

The United States (U.S.) Department of the Navy (Navy) has prepared this Supplemental Environmental Impact Statement/Overseas Environmental Impact Statement (SEIS/OEIS) to supplement the 2019 Surveillance Towed Array Sensor System (SURTASS) Low Frequency Active (LFA) SEIS/SOEIS (U.S. Department of Navy 2019), and earlier environmental analyses (U.S. Department of Navy 2001, 2007a, 2012, 2015b, 2017, 2019) pursuant to the National Environmental Policy Act (NEPA)[1] and Executive Order (EO) 12114. This SEIS/OEIS incorporates multiple associated documents by reference (U.S. Department of Navy 2001, 2007a, 2012, 2015b, 2017, 2019). The Navy is the lead federal agency, with the National Marine Fisheries Service (NMFS) acting as a cooperating agency.

The Navy proposes to continue utilizing SURTASS LFA and Compact LFA (CLFA) sonar systems onboard U.S. Navy surveillance ships for training and testing activities conducted in the western and central North Pacific and eastern Indian Oceans (Figure ES-1). "SURTASS LFA sonar systems" are inclusive of both the LFA and CLFA systems, each having similar acoustic operating characteristics. A detailed description of the Proposed Action is provided in Chapter 2 (Proposed Action and Alternatives).

[1] For purposes of this SEIS/OEIS, the Navy has voluntarily elected to generally follow those Council of Environmental Quality regulations at 40 CFR Parts 1500-1508 that were in place at the outset of this SEIS/OEIS, in addition to Navy's procedures/regulations implementing NEPA at 32 CFR Part 775, to meet the agency's obligations under NEPA, 42 U.S.C. 4321 et seq.

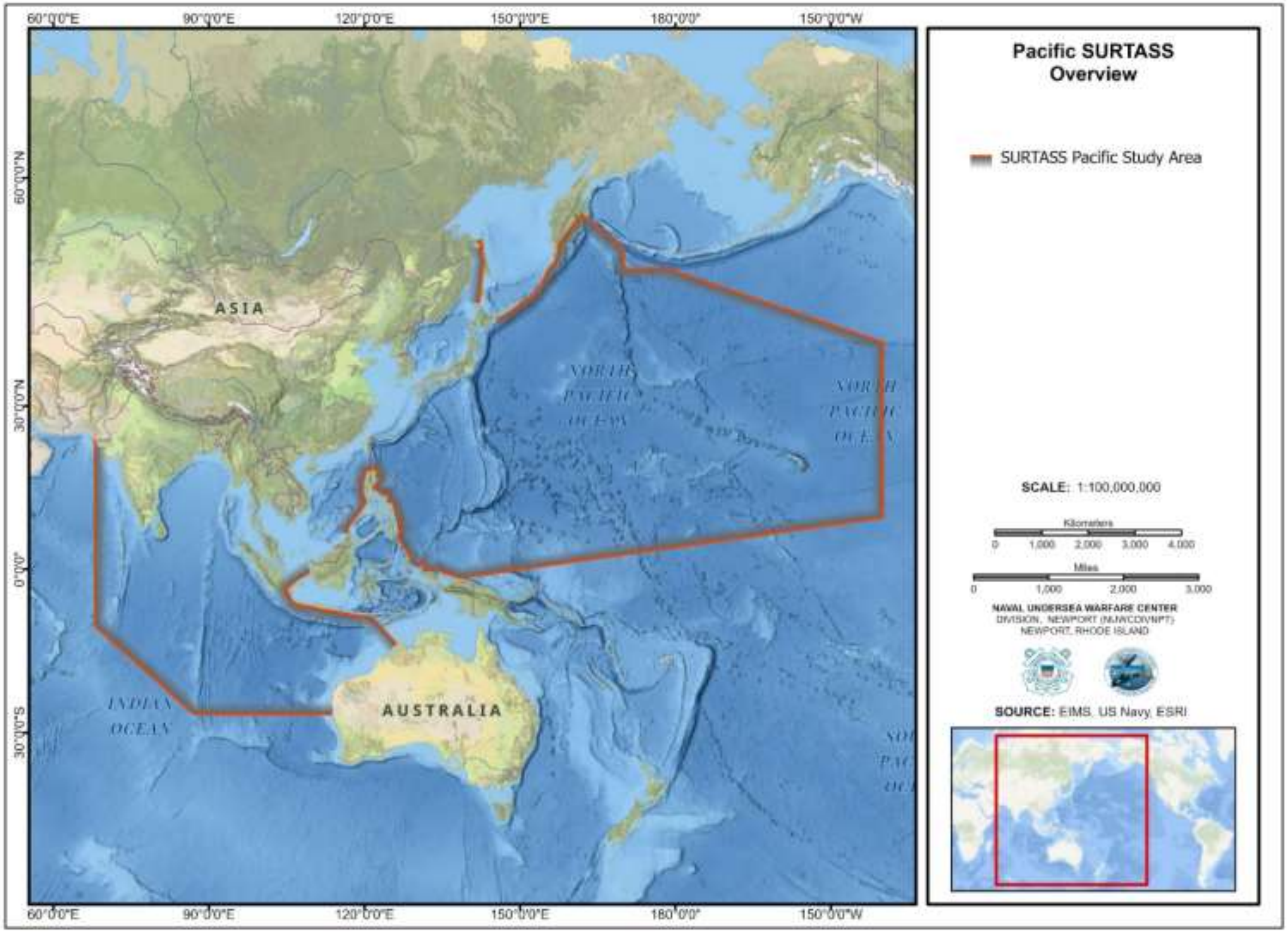

Figure ES-1. Study Area for the Pacific SURTASS LFA Sonar Systems in the non-Arctic areas of the Western and Central North Pacific and Eastern Indian Ocean

ES.2 Purpose of and Need for the Proposed Action

The purpose of the Navy's Proposed Action as detailed in this SEIS/OEIS is to perform training and testing activities that ensure the Navy remains proficient in the use of SURTASS LFA sonar in support of the Navy's mission. The need for the Proposed Action is to maintain a system and crews capable of detecting at long ranges the increasingly technologically advanced foreign submarine presence that threatens our national security.

The Navy will request authorization to "take" marine mammals incidental to conducting training and testing activities in the Study Area to comply with the Marine Mammal Protection Act (MMPA) and Endangered Species Act (ESA). NMFS' purpose is to evaluate the Proposed Action pursuant to its authority under the MMPA, and to make a determination whether to promulgate regulations and issue a Letter of Authorization (LOA) including any conditions necessary to meet the statutory mandates of the MMPA. NMFS needs to render a decision regarding the request for an incidental take authorization (ITA) due to NMFS' responsibilities under the MMPA (16 United States Code [U.S.C.] section 1371(a)(5)(A)) and its implementing regulations.

ES.3 Scope and Content

This SEIS/OEIS was prepared to update the Navy's assessment of the potential environmental impacts associated with proposed training and testing activities to be conducted in the Study Area. Some modifications to the 2019 SEIS/SOEIS that will be analyzed in this SEIS/OEIS include the following: the incorporation of recent science that has been published since the 2019 SEIS/SOEIS, the use of new analytical methods to calculate behavioral and auditory effects of marine mammals, and the use of updated marine mammal densities.

NMFS is a cooperating agency because the scope of the Proposed Action and alternatives involves activities that have the potential to affect protected resources under the agency's jurisdiction and for which they have special expertise, including marine mammals, threatened and endangered species, essential fish habitat, and national marine sanctuaries. NMFS' special expertise and authority are based on its statutory responsibilities under the MMPA, as amended (16 U.S.C. section 1361 et seq.), the ESA (16 U.S.C. section 1531 et seq.) and the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. section 1801 et seq.). NMFS may adopt this SEIS/OEIS and issue a separate Record of Decision (ROD) associated with its decision on whether to grant the Navy's request for ITAs.

This SEIS/OEIS has been prepared in accordance with NEPA to examine the environmental effects of the proposed actions within the United States and its territories, and in accordance with EO 12114 (44 *Federal Register* [FR] 1957) to examine effects of the proposed actions on the environment outside the United States, its territories, and possessions.

ES.4 Proposed Action and Alternatives

The Navy proposes to conduct training and testing activities that utilize SURTASS LFA sonar systems onboard U.S. Navy surveillance ships in the Study Area (Figure ES-1).

Alternatives were developed for analysis based upon a set of screening factors. These reasonable screening factors require that an alternative must: allow the Navy to meet all training and testing requirements for SURTASS LFA sonar systems, vessels, and crews; allow the Navy to meet all requirements for vessel crew, maintenance, and repair schedules for SURTASS LFA sonar vessels; allow for a fleet of at least four SURTASS LFA- equipped vessels in the Study Area while upgrading to newer vessels over the reasonably foreseeable future; and provide testing and training access to diverse and variable marine environments that replicate real-world conditions where sailors would be expected to operate. NMFS' Proposed Action is to promulgate regulations and issue an LOA under the MMPA of 1972, as amended (16 U.S.C. 1361 et seq.) authorizing take of marine mammals incidental to proposed SURTASS LFA activities.

Under the No Action Alternative, the Proposed Action would not occur, and therefore the SURTASS LFA sonar training and testing activities would be discontinued in August 2026 and no further activities would occur. The Navy's purpose and need would not be met since its ability to train and test to locate and defend against enemy submarines would be greatly impaired. For NMFS, denial of the Navy's application for ITAs constitutes the NMFS No Action Alternative, which is consistent with NMFS' statutory obligation under the MMPA to grant or deny requests for takes incidental to specified activities.

Under Alternative 1, the Preferred Alternative, 1,100 hours of LFA sonar transmissions are planned per year for training activities, pooled across all SURTASS LFA sonar equipped vessels stationed in the Pacific. This would cover training activities for four operational vessels.

Under Alternative 2, up to a maximum of 2,490 hours of LFA sonar transmission are planned per year for training and testing activities, pooled across all SURTASS LFA sonar equipped vessels stationed in the Pacific. This alternative assumes an increase in training requirements, as well as a need for additional SURTASS LFA sonar equipped vessels to be operational in the Study Area, based on training requirements or a change in geopolitics. Like under Alternative 1, 1,100 hours of LFA sonar transmissions are planned per year for training activities in years 1-4. The Navy anticipates that up to one new Tactical-Auxiliary General Ocean Surveillance (T-AGOS) vessel would be ready for at-sea testing within the Study Area annually beginning in 2030. Thus, the analysis under Alternative 2 includes 840 annual hours of testing of new T-AGOS vessels in years 5-7. It is possible that up to two of the new vessels being tested annually could be added to the fleet as opposed to replacing existing vessels, meaning the total number of vessels in the Study Area would be a maximum of six; this would necessitate and increase in training hours to a maximum of 1,650 for years 5-7.

ES.5 Summary of Environmental Effects

Environmental effects which might result from implementing the Proposed Action or alternatives are analyzed in this SEIS/OEIS. The following resource areas have been addressed in this SEIS/OEIS: air quality, acoustic marine environment, fish, sea turtles, marine mammals, protected marine habitats, and economic resources. This SEIS/OEIS provides a comparison of the proposed action and reasonable alternatives based on the reasonably foreseeable effects of their activities and the significance of those effects. The significance determination presented considers the context of the action and the intensity of the effect to determine the significance of reasonably foreseeable adverse effects of activities under the proposed action. A significance determination is only provided for activities that have reasonably foreseeable adverse effects on the human environment. To this end, the significance determination analysis reaches a significant/less than significant conclusion only for activities with reasonably foreseeable adverse effects on any of the listed factors.

Table ES-1 provides a summary of the potential adverse effects on the resources associated with each of the alternative actions analyzed.

ES.6 Reasonably Foreseeable Effects

Consistent with Section 102 of NEPA, reasonably foreseeable effects were analyzed for each resource addressed in Chapter 3 (Affected Environment and Environmental Consequences) for the No Action Alternative, Alternative 1 (Preferred Alternative), and Alternative 2. Analysis was not separated by alternative because the data available for the analysis was mostly qualitative in nature and, from a landscape-level perspective, these qualitative impacts are expected to be generally similar.

The Proposed Action would contribute incremental effects on the ocean ecosystem, which is already experiencing and absorbing a multitude of stressors to a variety of receptors. In general, it is not anticipated that the implementation of the Proposed Action would have a meaningful contribution to the ongoing stress or cause significant collapse of any particular marine resource, but it would contribute minute impacts on resources that are already experiencing various degrees of interference and degradation.

Table ES-1. Summary of Potential Adverse Effects on Resource Areas

Resource Area	***No Action Alternative***	***Alternative 1 (Preferred Alternative)***	***Alternative 2***
Acoustic Marine Environment	Baseline conditions would remain unchanged or would improve slightly after cessation of ongoing military readiness activities.	Use of SURTASS LFA sonar would increase baseline noise conditions over a narrow low-frequency range within the Study Area. These increases would only occur during use of and relatively near the source itself and would be negligible. Due to the large size of the Study Area, acoustic transmissions would not be localized to one area but would be spread widely throughout.	The amount of SURTASS LFA sonar used under Alternative 2 is greater than that of Alternative 1. This increase would still result in negligible increases in the acoustic environment. Adverse effects on the acoustic marine environment under Alternative 2 would be as described under Alternative 1.
Biological Resources	Baseline conditions would remain unchanged or would improve slightly after cessation of ongoing military readiness activities.	Exposure of marine fish, sea turtles, and marine mammals to noise from SURTASS LFA sonar systems could result in behavioral reactions, masking, or temporary threshold shift by individual animals but would not have any population level impacts.	The amount of SURTASS LFA sonar used under Alternative 2 is greater than that of Alternative 1; this increase would likely lead to additional individual animals exposed to SURTASS LFA sonar. Adverse effects on biological resources under Alternative 2 would be as described under Alternative 1.
Marine Protected Habitats	Baseline conditions would remain unchanged or would improve slightly after cessation of ongoing military readiness activities.	There is no potential for loss or destruction of marine habitats due to use of SURTASS LFA sonar. Implementation of mitigation measures would limit acoustic energy present in protected habitats.	The number of vessels and SURTASS LFA sonar used under Alternative 2 is greater than under Alternative 1. This increase would not increase potential for loss or destruction of marine habitats. Adverse effects to marine protected habitats under Alternative 2 would be as described under Alternative 1.
Economic Resources	Baseline conditions would remain unchanged or would improve slightly after cessation of ongoing military readiness activities.	SURTASS LFA sonar transmissions would not limit economic use of the Study Area (i.e., fisheries). With implementation of mitigation measures, other recreational uses of the Study Area would also not be limited.	The number of vessels and SURTASS LFA sonar used under Alternative 2 is greater than under Alternative 1. This increase would still not limit economic use of the Study Area. Adverse effects on economic resources under Alternative 2 would be as described under Alternative 1.

GHG = greenhouse gases; SURTASS = Surveillance Towed Array Sensor System; LFA = Low Frequency Active

ES.7 Mitigation

Mitigation measures would be implemented during the Proposed Action. Mitigation measures are used specifically to avoid or reduce potential impacts to a resource (Chapter 4).

The Navy implements a three-part monitoring protocol that is highly effective at detecting marine species, with detection resulting in the suspension or delay of SURTASS LFA sonar transmissions. The Navy would conduct the following activity-based mitigation measures whenever SURTASS LFA sonar is used for training and testing activities:

- Visual observation for marine mammals and sea turtles from the SURTASS LFA sonar vessels during daylight hours by personnel trained to detect and identify sea turtles and marine mammals at sea;
- Passive acoustic monitoring using the passive SURTASS towed array to listen for sounds generated by marine mammals as an indicator of their presence; and
- Active acoustic monitoring using the high frequency marine mammal monitoring (HF/M3) sonar, which is a Navy-developed, enhanced high frequency commercial sonar, to detect, locate, and track marine mammals and, to some extent, sea turtles, that pass close enough to the SURTASS LFA sonar's transmit array to enter the LFA mitigation zone.

Delay of initial SURTASS LFA sonar transmissions or suspension of ongoing transmissions will occur if the Navy detects a marine mammal or sea turtle entering or already located within the LFA mitigation zone. The suspension or delay of SURTASS LFA sonar transmissions would occur if the marine animal were detected by any of the monitoring methods: visual, passive acoustic, or active acoustic monitoring. During the delay/suspension, active acoustic, visual, and passive acoustic monitoring for marine mammals and sea turtles would continue. SURTASS LFA sonar transmissions would be allowed to commence/resume no sooner than 15 minutes after all marine mammals/sea turtles are no longer detected within the SURTASS LFA sonar mitigation zone and no further detections of marine species by visual, passive acoustic, and active acoustic monitoring have occurred within the mitigation zone.

ES.8 Public Involvement

The Navy solicited public and agency comments during a scoping period from August 21, 2024 through September 19, 2024. Comments received during the scoping period were considered in preparing the Draft SEIS/OEIS. The public involvement process is further discussed in Appendix A (Public and Agency Participation).

Draft Supplemental Environmental Impact Statement/ Overseas Environmental Impact Statement

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

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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
3S	Sea Mammals and Sonar Safety
AIM	Acoustic Integration Model
AINJ	auditory injury
AM	amplitude-modulated
ANSI	American National Standards Institute
APPS	Act to Prevent Pollution from Ships
ASW	anti-submarine warfare
ATOC	Acoustic Thermometry of Ocean Climate
avg	average
BRS	behavioral response study
CAA	Clean Air Act
CASS-GRAB	Comprehensive Acoustic Simulation System/Gaussian Ray Bundle
CBD	Convention on Biological Diversity
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CLFA	Compact LFA
CNMI	Commonwealth of the Northern Mariana Islands
CNP	Central North Pacific
CO_2	carbon dioxide
CSR	coastal standoff range
CV	coefficient of variation
dB	decibels
dB re 1 µPa	decibels referenced to 1 micropascal
dB re 1 $µPa^2$	decibels referenced to 1 micropascal squared
dB re 1 $µPa^2$-s	decibels referenced to 1 micropascal squared per second
DPS	distinct population segment
ECS	Ecosystem Component Species
EEZ	Exclusive Economic Zone
EFH	essential fish habitat
EIS	Environmental Impact Statement
EO	Executive Order

Acronym	*Definition*
ESA	Endangered Species Act
ESU	evolutionary significant unit
fGC	fecal glucocorticoid metabolites
FEP	Fishery Ecosystem Plan
FM	frequency-modulated
FOEIS	Final Overseas Environmental Impact Statement
FR	Federal Register
FSEIS	Final Supplemental Environmental Impact Statement
ft	feet
GHG	greenhouse gas(es)
HBW	Humpback whale
HCTT	Hawaii-California Training and Testing
HF	high-frequency
HF/M3	high frequency marine mammal monitoring
HLA	horizontal line array
HRC	Hawaii Range Complex
HSTT	Hawaii-Southern California Training and Testing
Hz	Hertz
IFKW	Insular false killer whale
IMMA	Important Marine Mammal Area
INRMP	Joint Region Marianas Integrated Natural Resources Management Plan
ITA	incidental take authorization
IUCN	International Union for Conservation of Nature
IWC	International Whaling Commission
kHz	kilohertz
km	kilometer(s)
kt	knot(s)
lb	pounds
LOA	Letter of Authorization
LF	low frequency
LFA	low frequency active
LFS SRP	Low-Frequency Sound Scientific Research Program
m	meter(s)
max	maximum
M3	marine mammal monitoring
MF	mid-frequency
MFA	mid-frequency active

Acronym	*Definition*
MHI	Main Hawaiian Islands
mi	mile(s)
MILCREW	military crew
min	minute(s)
MITT	Mariana Islands Training and Testing
MMPA	Marine Mammal Protection Act
MNM	marine national monument
MPA	marine protected area
mph	mile(s) per hour
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
N/A	not applicable
NAEMO	Navy Acoustic Effects Model
Navy	United States Department of the Navy
NEPA	National Environmental Policy Act
NM	nautical mile(s)
NMFS	National Marine Fisheries Service
NMS	National Marine Sanctuary
NMSA	National Marine Sanctuaries Act
NMSDD	Navy Marine Species Density Database
NOAA	National Oceanic and Atmospheric Administration
NPRW	North Pacific Right Whale
OBIA	Offshore Biologically Important Areas
OCA	otariids and other non-phocid marine carnivores in-air
OCW	otariids and other non-phocid marine carnivores in-water
OEIS	Overseas Environmental Impact Statement
PAC	Pacific
PCA	phocid carnivores in-air
PCW	phocid carnivores in-water

Acronym	*Definition*
PE	parabolic equation
PMRF	Pacific Missile Range Facility
PTS	permanent threshold shift
RIMPAC	Rim of the Pacific Exercise
rms	root mean square
ROD	Record of Decision
SEIS	Supplemental Environmental Impact Statement
sec	second(s)
SEL	sound exposure level
SEL_{cum}	cumulative sound exposure level
SL	source level
SOEIS	Supplemental Overseas Environmental Impact Statement
SOCAL-BRS	Southern California BRS
SoNG	Swatch-of-No-Ground
SOP(s)	standard operating procedure(s)
SPE	single ping equivalent
SPL	sound pressure level
SRS	Sanctuary Resource Statement
SURTASS	Surveillance Towed Array Sensor System
T-AGOS	Tactical-Auxiliary General Ocean Surveillance
TS	threshold shift
TTS	temporary threshold shift
U.S.	United States
U.S.C.	United States Code
USCG	U.S. Coast Guard
USNS	U.S. Naval Ship
USFWS	U.S. Fish and Wildlife Service
VHF	very high-frequency
VLA	vertical line array
VLF	very low-frequency
WETS	Wave Energy Test Site
WNP	Western North Pacific
WPFMC	Western Pacific Fishery Management Council
yd	yard(s)

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1 Purpose of and Need for the Proposed Action

1.1 Introduction

The United States (U.S.) Department of the Navy (Navy) has prepared this Supplement to the 2019 Surveillance Towed Array Sensor System (SURTASS) Low Frequency Active (LFA) Supplemental Environmental Impact Statement (SEIS)/Supplemental Overseas Environmental Impact Statement (SOEIS) (U.S. Department of Navy 2019) (herein referred to as the 2019 SEIS/SOEIS) pursuant to the National Environmental Policy Act (NEPA)[2] and Executive Order (EO) 12114, *Environmental Effects of Major Federal Actions Abroad*. The Navy proposes to continue utilizing SURTASS LFA and Compact LFA (CLFA) sonar systems onboard U.S. Navy surveillance ships for training and testing activities conducted under the authority of the Secretary of the Navy in the western and central North Pacific and eastern Indian Oceans[3]. In this SEIS/Overseas Environmental Impact Statement (OEIS), the terms "SURTASS LFA sonar" or "SURTASS LFA sonar systems" are inclusive of both the LFA and CLFA sonar systems, each having similar acoustic operating characteristics. The Navy prepared this SEIS/OEIS by assessing the potential environmental impacts associated with the proposed training and testing activities to be conducted within the Study Area.

This SEIS/OEIS was prepared to update the Navy's assessment of the potential environmental impacts associated with proposed training and testing activities to be conducted in the Study Area. This SEIS/OEIS will analyze some modifications to the Proposed Action as well as to incorporate the continuing development of best available science. It was prepared, using the best available science, to update the Navy's assessment of the potential environmental impacts associated with proposed new and ongoing training and testing activities. Additionally, this SEIS/OEIS analysis of impacts on the marine environment has resulted in different impacts from the previous environmental documentation. Finally, this SEIS/OEIS also supports the regulatory reauthorization under various environmental statutes, to include the Marine Mammal Protection Act (MMPA) and the Endangered Species Act (ESA). These proposed activities are generally consistent with those analyzed in the 2019 SEIS/SOEIS and other analyses presented in Section 1.5, and are representative of the training and testing activities that the Navy have been conducting in the Study Area for decades.

Previous NEPA and EO 12114 documents included the use of SURTASS LFA sonar during certain military operations. However, this SEIS/OEIS analyzes SURTASS LFA during only training and testing activities and not during military operations, which are non-discretionary and conducted at the direction of the National Command Authority (the President and the Secretary of Defense).

The geographic scope analyzed in this document also differs from the SURTASS LFA sonar documents under NEPA and EO 12114 written prior to 2017 but remains the same as that analyzed in the 2019 SEIS/SOEIS. The geographic scope of the pre-2017 documents for covered SURTASS LFA sonar activities

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[2] For purposes of this SEIS/OEIS, the Navy has voluntarily elected to generally follow those Council of Environmental Quality regulations at 40 CFR Parts 1500-1508 that were in place at the outset of this SEIS/OEIS, in addition to Navy's procedures/regulations implementing NEPA at 32 CFR Part 775, to meet the agency's obligations under NEPA, 42 U.S.C. 4321 et seq.

[3] Throughout this document, the terms "training and testing activities" or "covered SURTASS LFA sonar activities" are used to represent the Proposed Action.

was the non-polar areas of the Atlantic, Pacific, and Indian Oceans and the Mediterranean Sea. The geographic scope of this SEIS/OEIS and the Navy's Proposed Action is the western and central North Pacific and eastern Indian Oceans. The Navy scoped the geographic extent of this document to better reflect the areas where the Navy anticipates conducting SURTASS LFA sonar training and testing activities now and into the reasonably foreseeable future. The operating features of SURTASS LFA sonar have remained the same since the 2001 Final Overseas Environmental Impact Statement (FOEIS)/ Environmental Impact Statement (EIS), with the exception that the typical duty cycle of SURTASS LFA sonar (ratio of time that the sonar is pinging to the total time of use including intervals between pings), based on historical SURTASS LFA sonar operational parameters, is 7.5 to 10 percent (U.S. Department of Navy 2007a) rather than 10 to 20 percent (U.S. Department of Navy 2001).

This SEIS/OEIS incorporates acoustic effects analyses to estimate the potential effect of SURTASS LFA sonar on marine mammals. Acoustic effects analyses begin with mathematical modeling to predict the sound transmission patterns from sonar. These data are then coupled with updated marine species distribution and abundance data to determine the sound levels likely to be received by marine mammals. Finally, received exposure levels are compared to the most up-to-date acoustic criteria and thresholds to estimate the specific effects that marine mammals exposed to SURTASS LFA sonar may experience. Unlike the previous iterations of environmental planning, this SEIS/OEIS includes use of the Navy Acoustic Effects Model (NAEMO) to estimate acoustic exposure to marine mammals from SURTASS LFA sonar systems. This SEIS/OEIS and associated analyses support consultations associated with regulatory permits and authorizations for SURTASS LFA sonar training and testing activities.

The Navy, as the lead agency for the Proposed Action, is responsible for the scope and content of this SEIS/OEIS. Consistent with NEPA (Section 4336(a)), National Marine Fisheries Service (NMFS) is a cooperating agency because the scope of the Proposed Action and alternatives involves activities that have the potential to affect protected resources under the agency's jurisdiction and for which they have special expertise, including marine mammals, threatened and endangered species, and essential fish habitat (EFH). NMFS' special expertise and authority are based on its statutory responsibilities under the MMPA, as amended (16 United States Code [U.S.C.] section 1361 et seq.), the ESA (16 U.S.C. section 1531 et seq.), and the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). The Navy plans to request an incidental take authorization (ITA) under the MMPA, as amended, to take marine mammals incidental to proposed training and testing activities. NMFS is required to evaluate the applicant's request pursuant to the specific requirements of the MMPA and, if appropriate, issue an ITA under the MMPA. In addition, NMFS has an independent responsibility to comply with NEPA and may adopt the Navy's Final SEIS/OEIS after independent review to fulfill its NEPA obligations. NMFS may adopt this SEIS/OEIS and issue a separate Record of Decision (ROD) associated with its decision to grant or deny the Navy's request for an ITA pursuant to section 101(a)(5)(A) of the MMPA.

1.2 Location

The location of the Proposed Action is the western and central North Pacific and eastern Indian Oceans (Figure 1-1). A coastal standoff range (CSR) associated with SURTASS LFA requires any sonar transmission to be less than 180 decibels referenced to 1 micropascal (dB re 1 µPa) (root mean square [rms]) (sound pressure level [SPL]) at a distance of 12 nautical miles (NM) from any emergent land. As a result, vessels operating SURTASS LFA sonar will only operate outside of 12 NM from land.

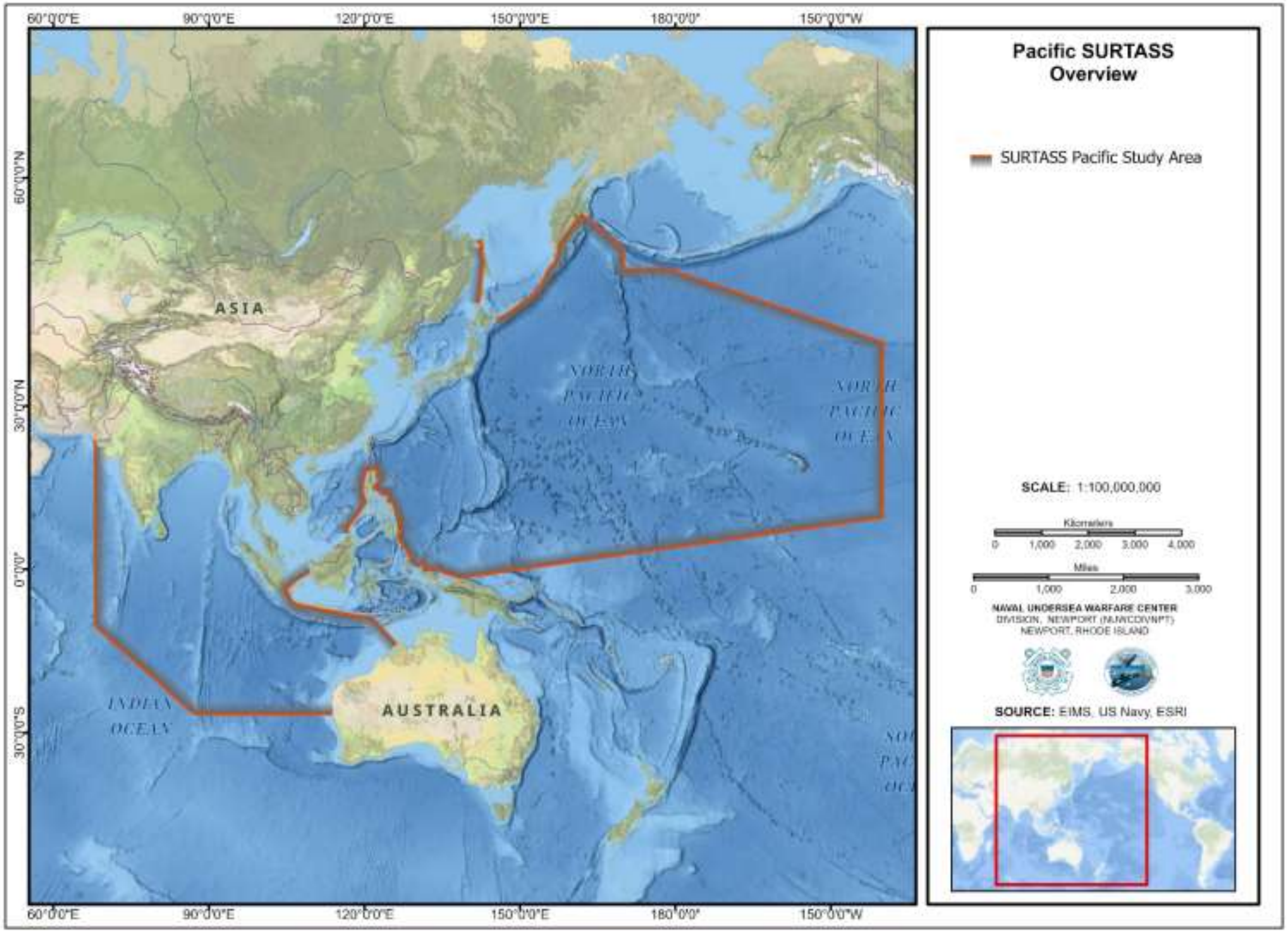

Figure 1-1. Study Area for SURTASS LFA Sonar Systems in the Western North Pacific and Indian Oceans

1.3 Purpose of and Need for the Proposed Action

> 10 U.S.C. section 8062: "The Navy shall be organized, trained, and equipped for the peacetime promotion of the national security interests and prosperity of the United States and for prompt and sustained combat incident to operations at sea. It is responsible for the preparation of naval forces necessary for the duties described in the preceding sentence except as otherwise assigned and, in accordance with integrated joint mobilization plans, for the expansion of the peacetime components of the Navy to meet the needs of war."

The Navy's statutory mission is to train and equip naval forces that are combat-ready and capable of accomplishing the peacetime promotion of America's national security interests, including deterring maritime aggression and maintaining freedom of navigation in ocean areas (10 U.S.C. Section 8062). Due to the advancements and use of quieting technologies in diesel-electric and nuclear submarines, undersea submarine threats have become increasingly difficult to locate solely using passive acoustic technologies. At the same time, the distance at which submarine threats can be detected has been decreasing due to these quieting technologies, and improvements in torpedo and missile design have extended the effective range of these weapons. To meet the requirement for improved capability to detect quieter and harder-to-find foreign submarines at greater distances, the Navy developed and uses SURTASS LFA sonar.

The purpose of the Navy's Proposed Action is to perform training and testing activities – collectively referred to as military readiness activities – to ensure that the Navy remains proficient in the use of SURTASS LFA sonar in support of the Navy's mission. Additionally, the Proposed Action could include the at-sea sonar testing of up to three new Tactical-Auxiliary General Ocean Surveillance (T-AGOS) vessels (one per year) starting in 2030. The need for the Proposed Action is to maintain a system and crews capable of detecting at long ranges the increasingly technologically advanced foreign submarine presence that threatens our national security.

The Navy will request authorization to "take" marine mammals incidental to conducting military readiness activities in the Study Area. Take under the MMPA is defined in 16 U.S.C. section 1362 as "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal." For military readiness activities, harassment is defined under this section as "(i) any act that injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment] or (ii) any act that disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing 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 [Level B harassment]."

ITAs provide an exception to the take prohibition in the MMPA and ensure that the Proposed Action complies with the MMPA and implementing regulations. ITAs may be issued as regulations and associated Letter of Authorization (LOA) under section 101(a)(5)(A) of the MMPA. The Navy is requesting a rulemaking and the issuance of an LOA for the Proposed Action.

NMFS' purpose is to evaluate the Navy's Proposed Action pursuant to its authority under the MMPA, and to make a determination whether to issue an ITA and LOA, including any conditions necessary to meet the statutory mandates of the MMPA. To issue an ITA[4], NMFS must evaluate the best available scientific information and find that the take will have a negligible impact on the affected marine mammal species or stocks and will not have an unmitigable impact on their availability for taking for subsistence uses (the latter finding is not relevant for this Proposed Action). NMFS cannot issue an ITA unless it can make the required findings. NMFS must also prescribe permissible methods of taking, other "means of affecting the least practicable adverse impact" on the affected species or stocks and their habitat, and monitoring and reporting requirements. The need for NMFS' action is to consider the impacts of the Proposed Action on marine mammals and meet NMFS' obligations under the MMPA. This Draft SEIS/OEIS analyzes the environmental impacts associated with proposed military readiness activities within the Study Area for which the Navy is seeking authorization to take marine mammals. The analysis of mitigation measures includes the requirements for protection and management of marine resources. The analysis of mitigation measures considers benefits to species or stocks and their habitat and analyzes the practicability and efficacy of each measure. This analysis of mitigation measures was used to support requirements pertaining to mitigation, monitoring, and reporting that would be specified in the final regulations and subsequent LOA, if issued.

1.3.1 Why the Navy Trains

The continued proliferation of adversary submarines poses threats not only to national security but also to regional geopolitical stability and global commerce. More than 460 submarines are operated by approximately 40 countries worldwide (Global Firepower 2025). As a result, detection of and defense against enemy submarines is a top Navy priority. Anti-submarine warfare (ASW) training and testing activities prepare and equip sailors for countering such threats. Failure to detect and defend against hostile submarines can cost lives.

As stated in the Chief of Naval Operations 2024 Navigation Plan, "To prevail in war, naval forces need an integrated and distributed training capability to master high-end tactics, raise operator proficiency baseline, and generate readiness." The Navy is statutorily mandated to protect U.S. national security by being ready, at all times, to effectively prosecute war and defend the nation by conducting operations at sea. Operations at sea are essential to protecting U.S. national interests, considering that 70 percent of the earth is covered in water, 80 percent of the planet's population lives within close proximity to coastal areas, and 90 percent of global commerce is conducted by sea.

1.3.2 Why the Navy Tests

The Navy's research and acquisition community, including Naval Sea Systems Command, provides weapons, systems, and platforms to the Navy to support its missions and give it a technological advantage over the United States' potential adversaries. This community is at the forefront of researching, developing, testing, evaluating, acquiring, and delivering modern platforms, combat systems, and related equipment to meet Fleet capability and readiness requirements. The Navy's

[4] NMFS' issuance of MMPA ITA (i.e., Letter of Authorization) is a major federal action (NMFS' Proposed Action) and is considered a connected action under NEPA, with a discrete purpose and need relative to NMFS' statutory and regulatory obligations. Consequently, NMFS has an independent responsibility to comply with NEPA. If NMFS makes the findings necessary to issue the requested Letter of Authorization, it will rely on the information and analyses in this document. NMFS intends to adopt the Final SEIS/OEIS to fulfill its NEPA obligations and issue its own Record of Decision, if appropriate.

research organizations and laboratories concentrate primarily on the development of new science and technology and include the initial testing of concepts that are relevant to the Navy of the future, including ship, aircraft, and weapons systems that support all Naval platforms throughout their life cycles, from acquisition through sustainment to end of life. Testing new weapons, systems, and platforms is a required step in the implementation process.

1.4 Scope of Environmental Analysis

In this SEIS/OEIS, the Navy has analyzed potential environmental impacts associated with the Proposed Action and Alternatives in the Pacific (PAC) SURTASS LFA sonar system Study Area; the western and central North Pacific and eastern Indian Oceans. Since the completion of the 2019 SEIS/SOEIS, the best available science has been updated, the regulatory environment has changed, and the impact analysis has been refined. All of this has been incorporated into this SEIS/OEIS analysis. The range of alternatives includes the No Action Alternative and two action alternatives to the Proposed Action that are considered in this SEIS/OEIS. This SEIS/OEIS updates the 2019 analysis of direct, indirect, and cumulative impacts that may result from the Proposed Action. This SEIS/OEIS will cover new T-AGOS vessels as well as an updated analysis of the proposed activities and associated number of SURTASS LFA sonar transmit hours, based on a reexamination of current and predicted requirements of SURTASS LFA sonar training and testing into the foreseeable future. The resulting environmental resource areas analyzed in this SEIS/OEIS include acoustic marine environment, fish, sea turtles, marine mammals, protected marine habitats, and economic resources. Further discussion of all environmental resources and their consideration is included in Chapter 3.

NMFS is a cooperating agency because the scope of the Proposed Action and alternatives involves activities that have the potential to affect protected resources under the agency’s jurisdiction and for which they have special expertise, including marine mammals, threatened and endangered species, and EFH. NMFS’ special expertise and authority are based on its statutory responsibilities under the MMPA, as amended (16 U.S.C. section 1361 et seq.), the ESA (16 U.S.C. section 1531 et seq.), and the MSFCMA. NMFS may adopt this SEIS/OEIS and issue a separate ROD associated with its decision on whether to grant the Navy’s request for ITA.

1.5 Key Documents

Several key source documents are the foundation for this SEIS/OEIS, and appropriate sections of these documents are incorporated by references in this SEIS/OEIS. These documents are considered key documents because of the applicability in the action, analyses, or impacts to the Proposed Action detailed herein. Documents incorporated by reference herein, in part or in their entirety, include:

- FOEIS/EIS for SURTASS LFA Sonar (U.S. Department of Navy 2001)—The first environmental analysis for SURTASS LFA sonar considered the employment of up to four SURTASS LFA sonar systems in the Atlantic, Pacific, and Indian oceans and Mediterranean Sea.
- Final Supplemental EIS (FSEIS) for SURTASS LFA sonar (U.S. Department of Navy 2007a)—This first supplemental document was prepared to remedy the deficiencies identified by order of the U.S. District Court for the Northern District of California, including the need for additional alternatives analysis, mitigation and monitoring, as well as an analysis of the potential impacts of low frequency (LF) sound on fishes.

- FSEIS/SOEIS for SURTASS LFA sonar (U.S. Department of Navy 2012)—In addition to reviewing and updating the information available on the potential impacts of SURTASS LFA sonar on the environment, this second supplemental impact assessment also provided a comprehensive analysis of offshore biologically important areas (OBIAs), of the 12-NM coastal standoff distance, and of potential cumulative impacts associated with operation of other active sonar sources.
- FSEIS/SOEIS for SURTASS LFA sonar (U.S. Department of Navy 2015b)—Pursuant to the amended summary judgment order issued by the U.S. District Court for the Northern District of California on May 22, 2014, this third supplemental impact document was prepared for the limited purpose of remedying the NEPA deficiency identified in the Court's order. The Court specified that the Navy failed to use the best available data in its 2012 FSEIS/SOEIS (U.S. Department of Navy 2012) when it determined potential impacts from employment of SURTASS LFA sonar systems on one rather than the more updated five stocks of common bottlenose dolphins (*Tursiops truncatus*) in Hawaiian waters.
- FSEIS/SOEIS for SURTASS LFA Sonar (U.S. Department of Navy 2017)—This fourth supplemental document for SURTASS LFA sonar updated information relevant to determining impacts on the marine environment, including using the latest acoustic criteria and thresholds promulgated by NMFS (NMFS 2016).
- FSEIS/SOEIS for SURTASS LFA Sonar (U.S. Department of Navy 2019) – This fifth impact assessment document for SURTASS LFA sonar analyzed a different geographic scope from the previous versions. This new geographic scope focused on the western and central North Pacific and eastern Indian Oceans as opposed to all non-polar waters of the globe, which better reflected the areas where the Navy anticipated conducting SURTASS LFA sonar training and testing activities.

Throughout this SEIS/OEIS, the collection of these key documents will be referred to as "previous SURTASS LFA environmental analyses."

1.6 Public and Agency Participation and Intergovernmental Coordination

Refer to Appendix A (Public and Agency Participation) for more information.

1.7 Organization of this Supplemental Environmental Impact Statement/Overseas Environmental Impact Statement

The organization of this SEIS/OEIS is shown in Table 1-1.

Table 1-1. Organization of this Supplemental Environmental Impact Statement/Overseas Environmental Impact Statement

Chapter/Appendix	*Title*	*Description*
Chapter 1	Purpose and Need	Purpose and need for the Proposed Action.
Chapter 2	Proposed Action and Alternatives	Proposed Action, alternatives considered but eliminated in this SEIS/OEIS, and alternatives to be carried forward in this SEIS/OEIS.
Chapter 3	Affected Environment and Environmental Consequences	Existing conditions of the affected environment and analysis of the potential impacts of the Proposed Action under each alternative. This includes an assessment of cumulative effects.
Chapter 4	Mitigation, Monitoring, and Reporting	Describes the mitigation measures that will be implemented to avoid or reduce potential impacts.
Chapter 5	Regulatory Considerations	Considerations required under NEPA and description of how the Navy complies with other federal, state, and local plans, policies, and regulations.
Chapter 6	List of Preparers	The key authors and reviewers of this SEIS/OEIS.
Appendix A	Public and Agency Involvement	The Navy's public scoping process, including copies of public notices, a list of stakeholders who were engaged via letter or email, and comments received by the Navy either via mail or electronic submittal. Includes a summary of the scoping comments received and a copy of all scoping comments received. Public comments on the Draft SEIS/OEIS and the Navy's responses are provided in the Final SEIS/OEIS. This appendix will include copies of relevant Federal Register notices.
Appendix B	Acoustic Impacts Supporting Information	Brief background and explanations of acoustic terminology and concepts, as well as additional information on the existing acoustic environment.
Appendix C	Biological Resources Supplemental Information	Background and affected environment information on the biological resources found in the Study Area.
Appendix D	Acoustic Effects Analysis	The analysis of how marine mammals are potentially impacted by acoustic energy in the water.
Appendix E	Recreational Dives Sites in the Study Area	A list of all known public dive sites in the Study Area.
Appendix F	Marine Mammal Offshore Biologically Important Area (OBIA) Analysis	Background information on the OBIA designation process, and detailed information on the evaluation of OBIAs since the 2019 SEIS/SOEIS.

2 Proposed Action and Alternatives

2.1 Proposed Action

This chapter describes the SURTASS LFA sonar training and testing activities that comprise the Proposed Action and that are necessary to meet the Navy's ASW and national security mission. The U.S. Navy proposes to continue utilizing SURTASS LFA sonar systems onboard U.S. Navy surveillance ships for training and testing conducted under the authority of the Secretary of the Navy in the non-Arctic western and central North Pacific and eastern Indian Oceans. The U.S. Navy currently has four surveillance ships that utilize SURTASS LFA sonar systems: U.S. Naval Ship (USNS) VICTORIOUS (T-AGOS 19); USNS ABLE (T-AGOS 20); USNS EFFECTIVE (T-AGOS 21); and USNS IMPECCABLE (T-AGOS 23). The Navy intends to develop and field additional SURTASS LFA sonar equipped vessels, either to replace or complement the Navy current SURTASS LFA sonar equipped fleet. The Navy is currently approved under the LOA issued in 2019 to transmit a maximum of 592 sonar transmission hours per year. NMFS' Proposed Action is to evaluate the Navy's request for authorizations to take marine mammals pursuant to its authority under the MMPA, and to make a determination whether to promulgate regulations and issue an LOA. NMFS needs to render a decision regarding the request for an ITA due to NMFS' responsibilities under the MMPA (16 U.S.C. 1371(a)(5)(A)) and its implementing regulations.

As part of each action alternative, the Navy proposes to implement the same suite of activity-based (referred to in previous SURTASS LFA environmental analyses as "procedural mitigation") and geographic mitigation measures during SURTASS LFA sonar training and testing activities as were included in the 2019 SEIS/SOEIS. Specifically, under either action alternative, the Navy would ensure that SURTASS LFA sonar received levels from the Proposed Action are below 180 dB re 1 µPa (rms) within 12 NM (22 kilometers [km]) of any emergent land[5] and within 0.54 NM (1 km) seaward of the boundary of any designated OBIAs during their effective periods of biological activity. Additionally, 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 national security presents a requirement that dictates otherwise. If a national security requirement to conduct more than 25 percent of the authorized hours of SURTASS LFA sonar within 10 NM 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 exceedance of 25 percent) in its annual activity reports submitted to NMFS.

In addition, SURTASS LFA sonar training and testing activities would not occur within the territorial seas of foreign nations. As described in the 2019 SEIS/SOEIS, twenty-nine OBIAs were designated worldwide, four of which are found in the Study Area. As part of the Proposed Action, a review of potential additional areas to designate as OBIAs was conducted; consequently, five additional OBIAs have been designated in the Study Area (Chapter 4). Further, SURTASS LFA sonar received levels associated with training and testing activities are not to exceed 145 dB re 1 µPa (rms) within Hawaii State waters or within known recreational and commercial dive sites unless both of the following conditions are met:

[5] Emergent land is defined here as low-lying but emergent land features that a country considers land and uses as a baseline from which to measure their maritime boundaries.

(1) should national security present a requirement to transmit SURTASS LFA sonar during training or testing activities such that exposure within Hawaii state waters or known recreational or commercial dive sites may exceed received levels of 145 dB re 1 µPa (rms), naval units would obtain permission from the appropriate designated Command authority prior to commencement of the activity; and (2) prior to conducting the training or testing activity, the designated Command authority shall conduct a risk assessment, taking into account the potential for exposure of SURTASS LFA sonar to divers.

Visual observation, passive acoustic, and active acoustic (high frequency marine mammal monitoring [HF/M3] sonar) monitoring would also be employed as a means of mitigation. Observation and detection techniques would be employed to minimize, to the greatest extent practicable, impacts to marine mammals or sea turtles associated with SURTASS LFA sonar within a 2,000 yards (yd; 1.8 km) mitigation/buffer zone for SURTASS LFA sonar. The proposed suite of mitigation measures described in Chapter 4 of this SEIS/OEIS were developed to meet both the Navy's purpose and need to train and test and NMFS's independent purpose and need to evaluate the potential impacts of Navy's activities. The Navy would implement mitigation measures to avoid or reduce potential impacts from the Proposed Action on environmental resources. Mitigation measures would be implemented under either Action Alternative.

2.1.1 Description of the SURTASS LFA Sonar System

SURTASS LFA sonar is a long-range system that transmits in the LF band (below 1,000 Hertz [Hz]) that is composed of both active and passive components (Figure 2-1). The active component is the LFA sonar source array while the passive component is the SURTASS receive array.

Sonar is an acronym for sound navigation and ranging, and its definition includes any system that uses underwater sound, or acoustics, for observations and communications. Sonar systems are used for many purposes, ranging from commercial "fish finders" to military ASW systems used for detection and classification of submarines. The two basic types of sonar used in the SURTASS LFA sonar system are passive and active sonar. Passive sonar detects sound created by a source. Passive sonar is similar to people hearing sounds that are transmitted through the air to the human ear. Very simply, passive sonar "listens" without transmitting any sound signals. Active sonar detects objects by creating a sound pulse or "ping" that is transmitted from the system through the water, reflects off a target object, and returns in the form of an echo to be detected by a receiver. Active sonar is a two-way transmission of sound waves through water (sound source to reflector to receiver).

SURTASS LFA sonar systems were initially installed on two SURTASS vessels. As undersea warfare requirements continued to transition to the littoral ocean regions, a compact version of the LFA sonar system deployable on SURTASS LFA-equipped vessels was needed. This compact sonar system upgrade is known as CLFA and consists of smaller, lighter-weight source elements than in the SURTASS LFA sonar system. CLFA sonar improvements include:

- Operational frequency within the 100 to 500 Hz range, matched to shallow-water environments with little loss of detection performance in deep-water environments;
- Improved reliability and ease of deployment; and
- Lighter-weight design with mission weight of 142,000 pounds (lb) for the CLFA sonar system versus 324,000 lb mission weight for the LFA sonar system.

The operational characteristics of the CLFA sonar system are comparable to the original LFA sonar system as detailed in Subchapter 2.1 of the FOEIS/EIS (U.S. Department of Navy 2001). Therefore, the potential impacts from CLFA sonar are expected to be similar to, but not greater than, the impacts associated with the LFA sonar system. For this reason, in this SEIS/OEIS the term SURTASS LFA sonar is used inclusively of the LFA and/or the CLFA sonar systems, unless otherwise specified.

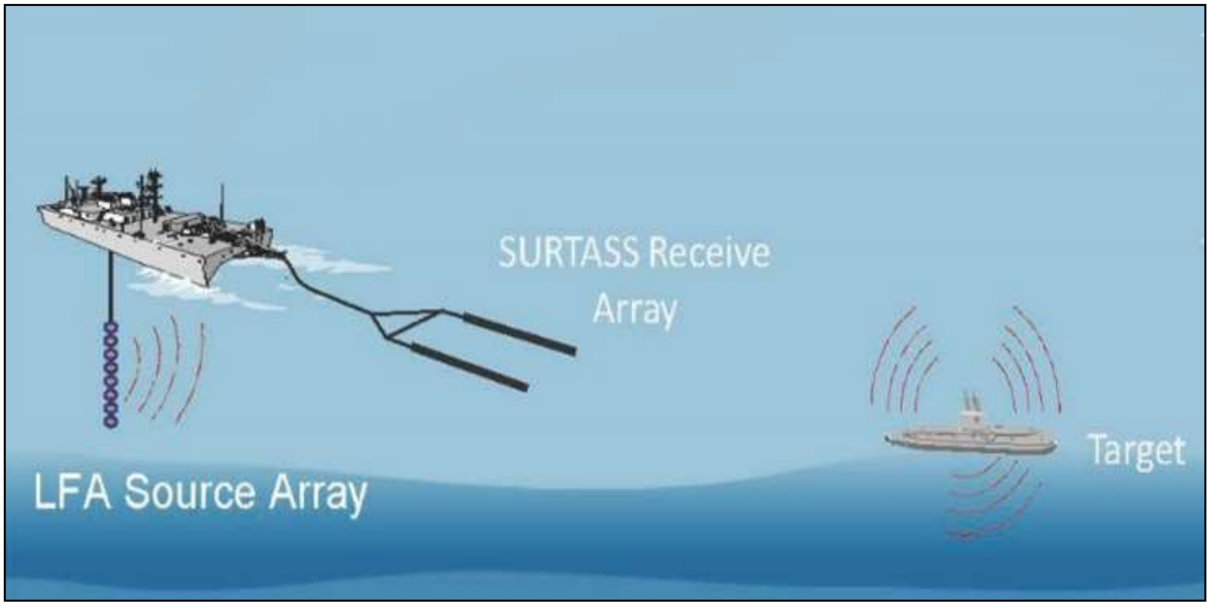

Figure 2-1. Schematic of a SURTASS LFA Sonar System Deployed from a T-AGOS Vessel Including the Passive SURTASS Horizontal Line Array (Receive Array) of Hydrophones and the Active Vertical Line Array of LF Sonar Projectors (Source Array).

2.1.1.1 Active Sonar System Components

The active component of the SURTASS LFA sonar system, SURTASS LFA sonar, is employed when active sound signals are needed to detect and track underwater targets of interest. SURTASS LFA sonar complements SURTASS passive activities by actively acquiring and tracking submarines when they are in quiet operating modes, measuring accurate target range, and re-acquiring lost contacts.

SURTASS LFA sonar consists of a vertical source array of sound-producing elements that are suspended by cable under one of the T-AGOS vessels (Figure 2-1). 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 SURTASS LFA sonar source is a vertical line array (VLA) consisting of up to 18 source projectors. Each SURTASS 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 source frequency ranges between 100 and 500 Hz.

2.1.1.2 Passive Sonar System Components

SURTASS is the passive, or listening, component of the system that detects returning sounds from submerged objects, such as threat submarines, through the use of hydrophones. Hydrophones transform mechanical energy (i.e., received acoustic sound waves) to an electrical signal that can be analyzed by the sonar processing system. The return (received) signals, which are usually below background or ambient noise level, are processed and evaluated to identify and classify potential underwater threats. SURTASS consists of a twin-line, “Y” shaped horizontal line array (HLA) of hydrophones with two apertures that is approximately 1,000 feet (ft; 305 meters [m]) long.

2.1.1.3 High-Frequency Active Sonar (HF/M3)

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 yd [1.8 km]). This source would operate at a source level (SL) 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.

2.1.1.4 Operating Profile

The operating features of the active component of the SURTASS LFA sonar system, SURTASS LFA sonar, are:

- The SL of an individual source projector on the SURTASS LFA sonar array is approximately 215 dB re 1 µPa at 1 m (rms) or less. For the array SL, the effective SL of the system design was used. Effective SL is a theoretical value, hypothetically measured at 1 m from the array on its horizontal axis, calculated from the formula: SLE + 20 Log10(N), where SLE = SL of an individual projector and N = number of projectors.
- Frequency range of 100 to 500 Hz.
- The typical SURTASS 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 (FM) 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 (min).

The Navy’s proposed area for SURTASS LFA sonar training and testing activities includes the non-polar areas of the western and central North Pacific and eastern Indian oceans, not including the western Indian Ocean or Sea of Okhotsk. The Study Area for this SEIS/OEIS is the same as was presented in the 2019 SEIS/SOEIS.

Although SURTASS LFA sonar vessels usually operate independently from one another, SURTASS LFA sonar vessels may operate in conjunction with other naval air, surface, or submarine assets as part of naval exercises. SURTASS LFA sonar vessels generally travel in straight lines or racetrack patterns depending on the scenario. When the SURTASS or LFA sonar arrays are deployed, a SURTASS LFA sonar vessel must maintain a speed of at least 3 knots (kt), with a typical speed of 4 kt. When not towing the SURTASS or LFA sonar arrays, T-AGOS vessels travel at maximum speeds up to 12 kt. Movements of SURTASS LFA sonar vessels are not unusual or extraordinary and are in line with routine operations of seagoing vessels.

2.1.2 Standard Operating Procedures

Standard operating procedures (SOPs) apply to the Proposed Action. SOPs serve the primary purpose of providing for safety and mission success, and they are implemented regardless of their secondary benefits (e.g., reducing effects to a resource). This section presents an overview of the SOPs that are incorporated into the Proposed Action in this document. SOPs that apply to SURTASS LFA sonar training and testing activities include:

- Navy Lookouts shall qualify in accordance with the Lookout Personnel Qualification Standard (NAVEDTRA 12968-D) and execute their duties in accordance with the Lookout Training Handbook.
- While on watch, personnel shall employ visual search techniques, including the use of binoculars, using a scanning method in accordance with the Lookout Training Handbook. While Navy personnel stand watch throughout the day and night, those assigned specifically as marine species observers would be on watch only during daylight hours (30 min before sunrise through 30 min after sunset).
- Watch standing personnel shall make use of marine species detection cues and information to limit interaction with marine species to the maximum extent possible consistent with safety of the ship.
- While in transit, the vessel shall be alert at all times, use extreme caution, and proceed at a 'safe speed' so that the vessel can take proper and effective action to avoid a collision with any sighted object or disturbance, including any marine mammal or sea turtle, and can be stopped within a distance appropriate to the prevailing circumstances and conditions.
- When whales have been sighted in the area, Navy vessels shall increase vigilance and take reasonable and practicable actions to avoid collisions and activities that might result in close interaction of naval assets and marine mammals.
- All vessels shall maintain logs and records documenting training operations should they be required for event reconstruction purposes. Logs and records shall be kept in accordance with Navy guidance.

2.2 Action Alternatives

NEPA and Navy regulations state that an EIS must rigorously explore and objectively evaluate all reasonable alternatives for implementing a proposed action, and for alternatives eliminated from detailed study, briefly discuss the reasons for their elimination. To be reasonable, an alternative, except for the no action alternative, must meet the stated purpose of and need for the proposed action.

2.2.1 Reasonable Alternative Screening Factors

Screening criteria were developed to aid in assessing the feasibility of proposed alternatives and defining the range of reasonable alternatives. Potential alternatives that meet the Navy's purpose and need were evaluated against the following screening factors:

- Must allow the Navy to meet all training and testing requirements for SURTASS LFA sonar systems, vessels, and crews;
- Must allow the Navy to maintain a fleet of at least four SURTASS LFA-equipped vessels in the Study Area while upgrading to newer vessels over the reasonably foreseeable future; and,
- Provides testing and training access to diverse and variable marine environments that replicate real-world conditions where Sailors would be expected to operate.

Two action alternatives (Action Alternative 1 and Action Alternative 2) were identified as meeting the Navy's purpose and need and requirements of the screening factors. The No Action Alternative would not allow the Navy to meet any of the screening factor requirements or the Navy's purpose and need.

2.2.2 Alternatives Carried Forward for Analysis

After consideration of the screening factors, the Navy has carried forward for analysis two action alternatives that meet the purpose and need for the Proposed Action. Both action alternatives utilize the SURTASS LFA sonar systems within the parameters described in the Operating Profile (Section 2.1.1.4), incorporating the proposed mitigation measures described in further detail in Chapter 4 of this SEIS/OEIS.

2.2.2.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur, and therefore the SURTASS LFA sonar training and testing activities would not occur beyond August 2026. The Navy's purpose and need would not be met since its ability to train and test to locate and defend against enemy submarines would be greatly impaired.

Although the No Action Alternative would not meet the Navy's purpose and need for the Proposed Action, as required by NEPA, the No Action Alternative is carried forward for analysis in this SEIS/OEIS, as it provides a baseline for measuring the environmental consequences of the two action alternatives.

For NMFS, denial of the Navy's application for an ITA constitutes the NMFS No Action Alternative, which is consistent with NMFS' statutory obligation under Section 101(a)(5)(A) the MMPA to grant or deny requests for take incidental to specified activities.

2.2.2.2 Alternative 1 (Preferred Alternative)

Under Alternative 1, the Navy proposes to use 1,100 hours of SURTASS LFA sonar training per year, which appears to be an increase from the previously authorized 592 hours. However, this increase does not reflect new or additional training requirements. Instead, it is the result of a change in how the Navy counts an "hour" of transmission. Previously, SURTASS LFA sonar hours were calculated by adding the portions of time a sonar emits sound during its "duty cycle" (ratio of time the signal is on compared to off), whereas other Navy sonar systems, such as mid-frequency (MF) and HF active sonar, report hours based on "duration" time (total time the source is active, including silent periods between pings.) To bring SURTASS LFA sonar in line with these other systems, the Navy developed a conversion method that considers various factors including LFA sonar pings, wave trains, and other classified considerations. As a result, the 1,100 hours of annual SURTASS LFA training requested are equivalent to the 592 hours authorized under the previous counting method.

The following were considered during the Navy's analysis: 1) previous annual SURTASS LFA sonar transmission hours; 2) the number of SURTASS LFA sonar vessels available for training and testing activities and the need for their maintenance; 3) Navy requirements setting the minimum level of annual at-sea proficiency training hours for SURTASS LFA sonar operators and civilian crew, which can only be met by using SURTASS LFA sonar in an actual at-sea environment; 4) the need to use SURTASS LFA sonar assets to support acoustic research testing using Navy ships of opportunity; and 5) potential participation of SURTASS LFA sonar vessels in naval exercises within the Study Area (e.g., Valiant Shield, Rim of the Pacific Exercise [RIMPAC]). Based on this analysis, the Navy concluded that the minimum required number of SURTASS LFA sonar transmission hours is 1,100 hours per year pooled across SURTASS LFA sonar equipped vessels operating in the Study Area.

The SURTASS LFA sonar transmission hours under Action Alternative 1 (1,100 hours per year pooled across all SURTASS LFA sonar equipped vessels) represent a distribution across three activities including:

- Training (i.e., contractor crew proficiency training, military crew [MILCREW] proficiency training, active training)
- Maintenance and upgrades (equipment maintenance checks, LFA/CLFA maintenance/performance testing, other maintenance/testing)
- Exercises (e.g., Valiant Shield, RIMPAC)

Alternative 1 does not include additional testing outside of the maintenance and upgrades addressed in the second bullet above. Each of these activities utilizes the SURTASS LFA sonar system within the operating profile described above (Section 2.1.1.4), therefore the number of hours estimated for each activity is merely for planning purposes.

2.2.2.3 Alternative 2

Under Alternative 2, up to a maximum of 2,490 hours of SURTASS LFA sonar transmissions are planned per year for training and testing activities, pooled across all SURTASS LFA sonar equipped vessels operating in the Study Area. This alternative assumes an increase in training requirements, as well as a need for additional SURTASS LFA sonar equipped vessels to be operational in the Study Area, based on training requirements or a change in geopolitics. The Navy intends to add new vessels to its T-AGOS fleet over time. As new vessels are constructed and put into fleet use, the onboard LFA and HF/M3 sonar systems would also need to be updated, modified, or even re-designed. As the new vessels and sonar system components are developed and constructed, at-sea testing would be necessary before ships are put into operational use. The Navy anticipates that up to one new T-AGOS vessel would be ready for at-sea testing within the Study Area annually beginning in 2030. Thus, the analysis under Alternative 2 includes 840 annual hours of testing of new T-AGOS vessels for years 5-7. It is possible that two of the new vessels could be added to the fleet as opposed to replacing existing vessels, meaning the total number of T-AGOS vessels in the Study Area would be a maximum of six. 1,100 hours of SURTASS LFA sonar transmissions are planned per year for training activities pooled across all four current SURTASS LFA sonar equipped vessels operating in the Study Area for years 1-4, while up to 1,650 hours of SURTASS LFA sonar transmissions are planned per year for training activities pooled across all SURTASS LFA sonar equipped vessels for years 5-7. Although only one vessel could be added during year 5, the Navy has analyzed the maximum number of training hours for six SURTASS LFA-equipped vessels over years 5-7 to ensure conservative coverage and maximum flexibility. While Alternative 1 represented the anticipated number of SURTASS LFA sonar transmission hours required per year to meet the Navy’s purpose and need, Alternative 2 includes the additional hours of SURTASS LFA sonar transmission used during years 5-7 if the total number of active vessels in the Study Area were increased from four to six.

Alternative 2 represents an increased number of training and testing hours over that presented in Alternative 1 associated with maintaining the proficiency of contractor crew members and military personnel onboard SURTASS LFA sonar vessels. While the training hours allocated in Alternative 1 for training of military sonar operators meet the minimum standard required, the increased SURTASS LFA sonar transmission hours in Alternative 2 would provide additional training and testing capacity for two additional vessels to participate in at-sea exercises with other Navy units and to conduct acoustic research testing.

The SURTASS LFA sonar transmission hours under Action Alternative 2 (up to a maximum of 2,490 hours per year pooled across all SURTASS LFA sonar equipped vessels) represent a distribution across four activities including:

- Training (i.e., contractor crew proficiency training, MILCREW proficiency training, active training)
- Maintenance and Upgrades (equipment maintenance checks, LFA/CLFA maintenance/performance testing, other maintenance/testing)
- Exercises (e.g., Valiant Shield, RIMPAC); annual hours would remain the same under Alternative 2 as under Alternative 1, as the tempo of large Naval exercises would not increase.
- New SURTASS LFA sonar system testing starting in 2030.

Each of these activities utilizes the SURTASS LFA sonar system within the operating profile described above (Section 2.1.1.4), therefore the number of hours estimated for each activity is merely for planning purposes.

2.2.3 Alternatives Considered but not Carried Forward for Detailed Analysis

The initial FOEIS/EIS for SURTASS LFA sonar considered alternatives to SURTASS LFA sonar, such as other passive and active acoustic and non-acoustic technologies (e.g., radar, laser, magnetic, infrared, high- or MF active sonar, and others), as discussed in FOEIS/EIS Subchapters 1.1.2, 1.1.3, and 1.2.1; and Table 1-1 (U.S. Department of Navy 2001). These technologies were also addressed in the 2002 NMFS Final Rule (NOAA 2002) and the 2002 Navy ROD (U.S. Department of Navy 2002); the FOEIS/EIS concluded that these technologies did not meet the purpose and need of the proposed action to provide Naval forces with reliable long-range detection of submarines and, thus, did not provide adequate reaction time to counter potential threats. Furthermore, these technologies were not considered practicable and/or feasible for technical and economic reasons. The non-acoustic technologies were also re-examined in Subchapter 1.1.4 of the 2012 FSEIS/SOEIS for SURTASS LFA sonar (U.S. Department of Navy 2012), with the re-evaluation reaching the same conclusion as the 2001 FOEIS/EIS. No new information on alternate technologies or their capabilities has arisen since the analyses presented in the SURTASS LFA sonar documents written prior to 2019. These technologies also do not meet the purpose and need of this Proposed Action to provide Naval forces with the ability to train and test appropriately to become proficient in long-range detection of unknown or enemy sub-surface contacts in time to counter potential threats. Therefore, the relevant information from the 2001 and 2012 SURTASS LFA sonar documents remains valid and is incorporated by reference herein.

The Proposed Action requires a very large ocean area within the Study Area. The Navy considered reducing the Study Area to utilize regions with the lowest risk of impacting sensitive marine species; however, this would result in the need for potentially long and costly (i.e., increased fuel consumption) transits to these areas for training and testing and may also pull assets away from areas where they may be needed for real-world operations. Maintaining the large Study Area in the western and central North Pacific and eastern Indian Oceans meets the purpose and need of the Proposed Action by allowing for the flexibility needed to maintain military readiness and meet training and testing requirements for SURTASS LFA.

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3 Affected Environment and Environmental Consequences

This chapter describes existing environmental resources and baseline conditions in the PAC SURTASS LFA Study Area and an analysis of the potential effects by the Proposed Action described in Chapter 2. The activities analyzed in this SEIS/OEIS are largely a continuation of activities that have been ongoing for decades and were previously analyzed in former NEPA documentation for this project, incorporated by reference. This updated analysis incorporates new information and scientific research completed since the completion of the 2019 SEIS/SOEIS.

The discussion of the affected environment in the Study Area focuses only on those resource areas potentially subject to effects resulting from implementation of the Proposed Action. Accordingly, the resource areas detailed in this SEIS/OEIS are acoustic marine environment, fish, sea turtles, marine mammals, protected marine habitats, and economic resources. The level of detail that describes a resource is commensurate with the anticipated level of potential environmental effects.

3.1 Approach to Analysis

3.1.1 Analysis Framework

Consistent with NEPA, the Navy must determine the environmental consequences of the Proposed Action and reasonable alternatives. This analysis provides a comparison of the proposed action and reasonable alternatives based on the reasonably foreseeable effects of their activities and the significance of those effects.

A significance determination under OPNAVINST M-5090.1 considers the context of the action and the intensity of the effect to determine the significance of adverse effects of activities under the proposed action. A significance determination was only made for activities that have reasonably foreseeable adverse effects on the human environment based on the seven listed factors in Table 3-1. To this end, the significance determination analysis reaches a significant/less than significant conclusion only for activities with adverse effects on any of the listed factors. This avoids conflating the degree of adverse effects on a particular resource with the holistic look at activity effects on the human environment. Ultimately, the significance determinations in each subsequent section are used to compare environmental consequences amongst the alternatives.

Table 3-1. Factors to Consider for Intensity of Effects

The Navy analyzed the intensity of effects considering the following factors, as applicable to the proposed action and in relationship to one another:
1) The degree to which the action may adversely affect public health and safety.
2) The degree to which the action may adversely affect unique characteristics of the geographic area such as historic or cultural resources, parks, Tribal sacred sites, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas.
3) Whether the action may violate relevant Federal, State, Tribal, or local laws or other requirements or be inconsistent with Federal, State, Tribal, or local policies designed for the protection of the environment.
4) The degree to which the potential effects on the human environment are highly uncertain
5) The degree to which the action may adversely affect resources listed or eligible for listing in the National Register of Historic Places.
6) The degree to which the action may adversely affect an endangered or threatened species or its habitat, including habitat that has been determined to be critical under the Endangered Species Act of 1973.
7) The degree to which the action may adversely affect rights of Tribal Nations that have been reserved through treaties, statutes, or Executive Orders.

3.1.2 Environmental Resources not Analyzed

Since SURTASS LFA sonar training and testing activities would occur within the marine environment and principally entail the introduction of acoustic energy into that environment, the Proposed Action would have no reasonably foreseeable adverse effects on the following resources under either action alternative:

- Air Quality – Navy SURTASS LFA sonar vessels would not homeport or conduct major vessel maintenance at the ports in Hawaii, Guam, nor the Commonwealth of the Northern Mariana Islands (CNMI). The air emissions of the SURTASS LFA sonar vessels are not subject to the provisions of the Clean Air Act (CAA) because they would not be operating in the state and territory waters of Hawaii, Guam, and the CNMI. Therefore, no general conformity analysis is required. The Navy has also determined that all air emissions generated as a result of the training and testing activities of SURTASS LFA sonar would occur outside of U.S. state and territory waters (i.e., beyond 12 NM from shore). The CSR mitigation requires any sonar transmission to be less than 180 dB re 1 µPa (rms)(SPL) at a distance of 12 NM from any emergent land. As a result, vessels operating SURTASS LFA sonar will only operate outside of 12 NM from land, well beyond the waters of Hawaii, Guam, and the CNMI, which extend 3 NM from the coast. Therefore, no air quality analysis would be required under NEPA herein. Under EO 12114 and section 10-3.24 of the OPNAV M-5090.1, significant harm occurs when a major federal action introduces a product into the global commons that is prohibited or strictly regulated in the United States because its toxic effects create a serious public health risk; or a product that is strictly regulated or prohibited in the United States because it is radioactive. The Proposed Action will not produce any air emissions that have the potential to cause significant harm, as defined by EO 12114 and the OPNAV M-5090-1. As a result, air quality will not be analyzed further.
- Airspace Resources – No airspace would be involved with the execution of the Proposed Action. All training and testing activities associated with use of SURTASS LFA sonar would occur in the marine environment and enlist no airspace platforms or resources.
- Marine Invertebrates – Refer to the 2019 SEIS/SOEIS for full details regarding marine invertebrate species not further considered. No new information, science, or regulations would change the 2019 SEIS/SOEIS analysis or conclusions.
- Seabirds – Refer to the 2019 SEIS/SOEIS for full details regarding seabird species not further considered. No new information, science, or regulations would change the 2019 SEIS/SOEIS analysis or conclusions.
- Sea snakes – Refer to the 2019 SEIS/SOEIS for full details regarding marine sea snake species not further considered. No new information, science, or regulations would change the 2019 SEIS/SOEIS analysis or conclusions.
- Cultural Resources – The Proposed Action would not affect any marine cultural resources, such as shipwrecks, since the generation of underwater sound would not affect any cultural artifacts, nor would any equipment be deployed from the SURTASS LFA sonar vessels to the seafloor where cultural artifacts would be located.
- Geological Resources – The Proposed Action would be at-sea deployments of in-water sonar systems and related equipment that entail no deployment to the seafloor of any equipment that may cause physical disturbances to marine geological resources, including seafloor sediments.

- Hazardous Materials and Wastes – No hazardous waste or materials would be handled during the execution of the Proposed Action and no release of hazardous waste or materials is foreseeably expected as a result of the Proposed Action. Although some incidental discharges from the SURTASS LFA sonar vessels are normal for ship operations, SURTASS LFA vessels are operated in compliance with all requirements of the Clean Water Act and the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78), as implemented under the Act to Prevent Pollution from Ship (APPS; 33 U.S.C. 1901 to 1915). Operation of the SURTASS LFA sonar system itself would not result in the discharge of pollutants regulated under the APPS. Under the Clean Water Act, all discharges will comply with the Uniform National Discharge Standards; no unregulated environmental effects would occur in association with the operation of the SURTASS LFA sonar vessels.
- Infrastructure – Maintenance, repair, and porting to access ship staff associated with the Proposed Action require no expansion or alteration to any shore facilities. No changes to support facilities are planned as part of the Proposed Action.
- Land Use – The Proposed Action would occur at sea. As such, no construction activities associated with any terrestrial resources would be conducted and the Proposed Action would not involve any activities inconsistent with current or foreseeable land-use approaches and patterns.
- Public Health and Safety – SURTASS LFA sonar would be employed for training and testing activities such that received levels would not exceed 145 dB re 1 µPa (rms) at dive sites (or in Hawaii State waters, Guam territorial waters, and CNMI territorial waters) where humans could potentially be affected by SURTASS LFA sonar transmissions unless a national security requirement exists. Employment of the SURTASS LFA sonar systems would be accomplished by skilled and trained merchant mariners and Navy personnel following all prudent safety measures. As such, no significant effects to public health and safety are reasonably foreseeable.
- Socioeconomic – The Proposed Action does not involve any activities that would contribute to changes in sociological resources such as demography, communities, or social institutions.
- Transportation – During the Proposed Action, T-AGOS vessels would make no unusual maneuvers and operate according to all maritime regulations and normal oceanic vessel operation. No effects to ocean-going ship or boating traffic would result from the training and testing activities of SURTASS LFA sonar.
- Water Resources – Only two components of water resources, marine waters and marine sediments, are germane to a Proposed Action that takes place entirely in oceanic waters. Training and testing activities of SURTASS LFA sonar would have no effect on marine sediments as all equipment would only be deployed in the marine water column. No part of the Proposed Action would affect seafloor sediments. The execution of the Proposed Action would add sound to the ambient ocean environment, and water quality may potentially be affected should pollutants be discharged from the SURTASS LFA sonar vessels into oceanic waters. As such, only the marine environment is considered further herein.

These resources have not been considered further herein.

3.1.3 Environmental Stressors

Military readiness activities that comprise the Proposed Action may produce one or more stimuli that cause stress on a resource. Each element of the Proposed Action was examined to determine its potential stressors. The term stressor is broadly used in this document to refer to an agent, condition, or other stimulus that causes stress to an organism or alters physical, socioeconomic, or cultural resources. Not all stressors affect every resource, nor do all elements of the Proposed Action produce all stressors.

The reasonably foreseeable effects of the Proposed Action were analyzed based on these potential stressors being present within range of the resource. Direct effects result when an action and a resource occur at the same time and place. Indirect effects result when a direct effect on one resource induces an effect on another resource (referred to as a secondary stressor). Indirect effects would be reasonably foreseeable because of a functional relationship between the directly affected resource and the secondarily affected resource. Cumulative effects are the incremental effects of the action added to other past, present, and reasonably foreseeable future actions.

In determining effects to the environment, both the indirect and direct effects of an action are identified and assessed. The aspects of the Proposed Action that may affect the environment are the physical and acoustic stressors for which risk of exposure is estimated below, and there are monitoring and mitigation measures proposed to reduce the likelihood of possible exposure (Chapter 4). The SURTASS component is a passive system that only receives and does not transmit any sound energy and therefore is not discussed as an acoustic stressor.

The principal stressors related to the Proposed Action are:

- Physical stressors – vessel movement, passive sonar array movement and entanglement
- Acoustic stressors – underwater vessel anthropogenic sound, underwater HF/M3 sonar anthropogenic sound, underwater LFA sonar anthropogenic sound

Although these potential stressors related to the use of SURTASS LFA sonar have been described in detail in previous SURTASS LFA environmental analyses (U.S. Department of Navy 2001, 2007b, 2012, 2017, 2019) and are incorporated herein by reference, a brief summary is provided, including how potential effects are reduced or eliminated by the operational characteristics of the Proposed Action sonar system and vessels in addition to the monitoring measures and mitigation measures (Chapter 4).

3.1.3.1 Physical Stressors

The following stressors are considered as potential physical stressors that may lead to effects associated with the Proposed Action: vessel movement, and passive sonar array movement and entanglement.

3.1.3.1.1 Vessel Movement

As described in Section 2.2.2, the Proposed Action would involve the annual use of four (Alternative 1) to a maximum of six (Alternative 2) T-AGOS vessels for training. Under Alternative 2, the Navy may deploy one additional T-AGOS vessel for at-sea sonar testing annually in the eastern portion of the Study Area. All T-AGOS vessels would travel at relatively slow speeds. When the SURTASS or LFA sonar arrays are deployed, the vessel must maintain a speed of at least 3 kt, with a typical speed of 4 kt. When not towing the SURTASS or LFA sonar arrays, T-AGOS vessels travel at maximum speeds of 10 or 12 kt. T-AGOS vessels have a catamaran-type split-hull shape and an enclosed propeller system.

Fish and sea turtles can easily sense objects such as vessels through vision and/or pressure changes (Hawkins and Johnstone 1978; Southwood et al. 2008) which allows marine species to avoid vessel strike. Additionally, slow vessel speeds reduce the likelihood of lethal collisions, especially with marine mammals (Gende et al. 2011; Vanderlaan and Taggart 2007; Wiley et al. 2011). Laist et al. (2001) noted that most severe and fatal injuries to marine mammals occurred when the vessel was traveling in excess of 14 kt; meanwhile, Vanderlaan and Taggart (2007) found that the greatest risk of a lethal strike with a marine mammal was when the vessel reached speeds of 8.6 to 15 kt. The design of the T-AGOS vessels make the potential for striking and harming a marine mammal or sea turtle very unlikely. For example, enclosed propellors, such as that of T-AGOS vessels, have been suggested to effectively reduce sharp force injuries to marine species, especially when combined with reduced speeds (i.e., 4 kt or less) (Schoeman et al. 2020). Movements of SURTASS LFA vessels are not unusual or extraordinary and are in line with routine operations of seagoing vessels. There are no documented strikes associated with SURTASS LFA-equipped vessels at sea. During vessel movement, personnel would act as lookouts for marine mammals and sea turtles within the vicinity of the vessel in accordance with monitoring and mitigation measures, which would further reduce the likelihood of vessel collision with marine species (Chapter 4).

The likelihood for T-AGOS vessels to strike a marine mammal, sea turtle, or marine fish is discountable due to the: (1) slow speed of SURTASS LFA sonar vessels when the SURTASS or LFA sonar arrays are deployed (3 or 4 kt) and when transiting (10 or 12 kt) during transit which potentially would allow marine species more time to sense vessels and swim out of the way; (2) the low densities of these species in the offshore areas where the vessels would be maneuvering; and (3) the Navy's monitoring and mitigation measures (Chapter 4) (NMFS 2017, 2019). Therefore, vessel movement will not be analyzed further herein.

3.1.3.1.2 Sonar Array Movement and Entanglement

The passive and LFA sonar arrays have minimal risk of entangling or striking a marine species. When the SURTASS VLA and HLA are being towed by a T-AGOS vessel, the vessel is traveling at a slow speed of 3 to 4 kt which would potentially allow marine species more time to sense objects and swim around them. Additionally, slow vessel speeds reduce the likelihood of collision with species (Section 3.1.3.1.1). The potential for any animal to be struck by, or entangled in, the arrays are discountable (NMFS 2017), as the slow tow speed would provide sufficient time for a marine animal to move and avoid the arrays if they were in close proximity. Furthermore, the LFA sonar array is rigid making entanglement extremely unlikely. For these reasons, entanglement or strike from the towed passive and LFA sonar arrays will not be analyzed further.

3.1.3.2 Acoustic Stressors

A background of acoustic terminology and concepts that may be used to further understand acoustic stressors can be found in Appendix B, Acoustic Impacts Supporting Information.

3.1.3.2.1 Underwater Vessel Sound

The ambient sound environment in both the Pacific and Indian Oceans are dominated by anthropogenic sound associated with ships (Miksis-Olds and Nichols 2016). Most of the underwater sound generated by ships is LF (less than 1 kHz), with a large portion of ship sound resulting from propeller cavitation that dominates the 50 to 150 Hz frequency range (Ross 1976). Ship anthropogenic sound is a result of the type of engine and propeller systems used as well as ship speed. Generally, larger (greater than 328 ft [100 m]), faster moving vessels generate more intense LF underwater sound than smaller, slower moving vessels or boats (Frankel and Gabriele 2017; Richardson et al. 1995; Southall et al. 2018).

Most research on ship sound is from large vessels, fishing vessels, or small boats (Hildebrand 2009; Richardson et al. 1995; Southall et al. 2018). Little to no research is available on the size class and hull design (catamaran hull) of the Navy's SURTASS LFA sonar vessels. SURTASS LFA sonar vessels range in size from 235 to 282 ft (72 to 86 m) in length (U.S. Department of Navy 2021). Vessels travel at speeds of

3 to 10 or 12 kt (U.S. Department of Navy 2021). Similarly-sized vessels are individual merchant ships (lengths of 276 to 400 ft [84 to 122 m]) that travel at speeds of 10 to 15 kt (NRC 2003). Measured ship SLs for merchant ships range from 161 decibels referenced to 1 micropascal squared (dB re 1 μPa^2) per Hz at 1 m around 10 Hz to 137 dB re 1 μPa^2 per Hz at 1 m around 300 Hz (NRC 2003).

SURTASS LFA sonar vessels are designed to generate minimal underwater noise which is imperative for the vessels purpose in detecting quiet, submersed vessels (Yankaskas and Slotwinski 1995). The specialized small waterplane area twin hull (catamaran-like) design and encased propeller system of the T-AGOS vessels produce less sound than other seagoing vessel hull or propeller designs (Forecast International 2000; Yankaskas and Slotwinski 1995). Thus, while the T-AGOS vessels produce some underwater sound, the relatively slow speeds at which the vessels typically operate and their specialized design and function likely result in the addition of less sound to the ambient underwater soundscape than various other ocean-going vessels (Forecast International 2000; Yankaskas and Slotwinski 1995). The potential effects of underwater vessel sound that are associated with the Proposed Action are addressed in the relevant resource analyses.

3.1.3.2.2 Underwater High-Frequency Marine Mammal Monitoring Sonar (HF/M3)

The HF/M3 sonar is a Navy-developed, enhanced 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 mitigation zone (2,000 yd [1.8 km]) (Section 2.1.1.3). The HF/M3 sonar and its operating protocols were designed to minimize possible effects on marine species.

The SL of 220 dB re 1 µPa at 1 m (rms) is required for the HF/M3 sonar to effectively detect marine mammals (and possibly sea turtles) to the extent of the 180 dB re 1 µPa LFA sonar mitigation and buffer zones under the most adverse oceanographic conditions (low echo return and high ambient sound). The maximum HF/M3 sonar pulse is 40 milliseconds, with source frequencies from 30 to 40 kHz, and a variable duty cycle that is nominally about 3 to 4 percent. The HF/M3 sonar system is located at the top of the SURTASS LFA sonar VLA, typically about 328 ft (100 m) below the sea surface.

The operating profile of the HF/M3 sonar and the high transmission loss of its HF signals (i.e., over 40 decibels [dB] of transmission loss in the first 100 m [328 ft] of the HF/M3 source) together reduce the possibility for the sonar to affect marine mammals and sea turtles. The HF/M3 operating profile detects marine mammals and sea turtles, enabling operators to take proper actions before effects occur to these species. The HF/MS sonar's high transmission loss would reduce sound intensity reaching marine mammals and turtles, lowering the likelihood of behavioral and hearing effects. Additionally, the HF/M3 sonar's frequency is not in the range of best hearing frequencies for mysticetes, pinnipeds, or sea turtles. It is within the best hearing range for odontocetes. However, the required ramp-up period from a SL of 180 dB re 1 µPa rms at 1 m in 10-dB increments to full power is designed to provide sufficient time for a marine mammal, such as an odontocete that can hear the HF/M3 signal, to move away from the vessel and the transmitting HF/M3 sonar. Effects from the HF/M3 sonar system are qualitatively analyzed for marine mammals.

3.1.3.2.3 Underwater Low Frequency Active Sonar System

The transmission of LF signals by the SURTASS LFA sonar system may affect the marine environment and biological resources within the Study Area. The characteristics of the signals transmitted by SURTASS LFA sonar and its operating profile are described in Section 2.1.1.4 and must be considered in determining the potential for effects on the marine environment and biological resources. SURTASS LFA training or testing activities would not be conducted within the CSR. Effects from the SURTASS LFA sonar system are qualitatively analyzed for fish and sea turtles and are quantitatively analyzed for marine mammals.

3.2 Acoustic Marine Environment

The marine environment includes the oceans associated with the Proposed Action. This section discusses common ambient sound sources currently found within the Study Area.

3.2.1 Affected Environment

Ambient sound is the typical or persistent background sound that is part of an environment and is a composite of sounds from multiple sources, including environmental, biological, and anthropogenic activities (Hildebrand 2009; Urick 1983). Anthropogenic LF sources of sound in the Study Area include shipping sound; oil and gas exploration (e.g., seismic airgun activity); and renewable energy (e.g., wind farms) (Hildebrand 2009). Sound generated by wind stress and biologically-produced (e.g., fish, marine mammals) sounds are some of the primary contributors to the natural ambient underwater soundscape in the LF range (Au and Hastings 2008; Dahl et al. 2007; NRC 2003; Yang et al. 2023).

The sound produced by shipping activity is the dominant source of anthropogenic underwater sound in the oceans. Shipping sound has frequencies centered from 10 to 200 Hz, but the sound may exceed 1 kHz (Dahl et al. 2007; Hildebrand 2009; Possenti et al. 2024; Zhang et al. 2020). Ambient sound in the deep ocean is commonly referenced to have increased by 3 dB per decade, or 0.55 dB per year, due to shipping, based on data from the 1950s and 1960s from the Northeast Pacific (outside of the Study Area) (Ross 1976, 1993). This prediction holds true in the Indian Ocean, as noise in the LF band (5 to 115 Hz) has increased 2 to 3 dB over the past decade largely due to an increase in shipping (Miksis-Olds et al. 2013).

In some ocean regions, sound generated by seismic airgun surveys dominate the ambient sound environment. Seismic airgun frequencies are mainly below 125 Hz, but their sounds range in frequency from 5 to 300 Hz (Han et al. 2023; Hildebrand 2009; Miksis-Olds and Nichols 2016). In 2012, seismic airgun signals were found to be a dominant source of sound off the north end of Diego Garcia in the Indian Ocean (Miksis-Olds and Nichols 2016).

Natural ambient underwater sound also contributes to the rising oceanic ambient sound level in the LF range (Au and Hastings 2008; Dahl et al. 2007; NRC 2003; Yang et al. 2023). For instance, mysticetes typically emit signals with fundamental frequencies well below 1 kHz (Au et al. 2006; Cerchio et al. 2001; Munger et al. 2008). Wind can generate underwater sound by creating surface waves, air bubbles, and by detaching water droplets (Hildebrand et al. 2021; NRC 2003). The effect of wind on ambient sound can shift with season. Širović et al. (2016) found that off Saipan, CNMI, wind was the dominant underwater sound source during the winter and spring. In Kona, Hawaii, the wind also influenced the underwater sound during the winter and was considered a dominant noise source during this season along with sound produced by humpback (*Megaptera novaeangliae*) and fin whales (*Balaenoptera physalus*) (Širović et al. 2016). However, vessels attributed to the majority of underwater noise at both sites during the summer months (Širović et al. 2016).

Underwater sound propagation, and thus underwater ambient sound, is influenced by a variety of abiotic factors, including water depth, topography of the environment, pH, salinity, temperature, and pressure (Brewer and Hester 2009; Erbe and Thomas 2022). For example, as rising carbon dioxide (CO_2) levels lead to ocean acidification, a reduction in sound absorption in the LF band is expected (Brewer and Hester 2009). A decrease in ocean acidity of about 0.45 pH would result in a decrease in sound absorption by approximately 50 percent for frequencies below 1 kHz (Brewer and Hester 2009; DOSITS 2021). As a result, LF sound would have to travel twice as far to lose the same amount of energy to absorption. The way in which abiotic factors influence sound propagation differs in shallow water (656 ft [200 m] or less) compared to deep water (greater than 656 ft [200 m]), as these abiotic factors are more variable in shallow water (DOSITS 2021; Haxel et al. 2013; McDonald et al. 2008; Veeriayan and Rajendran 2021).

A comprehensive overview of oceanic ambient sound can be found in Au and Hastings (2008), Richardson et al. (1995), and Urick (1983). Previous SURTASS LFA environmental analyses presented information on the natural and anthropogenic components of ambient ocean sound (U.S. Department of Navy 2001, 2012, 2017, 2019). Since the information presented therein remains valid and pertinent, it is incorporated by reference in this SEIS/OEIS.

3.2.2 Environmental Consequences

This section evaluates how and to what degree the activities described in Chapter 2 potentially affect the marine environment within the Study Area. The information below builds on the analyses previously conducted in the Navy's past analyses for SURTASS LFA sonar, which is incorporated herein by reference. The only stressor analyzed is the acoustic stressor: underwater SURTASS LFA. The potential effect to the marine environment due to SURTASS LFA sonar includes an increase in ambient soundscape. All physical (vessel movement, passive sonar array movement, and entanglement) or other acoustic (underwater vessel sound, and underwater HF/M3 sonar) stressors are not analyzed based on previous SURTASS LFA environmental analyses, best available science, and because negligible effects to the marine environment would be expected from these stressors (Refer to Chapter 4 in U.S. Department of Navy (2019)).

3.2.2.1 Acoustic Stressor: LFA Sonar

Previous SURTASS LFA environmental analyses analyzed potential effects of SURTASS LFA sonar on the marine environment. The information below builds on the analyses previously conducted in the Navy's past NEPA work for SURTASS LFA sonar, which are incorporated herein by reference.

3.2.2.1.1 Ambient Sound

Numerous anthropogenic sources input sound into the marine environment. SURTASS LFA sonar potentially would increase the ambient, or background, sound of the marine environment during transmissions. SURTASS LFA sonar transmissions, which typically last 60-sec per ping, would temporarily add to the ambient sound level in the frequency band 100 to 500 Hz.

Marine animals use underwater sound to sense and obtain information about the ocean environment, such as for communication, navigation, obstacle and predator avoidance, and prey detection (Erbe and Thomas 2022; Ferrara et al. 2019; Parmentier and Fine 2016; Reckendorf et al. 2023; Southall et al. 2007; Tolimieri et al. 2000). The ability for marine animals to use sound as an effective sensing medium in the ocean is dependent on the level of ambient or background sound in the marine environment, since that sound could potentially mask the animal's ability to sense (hear) sound. Masking is when the perception of a biologically important sound (i.e., signal) is interfered with by a second sound (i.e., noise). The effect of masking can vary depending on the ambient sound level within the environment, the received level and frequency of the noise, and the received level and frequency of the sound of biological interest (Clark et al. 2009; Foote et al. 2004; Parks et al. 2011; Southall et al. 2000).

Ambient sound levels would potentially increase during SURTASS LFA sonar transmissions. When ambient sound levels increase, some marine mammals that utilize the LF band for communication have been observed to employ noise compensation mechanisms. Baleen whales have been observed increasing the amplitude of their vocalizations to overcome increasing sound levels at specific frequencies; these compensation mechanisms for an increasingly noisy ocean environment in turn contribute to a slight increase in the naturally-derived component of rising ocean sound levels (Girola et al. 2023; Miksis-Olds et al. 2013). Refer to Sections 3.3.1.1, 3.4.1.1, and 3.5.1.1.3 for more information on marine animal hearing and vocalization.

SURTASS LFA sonar would annually input a low percentage of the total anthropogenic acoustic energy into the marine environment by the maximum of four (under Alternative 1) or six (under Alternative 2) T-AGOS vessels that would be present in the Study Area. Sounds produced by SURTASS LFA sonar would likely be widely dispersed throughout the Study Area; any noise would be temporary, and the affected area would be expected to return to the original state when these activities cease.

3.2.2.2 Summary of Potential Effects on the Marine Environment

3.2.2.2.1 Acoustic Marine Environment Significance Determination

As stated in Section 3.1.1, a significance determination is only required for activities that may have reasonably foreseeable adverse effects on the human environment based on the significance factors in Table 3-1. Acoustic stressors from the Proposed Action could have a reasonably foreseeable adverse effect; thus requiring a significance determination.

A stressor is considered to have a significant effect on the human environment based on an examination of the context of the action and the intensity of the effect. The effects of sonar transmissions would be considered significant if: a measurable or anticipated degree of change in the marine environment would be substantial and highly noticeable compared to existing conditions; either short-term or long-term changes are well outside the limits of natural variability in physical habitat characteristics; and/or the acoustic marine environment would be degraded over the long term or permanently such that it would no longer possess sustainable habitat requirements. If the context of the action and intensity of the effect do not reach the criteria listed above, the effects of sonar transmissions would be considered less than significant.

3.2.2.2.2 Effects under the No Action Alternative

Under the No Action Alternative, the Navy would not conduct the proposed training and testing activities in the Study Area. SURTASS LFA sonar would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.2.2.2.3 Effects under Alternative 1 (Preferred Alternative)

Alternative 1, Preferred Alternative, is described in detail in Section 2.2.2.2. Under Alternative 1, SURTASS LFA sonar would increase baseline noise conditions within the Study Area. SURTASS LFA sonar would be operated for a maximum of 1,100 hours annually across a maximum of four vessels.

The analysis of effects of how SURTASS LFA sonar would affect the acoustic marine environment under Alternative 1, Preferred Alternative, are consistent with a "less than significant" determination since a near negligible increase to the ambient soundscape is anticipated. Sonar transmissions are intermittent, occurring over a period of hours and dispersed across the entire geographic scope of the Study Area.

Pursuant to NEPA, acoustic transmissions associated with Alternative 1 would have less than significant effects on the marine environment within the Study Area. Pursuant to EO 12114, acoustic transmissions associated with Alternative 1 would not significantly harm the marine environment within the Study Area.

3.2.2.2.4 Effects under Alternative 2

Alternative 2 is described in detail in Section 2.2.2.3. SURTASS LFA sonar anthropogenic sound associated with Alternative 2 would increase baseline ambient sound conditions within the Study Area. Under Alterative 2, there would be a total of 2,490 hours of SURTASS LFA sonar transmissions annually across a maximum of six vessels.

Although activities under Alternative 2 occur at a slightly higher rate relative to Alternative 1, effects on the acoustic marine environment under Alternative 2 are not expected to be meaningfully different from those described under Alternative 1. Therefore, effects associated with the marine environment are the same as Alternative 1 with a “less than significant” determination.

Pursuant to NEPA, acoustic transmissions associated with Alternative 2 would have less than significant effects on the acoustic marine environment within the Study Area. Pursuant to EO 12114, acoustic transmissions associated with Alternative 2 would not significantly harm the marine environment within the Study Area.

3.3 Marine Fishes

3.3.1 Affected Environment

The Study Area spans two ocean basins and encompasses a wide variety of marine habitats. Fishes are not distributed evenly throughout the Study Area. In general, coastal ecosystems less than 656 ft (200 m) deep support a greater diversity of fish than the open ocean areas (Cohen 1970; Nelson et al. 2016), which is where the Proposed Action would occur; between 65 and 80 percent of global species occur in coastal waters, and open ocean areas support lower diversity and biomass of fish. Even though a smaller percentage of fish inhabit the open ocean, the Proposed Action would still have the potential to expose fishes in various life stages to SURTASS LFA sonar transmissions. Additionally, migratory fish may move into and out of the Study Area either annually or seasonally.

Given the vast and highly variable number of possible fish species in the Study Area, it is not feasible to describe and discuss all of the potentially occurring marine fishes individually. Species-level information is presented only for those marine and anadromous fish species, evolutionary significant units (ESUs), or distinct population segments (DPSs) listed under the ESA; this information is provided in Appendix C (Biological Resources Supplemental Information).

3.3.1.1 Fish Hearing and Sound Production

In previous SURTASS LFA environmental analyses (U.S. Department of Navy 2007a, 2012, 2017, 2019), detailed information on the hearing anatomy and measured hearing capabilities of fish were presented. Since this SEIS/OEIS builds upon that foundational information, only a basic overview of fish hearing and capabilities is presented here in addition to any recent scientific advances in fish hearing.

Although many researchers have investigated hearing and vocalization of fish species, hearing capability data only exist for a relatively small percentage of species (just over 100 out of the approximately 36,600 marine and freshwater fish) (Fricke et al. 2024; Ladich and Fay 2013; Popper 2023). The current data suggest that most fish species detect sounds from 50 Hz to 1 kHz, with best hearing sensitivity from 100 to 400 Hz (Popper 2003). Some fish possess morphological adaptations or specializations that can enhance their sensitivity to sound pressure and are able to hear sounds above 1 kHz to possibly as high as 180 kHz (Popper 2008; Popper et al. 2019). Based on the best hearing sensitivity of fish, SURTASS LFA sonar transmissions would be expected to be within the hearing range of most species of marine and anadromous fish.

All fish have two sensory systems to detect sound in the water: the inner ear, which functions very much like the inner ear in other vertebrates, and the lateral line, which consists of a series of receptors along the fish's body (Popper and Hawkins 2020; Popper and Schilt 2008). The lateral line system is sensitive to external particle motion arising from sources within a few body lengths of the animal (Popper et al. 2014). The lateral line detects particle motion at low frequencies from less than 1 Hz up to about 200 Hz (Coombs and Montgomery 1999; Hastings and Popper 2005; Higgs and Radford 2013; Popper et al. 2005a; Webb et al. 2008). The inner ears of fishes are directly sensitive to acoustic particle motion rather than acoustic pressure. The ear detects sounds from hundreds to thousands of Hz, depending on the species (best sensitivity 100 to 400 Hz) (Popper 2008; Slabbekoorn et al. 2010).

Some species of fish with a swim bladder are more sensitive to underwater sound since they can detect particle motion and sound pressure. A fish's swim bladder can enhance sound detection by converting acoustic pressure into localized particle motion, which may then be detected by the inner ear (Radford et al. 2012; Rogers et al. 2023). Fish with swim bladders generally have better sensitivity and better HF hearing than fish without swim bladders (Popper 2014; Popper and Hastings 2009; Rogers et al. 2023). For example, clupeiformes, which possess a swim bladder, are able to detect sounds to about 4 kHz (Colleye et al. 2016; Mann et al. 2001; Mann et al. 1997), whereas elasmobranchs (i.e., sharks and rays), which do not have a swim bladder, have a lower hearing range up to roughly 1 kHz (Casper and Mann 2009; Mickle et al. 2020). Structures such as gas-filled bubbles near the ear or a swim bladder increase sensitivity and allow for HF hearing capabilities and better sound pressure detection. Connections between the swim bladder and the inner ear also enhance hearing capabilities and sound pressure detection. One subfamily of clupeids (i.e., alosinae) can detect HF (10 to 100 kHz) and very high-frequency (VHF; above 100 kHz) sounds (Mann et al. 1997; Popper et al. 2022).

Based on this information above, fishes can be categorized by possession of similar anatomical features that affect their hearing capabilities and sensitivity (Popper and Fay 2011). The categories of fishes included are listed in Table 3-2 (Reviewed in: Popper et al. (2014)).

Fish not only detect sound but also produce sound. More than 109 families of fish are noted for producing sound, with most vocal fish producing LF sounds between 100 and 300 Hz (Ladich 2019; Rice et al. 2022; Rountree et al. 2003). Fish produce sounds in a variety of ways, such as by sonic muscles on or near the swim bladder, rubbing or striking of skeletal elements, grinding of teeth, or fast jaw slams (Fine and Parmentier 2015; Kasumyan 2008; Parmentier et al. 2007; Putland et al. 2019). Fish often produce sound under the following conditions: (1) they are alarmed or presented with harmful stimuli (Ladich 1997; Myrberg 1981; Pereira et al. 2020); (2) during the mating season for courtship, spawning, and defending territories (Fine and Parmentier 2015; Monczak et al. 2022; Pereira et al. 2014; Putland et al. 2019); (3) to maintain school or shoal cohesion (Van Oosterom et al. 2016); and (4) for purely social communication (Parmentier and Fine 2016; Rice et al. 2022).

Table 3-2. Categorization of Fish by Anatomical Features that Affect their Hearing Capabilities

Category	*Examples of fish that fit into the category*	*Description*	*Frequency Range*	*References*
No swim bladder or other gas chamber	elasmobranchs, paddlefish, some tuna	Hearing is limited to particle motion detection frequencies	Below 1 kHz	(Ladich and Fay 2013; Popper et al. 2014)
Swim bladder that is not involved in hearing	salmonids, sturgeon	Lack the anatomical hearing specializations and principally detect particle motion	Below 1 kHz potentially up to 1 kHz	(Ladich and Fay 2013; Popper and Calfee 2023; Popper et al. 2014; 2019)
Swim bladder or gas chamber involved in hearing	carp, sardines, anchovies, Pacific herring	Possess anatomical specializations that enhance hearing and can detect sound pressure	Below 1 kHz up to 5 kHz	(Ladich and Fay 2013; Mann et al. 2005; Popper et al. 2014)
Swim bladder and HF hearing	knifefish, shad[1]	Possess anatomical specializations that allows detection of ultrasonic stimulation and are capable of sound pressure detection	Below 1 kHz, from 10 to over 100 kHz, and possibly as high as 180 kHz	(Higgs et al. 2004; Ladich and Fay 2013; Mann et al. 2001; 1998)

HF = high-frequency; kHz = kilohertz

[1]These fish likely do not occur within the Study Area but rather serve as an example of fish with HF hearing.

3.3.1.2 Threatened and Endangered Marine and Anadromous Fish Species

Some of the ESA-listed fish that occur in the Pacific or Indian Oceans do not meet the criteria for co-occurrence with SURTASS LFA sonar usage. These fishes occur in inland, inshore, or very shallow coastal waters where SURTASS LFA sonar would not be ensonified and where fish would be protected by the coastal-standoff-range mitigation measures[6]. The ESA-listed marine and anadromous fish species that are excluded from further consideration on this basis are discussed in Table 3-3.

[6] While ESA allows for species to be listed based on best available scientific and commercial information in locations outside the U.S., the U.S. has limited jurisdiction (particularly in foreign territorial waters) to take action subsequent to listing. 50 CFR 402.02 indicates that interagency consultation under section 7 applies to actions carried out in the United States and high seas.

Table 3-3. ESA-listed Foreign Fish Species within the Study Area but Excluded for Further Consideration Due to Lack of Overlap with Proposed Stressors of Fishes

Common Name (Scientific Name)	*ESA Listing*	*Distribution*	*References*
Chinese sturgeon (*Acipenser sinensis*)	Endangered	Found within the middle and lower Yangtze River and coastal areas in the East China and Yellow Seas	79 FR 31222 (June 2, 2014); (Chang et al. 2021; NOAA 2025a)
Dwarf sawfish (*Pristis clavata*)	Endangered	Range is restricted to the shallow waters of coasts and estuaries of northern and northwestern Australia	79 FR 73977, (December 12, 2014); (NOAA 2025b; Stevens et al. 2008)
Green sawfish (*Pristis zijsron*)	Endangered	Mainly found along the northern coast of Australia; suitable habitat exists throughout the Indo-Pacific region, but there's insufficient records to determine presence	79 FR 73977 (December 12, 2014); (Harry et al. 2022; NOAA 2025c)
Kaluga sturgeon (*Huso dauricus*)	Endangered	Occur in the lower reaches of the Amur River in Russia and China and in coastal waters of the Sea of Okhotsk and Sea of Japan	79 FR 31222 (June 2, 2014); (Koshelev et al. 2014; NOAA 2025d)
Largetooth sawfish (*Pristis pristis*)	Endangered	Found in the Indo-Pacific region (Australia and southeast Asia); inhabit marine coasts, freshwater lakes, oxbow lakes, and rivers	79 FR 73977, (December 12, 2014); (Dineshbabu and Muniyappa 2005; NOAA 2025e)
Narrow sawfish (*Anoxypristis cuspidata*)	Endangered	Found in western Indo-Pacific region; live mainly in inshore waters to areas of 131 ft (40 m) in depth	79 FR 73977, (December 12, 2014); (Haque et al. 2023; Last and Stevens 2009; Pogonoski et al. 2002)

ESA = Endangered Species Act; ft = feet; m = meters; FR = Federal Register

Eight species of marine and anadromous fishes listed under the ESA may occur in the Study Area (Table 3-4). Populations of many ESA-listed fish species have been delineated into DPSs or ESUs. For a full write-up for each species, see Appendix C (Biological Resources Supplemental Information). No marine or anadromous fish species with potential occurrence in the Study Area are currently proposed for listing under the ESA.

Table 3-4. ESA-listed Marine and Anadromous Fishes that Potentially Occur in the Study Area

Species	Endangered Species Act Listing Status		Occurrence in Study Area
	Threatened	Endangered	
Chum salmon (*Oncorhynchus keta*)	Columbia River ESU; Hood Canal Summer-Run ESU	-	North Pacific Ocean
Coho salmon (*Oncorhynchus kisutch*)	Lower Columbia River ESU; Oregon Coast ESU	-	North Pacific Ocean
Giant manta ray (*Mobula birostris*)	Throughout Its Range	-	Throughout the Study Area south of approximately 40.45º N latitude
Oceanic whitetip shark (*Carcharhinus longimanus*)	Throughout Its Range	-	Throughout the Study Area between approximately 30°N and 35°S latitudes
Sakhalin sturgeon* (*Acipenser mikadoi*)	-	Throughout Its Range	North Pacific Ocean
Scalloped hammerhead shark (*Sphyrna lewini*)	Indo-West Pacific DPS	-	Indo-West Pacific Ocean
Sockeye salmon (*Oncorhynchus nerka*)	Lake Ozette ESU	Snake River ESU	North Pacific Ocean
Steelhead (*Oncorhynchus mykiss*)	California Central Valley DPS; Central California Coast DPS; Lower Columbia River DPS; Middle Columbia River DPS; Northern California-Coast DPS; Puget Sound DPS; Snake River Basin DPS; Upper Columbia River DPS; Upper Willamette River DPS	-	North Pacific Ocean

°N = degrees North latitude; °S = degrees South latitude; DPS = Distinct Population Segment; ESU = Evolutionary Significant Unit; * = ESA-listed Foreign Species

3.3.2 Environmental Consequences

This section evaluates how and to what degree the activities described in Chapter 2 potentially affect marine and anadromous fish known to occur within the Study Area. The information below builds on the analyses previously conducted in the Navy's past NEPA work for SURTASS LFA Sonar, which are incorporated herein by reference. The only stressor analyzed herein is underwater SURTASS LFA sonar. All physical (vessel movement, passive sonar array movement, and entanglement) or other acoustic stressors (underwater vessel sound and underwater HF/M3 sonar) are not analyzed because based on previous SURTASS LFA environmental analyses and best available science, negligible effects to fish are expected from these stressors (Refer to Chapter 4 in U.S. Department of Navy (2019)). The potential effects analyzed for fish due to the acoustic stressor, SURTASS LFA sonar, include the following: non-auditory effects, auditory effects, behavioral changes, masking, and physiological stress. These potential effects are discussed below.

3.3.2.1 Acoustic Stressor: SURTASS LFA Sonar

This section contains a summary of the research that examined the response of fish to LF sonar signals, including research specific to SURTASS LFA, with additional focus on research that has been published since the 2019 SEIS/SOEIS. The 2019 SEIS/SOEIS frequently used the American National Standards Institute (ANSI) sound exposure guidelines for fish (herein referred to as the ANSI Sound Exposure Guideline technical report) to assist in the analysis of effects to fish from the action alternatives (Table 3-5). Thus, thresholds and relative risk factors presented in the ANSI Sound Exposure Guideline technical report are summarized in the analysis of potential effects below. The potential effects from the action alternatives are based on the analysis of available literature related to each type of potential effect.

Table 3-5. Summary of Fish Exposure Thresholds for Low Frequency Sonar

Fish Hearing Group	*Recoverable Injury*	*TTS[3]*	*Masking*	*Behavior*
No swim bladder (particle motion detection)	(N)[1] Low (I) Low (F) Low	NC	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low
Swim bladder not involved in hearing (particle motion detection)[2]	> 218 SEL_{cum}	> 210 SEL_{cum}	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low
Swim bladder involved in hearing (primarily pressure detection)[2]	> 218 SEL_{cum}	210 SEL_{cum}	(N) Moderate (I) Low (F) Low	> 197 SPL_{rms}
Swim bladder involved in hearing and HF hearing sensitivity[3]	NA	210 SEL_{cum}	NA	NA

HF = high-frequency; N = near; I = intermediate; F = far; > = the given effect would occur above the reported threshold; SEL_{cum} = cumulative sound exposure level is measured in decibel referenced to 1 micropascal squared per second [dB re 1 µPa^2-s]); SPL_{rms} = root mean squared sound pressure level is measured in dB re 1 µPa; NA = information not available; TTS = temporary threshold shift; NC = no criteria are reported because effects from exposure to sonar are considered to be unlikely.

[1] Popper et al. (2014) states that distances should not be defined due to many variables influencing the distance effects are experienced, but if distances must be applied these distances might include (N) = tens of meters from the source, (I) = hundreds of meters from the source, and (F) = thousands of meters from the source.

[2] Popper et al. (2014) reports the thresholds in SPL_{rms} for mortality and potential mortal injury; and recoverable injury. The thresholds are based on studies by Kane et al. (2010) and Popper et al. (2007), although these papers focused primarily on mid-frequency active (MFA) sonar and not LFA. For easier comparison among thresholds, the SEL_{cum} values are used from Kane et al. (2010) and Popper et al. (2007) rather than the SPL_{rms} values.

[3] The Navy's draft EIS/OEIS for Hawaii- California Training and Testing (U.S. Department of Navy 2024a) rounded down the threshold for TTS from Popper et al. (2014) from exposure to LF sonar for all fish hearing groups with a swim bladder to a SEL_{cum} of 210 as a conservative measure, and the Navy has elected to do the same here.

References: (Doksæter et al. 2009; Kane et al. 2010; Popper et al. 2007; 2005a; 2014; U.S. Department of Navy 2024a)

3.3.2.1.1 Non-Auditory Effects

Non-auditory effects include direct acoustic effects on tissues or organs of a fish. Non-impulsive sound sources, such as sonar, have not been known to cause direct injury or mortality to fish (Kane et al. 2010; Popper et al. 2007; Popper et al. 2005a; Popper and Hawkins 2019). Various fish species have been exposed to LFA sonar signals in captive or laboratory settings and tested for direct injuries (Kane et al. 2010; Popper et al. 2007; Popper et al. 2005a). Examination of organs and tissues did not show any evidence of hemorrhage or rupture of organs or tissues (Kane et al. 2010; Popper et al. 2007; Popper et al. 2005a). Additionally, studies analyzed survival and/or behavior of the exposed fish and found that they swam normally after exposure, and no mortality occurred from approximately two hours to up to four days post-exposure (Kane et al. 2010; Popper et al. 2007; Popper et al. 2005a). No new studies of non-auditory effects to fish have been published since the 2019 SEIS/SOEIS that are relevant to LFA sonar.

As summarized in the ANSI Sound Exposure Guideline technical report (Popper et al. 2014), fish that lack swim bladders would have a low chance of mortality or potential injury from LF sources. Fish with swim bladders that are not involved or are involved in hearing do not show evidence of effect to the ear or non-auditory tissues when exposed to the rms pressure of 193 dB re 1 µPa; 218 cumulative sound exposure level (SEL_{cum}), which is measured in decibel referenced to 1 micropascal squared per second [dB re 1 μPa^2-s]) or less for LFA sonar (based on studies by Kane 2010; Popper et al. 2007) (Table 3-5). Non-auditory effects to fish from SURTASS LFA sonar are not expected because of the following: LFA sonar lacks the fast rise times, high peak pressures, and high acoustic impulse that could lead to mortality or injury in fish; fish exposed to LFA sonar signals in captive small exposure areas (that are likely unrealistic compared to field conditions) have not shown signs of non-auditory injury; and fish are mobile species that can easily swim out of the region of exposure.

3.3.2.1.2 Auditory Effects

Auditory effects include direct effects to fish hearing such as a temporary threshold shift (TTS) and permanent hearing loss. TTS is a temporary, recoverable loss of hearing sensitivity. A TTS may last several minutes to several weeks, and the duration may be related to the intensity of the sound source and the duration of the sound (including multiple exposures). Permanent hearing loss may be caused by the death of sensory hair cells in the ear, damage to auditory nerves, or damage to other tissues, such as the swim bladder, that may be part of the auditory pathway (Liberman 2016; Popper et al. 2014). However, the sensory hair cells of the inner ear in fish are regularly replaced over time when they are damaged (Breitzler et al. 2020; Popper et al. 2014; Popper et al. 2005b; Smith et al. 2006). As a consequence, auditory injury (AINJ)[7] has not been known to occur in fish and any hearing loss in fish may be as temporary as the timeframe required to repair or replace the sensory cells that were damaged or destroyed (Popper et al. 2014; Popper et al. 2005b; Smith et al. 2006). Therefore, AINJ is not further discussed.

Multiple studies have measured the effects of sound exposures from LFA sonar both immediately after exposure and up to several days thereafter. Maximum received SPLs were 193 dB re 1 µPa rms for 324

[7] The 2019 SURTASS SEIS/SOEIS used permanent threshold shift (PTS) to describe auditory injury that never recovered; however, this classification has since changed and is now considered AUD INJ (NMFS 2024), which the Navy also refers to as AINJ in this SEIS/OEIS (U.S. Department of Navy 2025).

or 648 sec (218 or 221 SEL_{cum} respectively) at frequencies ranging from 170 to 320 Hz (Kane et al. 2010; Popper et al. 2007) and 195 dB re 1 µPa rms for 324 sec (220 SEL_{cum}) in a follow-on study (Halvorsen et al. 2013). Two species with a swim bladder not involved in hearing, the largemouth bass (*Micropterus salmoides*) and yellow perch (*Perca flavescens*), showed no loss in hearing sensitivity from sound exposure immediately after the test and 24 hours later (Halvorsen et al. 2013; Ladich 2023)**.** All channel catfish (*Ictalurus punctatus*), a fish with a swim bladder involved in hearing, and some of the tested rainbow trout (*Oncorhynchus mykiss*), a fish with a swim bladder not involved in hearing, showed a threshold shift (up to 20 dB of hearing loss) immediately after exposure to the LF sonar when compared to baseline and control animals (Halvorsen et al. 2013; Popper et al. 2007). Small threshold shifts, 4 and 5 dB at 800 Hz and 1.6 kHz, respectively, were detected for up to 24 hours after the experiment in some channel catfish (Halvorsen et al. 2013). Although some rainbow trout showed signs of hearing loss, another group showed no hearing loss. The different results between rainbow trout test groups may be due to development or genetic differences in the various groups of fish (Popper et al. 2007). Catfish hearing returned to pre-testing conditions, or close to pre-testing conditions, within approximately 24 hours of exposure to LFA sonar (Halvorsen et al. 2013; Ladich 2023). Kane et al. (2010) examined the inner ears of catfish exposed to LFA sonar during necropsy and found no differences from the control groups in ciliary bundles or other features indicative of hearing loss. The maximum time fish were held post-exposure before being euthanized was 96 hours (Kane et al. 2010).

Some studies have suggested that there may be some loss of sensory hair cells due to high intensity sources, indicating a loss in hearing sensitivity; however, none of those studies concurrently investigated the subjects' actual hearing range after exposure to these sources. Enger (1981) found loss of ciliary bundles of the sensory cells in the inner ears of Atlantic cod (*Gadus morhua*) following one to five hours of exposure to pure tone sounds between 50 and 400 Hz with a SPL of 180 dB re 1 µPa. Hastings et al. (1996) demonstrated damage to some sensory hair cells in oscars (*Astronotus ocellatus*) one to four days following a one-hour exposure to a pure tone at 300 Hz with a SPL of 180 dB re 1 µPa, but no damage to the lateral line was observed. Oscars had a relatively small percentage of total hair cell loss from hearing organs despite long duration exposures. Effects from long-duration noise exposure studies are generally informative; however, they are not necessarily a direct comparison to effects from intermittent short-duration sounds generated during Navy activities involving sonar.

As noted in the ANSI Sound Exposure Guideline technical report (Popper et al. 2014), some fish species with a swim bladder involved in hearing may be more susceptible to TTS from high-intensity non-impulsive sound sources, such as sonar, depending on the duration and frequency content of the exposure. Popper et al. (2014) defined a threshold of 193 dB re 1 µPa rms for TTS for fish with a swim bladder. The threshold of 193 dB re 1 µPa rms is based on the studies by Kane et al. (2010) and Popper et al. (2007) discussed above that had a SEL_{cum} of 218 and 221, respectively. In addition, Halvorsen et al. (2013) found TTS when fish were exposed to 215 SEL_{cum}. However, other fishes showed no loss in hearing sensitivity from LF sound exposure (Halvorsen et al. 2013; Ladich 2023)**.** Because the results were variable, and because most fishes are sensitive to LF sound, the Navy's threshold for TTS from exposure to LF sonar for all fishes with a swim bladder was rounded down to a SEL_{cum} of 210 (U.S. Department of Navy 2024a) (Table 3-5). Furthermore, based on available data and the assumption that generalists are less susceptible to hearing loss than specialists, the onset of TTS is presumed to occur above this proposed threshold for hearing generalists (as evident by the greater than sign) (U.S. Department of Navy 2024a) (Table 3-5).

Although the results were variable, it can be assumed that TTS may occur in fish within the same hearing groups at similar exposure levels. The Navy (2024a) stated that fishes with HF hearing sensitivity may exhibit TTS from exposure to LF sonar at 210 SEL_{cum} (Table 3-5), and the Navy uses the same value here.

Although no new studies of auditory effects to fish have been published since the 2019 SEIS/SOEIS that are relevant to LFA sonar, Smith and Popper (2023) reviewed previous studies on TTS, including those discussed above. Smith and Popper (2023) ultimately determined that based on current data, TTS does not need to be considered when developing sound exposure criteria for fish because TTS is not likely to occur in fish when exposed to anthropogenic sound. Some of the points argued include the following: studies that reported TTS, exposed fish to intense sounds that fish would swim away from when subjected to in their natural environment; sound levels decrease as the distance from a source increases; and when TTS has been reported to occur in fish, it has occurred at such small levels that it would not be projected to effect the fitness or survival of a species (Smith and Popper 2023).

The potential for TTS is limited based on the points argued by Smith and Popper (2023). Additionally, the LFA sound used in the studies discussed above (Halvorsen et al. 2013; Kane et al. 2010; Popper et al. 2007) can be considered “worst-case” exposure, as fish received LFA sound for a total of 324 or 648 sec. The SURTASS LFA sonar source is a moving ship. A fish in one location will only receive maximum ensonification for a few seconds (depending on the ship speed and whether the fish is moving or not, and its direction of motion and speed). After the boat passes over or near the fish, the sound level would become much lower, especially if the fish were swimming away from the active sound source. If TTS does occur, fish are expected to recover in a few minutes to a few days. Overall, there is minimal potential for auditory effects to fish within the Study Area.

3.3.2.1.3 Behavioral Changes

Studies of fish have identified the following basic behavioral reactions to sound: alteration of natural behaviors (e.g., startle or alarm) and avoidance (Cox et al. 2018; McCauley et al. 2000). Fish must be able to detect a sound above its hearing threshold and above the ambient sound level before a behavioral reaction can potentially occur. Because most fish species can hear LF sounds (Popper 2003), they would be expected to be able to hear the LF sonar associated with the Proposed Action.

Popper et al. (2007; 2005a) recorded the behavioral reactions of rainbow trout and channel catfish to LFA sonar signals in a large experimental test tank (refer to, U.S. Department of Navy 2007a, Section 4.1.1.3, for Popper et al. unpublished results). Rainbow trout responded to the initial onset of sonar signals by showing a rapid burst of swimming (direction not specified). However, fish quickly returned to their pre-stimulus behavior for the duration of the sound presentation, even when the specific components of the sound changed. Channel catfish, in contrast, showed an initial startle response (rapid movement over a short distance; the direction was not specified) and then moved to the bottom of the test tank, where most fish oriented themselves toward the sound source. Channel catfish generally stayed in that position for the duration of the signal. Furthermore, they would show a startle response each time the specific sound changed. As soon as the sound was turned off, fish resumed pre-stimulus patterns of swimming. Popper and Hastings (2009) noted that the behavioral responses of these fish likely would have differed if fish were not restrained in test tanks and that the results likely lack insight into how fish exhibit behavioral responses in their natural environment. It is common for studies that address behavioral and physiological response to aquatic sound to occur in laboratory settings; Cox et al. (2018) conducted a meta-analysis on 42 studies and found that 36 occurred in a laboratory setting. Therefore, responses of fish to sounds in their natural environment are less well understood.

There is evidence that elasmobranchs (cartilaginous fish including sharks and rays) also respond to LF anthropogenic sounds. Studies have showed that various shark species were attracted to irregularly pulsed LF sounds (below several hundred Hz) in the same frequency range of sounds that might be produced by struggling prey (Casper et al. 2012; Myrberg et al. 1976; Myrberg Jr et al. 1969; Myrberg Jr et al. 1972; Nelson and Johnson 1972). However, abrupt and irregular anthropogenic sound (200 Hz—10 kHz, with most energy below 1 kHz) resulted in withdrawal responses of certain shark species (Chapuis et al. 2019).

The ANSI Sound Exposure Guideline technical report (Popper et al. 2014) suggests that fish with no swim bladder or a swim bladder not involved in hearing have a low probability of a behavioral response for any distance near, intermediate, or far from an LF sonar source (Table 3-5). For fish with a swim bladder involved in hearing, a threshold of greater than 197 dB re 1 µPa rms was defined. Fish would need to be in close proximity, likely less than 0.6 miles (mi; 1 km), to the LFA sonar associated with the Proposed Action while it is transmitting to be exposed to a received SPL of greater than 197 dB re 1 µPa rms.

Overall, there is the potential for minor, temporary changes in behavior among fish, including increased swimming rate, avoidance of the sound source, or changes in orientation to the sound source. However, these responses would occur only for fish with a swim bladder involved in hearing within close proximity to the sound source (0.6 mi [1 km]). If behavioral effects were to occur, they would be localized and infrequent due to the transient nature of the vessels transmitting LFA sonar associated with the Proposed Action, and reactions would only last a few seconds or minutes. Long-term consequences for fish populations are not expected based on the minor nature and short duration of the behavioral effects; and the low level and short duration of potential exposure to SURTASS LFA sonar.

3.3.2.1.4 Masking

Masking due to sonar has not been studied for fish. In general, masking is when the presence of a noise interferes with a fish's ability to hear biologically important sounds. Masking could lead to potential fitness costs depending on the severity of the reaction (Radford et al. 2014; Slabbekoorn et al. 2010). For example, masking could result in changes in predator-prey relationships by potentially inhibiting a fish's ability to detect predators and, therefore, increasing its risk of predation (Astrup 1999; Mann et al. 1998; Simpson et al. 2015; Simpson et al. 2016). Masking may limit the distance over which fish can communicate or detect important signals (Codarin et al. 2009; Ramcharitar et al. 2001; Ramcharitar et al. 2006), including sounds emitted from a reef for navigating larvae (Higgs 2005; Neenan et al. 2016). If the masking signal is brief (a few seconds or less), biologically important signals may still be detected, resulting in little effect to the individual. If the signal is longer in duration (minutes or hours) or overlaps with important frequencies for a particular species, more severe consequences may occur, such as the inability to attract a mate and reproduce. Holt and Johnston (2014) exposed fish to elevated sound levels and were the first to demonstrate the Lombard effect (i.e., increase in vocalization to compensate for increased background sound levels) in one species of fish. The Lombard effect is currently understood to be a reflex that may be unnoticeable to the animal or may lead to increased energy expenditure during communication.

Masking due to SURTASS LFA sonar only has the potential to occur during sonar transmissions (nominal 60-sec duration wavetrain every 10 min) and within the narrow bandwidth of the signal (duration of each continuous-frequency sound transmission within the wavetrain is no longer than 10 sec in the frequency range of 100 to 500 Hz). Based on this information, the potential for masking to fish would occur within the best hearing sensitivity range for most fish species of 100 to 400 Hz (Parmentier et al.

2021; Popper 2003) (Section 3.3.1.1). Even though most fish species hear within this range, all signals would not necessarily be masked for a fish species. Elasmobranchs are not expected to experience masking of biologically important species-specific signals as there has only been one study that has shown that elasmobranchs have the ability to actively produce sound and clicking sounds, and these sounds had a mean peak bandwidth (near 22.3 kHz), well above that of SURTASS LFA sonar (Fetterplace et al. 2022). However, predatory masking may occur to elasmobranchs within the SURTASS LFA sonar frequency range of 100 to 500 Hz. In playback studies of human generated sounds, sharks were attracted to pulsed LF sounds (40 to 800 Hz), in the same frequency range of sounds that might be produced by struggling prey (Myrberg 2001; Myrberg et al. 1976; Myrberg Jr et al. 1969; Myrberg Jr et al. 1972).

The ANSI Sound Exposure Guideline technical report (Popper et al. 2014) highlights a lack of data that exists for masking by sonar but suggests that the narrow bandwidth and intermittent nature of most sonar signals would result in only a limited probability of any masking effects (Table 3-5). Additionally, in most cases, the probability of masking would further decrease with increasing distance from the sound source. Even with the potential for masking to occur, it should be minimal as the SURTASS LFA sonar source is active only 7.5 to 10 percent of the vessel operating time, with a maximum 20 percent duty cycle. This means that for 90 to 92.5 percent of the time that SURTASS vessels are operating within an area, there is no potential for masking. Overall, minimal masking effects are expected for fish, and masking would be brief in nature if it were to occur.

3.3.2.1.5 Physiological Stress

Only a limited number of studies have measured the potential for physiological stress in fish. A stress response that has been observed in fish includes the production of cortisol (a stress hormone) when exposed to sounds such as boat anthropogenic sound, tones, or predator vocalizations. For example, Atlantic cod exposed to a short-duration upsweep (a tone that sweeps upward across multiple frequencies) across 100 Hz to 1 kHz had increases in cortisol levels, which returned to normal within one hour post-exposure (Lameijer 2021; Sierra-Flores et al. 2015). Nichols et al. (2015) found the giant kelpfish (*Heterostichus rostratus*) had increased levels of cortisol associated with increased sound level and intermittency of boat noise playbacks. Smith et al. (2004) found that increased ambient sound (160 to 170 dB re 1 µPa) caused an initial increase in cortisol in goldfish (*Carassius auratus*) that was not sustained over long-term exposures.

Fish may have physiological stress reactions to sounds that they can hear. Generally, stress responses are more likely to occur in the presence of potential threatening sounds or the sudden onset of impulsive sounds. The transmission of SURTASS LFA sonar, a non-impulsive sound, only occurs for a short period of time (duration of each continuous-frequency sound transmission within the wavetrain is no longer than 10 sec in the frequency range of 100 to 500 Hz), and the SURTASS LFA sonar source is only active for a small percent of time (7.5 to 10 percent of vessel operating time) while vessels associated with the Proposed Action are transiting. Additionally, the fish would need to be within the general proximity of the SURTASS LFA sonar while it is transmitting over the large Study Area to potentially experience a physiological effect. If a stress response does occur, they are typically brief (a few sec to min) if the exposure is short, or if fish habituate or tolerate the sound that is being presented. Physiological effects to fish are expected to be minimal due to the short period of time the SURTASS LFA sonar source is active, the need for fish to be within the proximity of the transiting vessel while it is transmitting LFA sonar, and the brief nature of fish stress responses.

3.3.2.2 Summary of Potential Effects on Fishes

3.3.2.2.1 Fish Significance Determination

As stated in Section 3.1.1, a significance determination is only required for activities that may have reasonably foreseeable adverse effects on the human environment based on the significance factors in Table 3-1. SURTASS LFA sonar from the Proposed Action could have a reasonably foreseeable adverse effect; thus, requiring a significance determination.

A stressor is considered to have a significant effect on the human environment based on an examination of the context of the action and the intensity of the effect. The effects of sonar transmissions would only be considered significant if: effects to fishes were short- or long-term and well outside the natural range of variability of species' populations, their habitats, or the natural processes sustaining them; behavioral and stress responses could be repeated, and hearing threshold shifts could be permanent; actions would affect any stage of a species' life cycle (i.e., breeding, feeding, growth, maturity), alter population structure, genetic diversity, or other demographic factors, and/or cause mortality beyond a number of individuals, resulting in a decrease in population levels; displacement and stress responses would be short or long term within and well beyond the Study Area; and habitat would be degraded long term or permanently so that it would no longer support a sustainable fishery and would cause the population of a managed species to become stressed, less productive, or unstable. If the context of the action and intensity of the effect do not reach the criteria listed above, the effects of sonar transmissions would be considered less than significant.

3.3.2.2.2 Effects under No Action Alternative

Under the No Action Alternative, the Navy would not conduct the Proposed Action activities in the Study Area. SURTASS LFA sonar transmissions would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment either would remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.3.2.2.3 Effects under Alternative 1 (Preferred Alternative)

Alternative 1, Preferred Alternative, is described in detail in Section 2.2.2.2. Under Alternative 1, SURTASS LFA sonar transmissions would increase baseline noise conditions within the Study Area. SURTASS LFA sonar would be operated for 1,100 hours annually.

The analysis of the effects of SURTASS LFA sonar anthropogenic sound to fish under Alternative 1, Preferred Alternative, is consistent with a "less than significant" determination since negligible auditory and non-auditory effects; and near negligible masking, physiological stress, and short-term behavioral reactions are anticipated.

Non-auditory and auditory effects would not be expected based on the following: fish are mobile species that can easily swim out of the region of brief exposure; studies that have tested LFA sonar exposure effects to fish exposed fish to "worst-case" scenarios and fish did not show signs of non-auditory injury, and showed either no AINJ or minimal TTS that did not affect the fitness or survival of fish; and direct injuries and non-auditory effects are not expected to fish due to the slow rise times and relatively low peak pressures of LFA sonar.

The most probable effects from Alternative 1 would be masking, physiological stress, and short-term behavioral reactions. Fish would only potentially be affected by SURTASS LFA sonar transmissions if a vessel was within close proximity to an individual while actively transmitting LFA sonar (7.5 to 10 percent of vessel operating time during training or testing activities). As stated above, fish are able to swim away from the vessels, which would limit their exposure to SURTASS LFA sonar and potential effects. The Navy intends to engage in informal consultation with NMFS regarding the Preferred Alternative.

Pursuant to NEPA and EO 12114, acoustic transmissions associated with Alternative 1 would have less than significant effects on fish within the Study Area.

3.3.2.2.4 Effects under Alternative 2

Alternative 2 is described in detail in Section 2.2.2.3. Alternative 2 STURTASS LFA sonar anthropogenic sound would increase baseline noise conditions within the Study Area. Under Alterative 2, there would be a total of 2,490 hours of SURTASS LFA sonar transmission annually.

Although activities under Alternative 2 would occur at a slightly higher rate relative to Alternative 1, effects on fish under Alternative 2 are not expected to be meaningfully different from those described under Alternative 1. Therefore, effects associated with fish are the same as Alternative 1 with a "less than significant" determination.

Pursuant to NEPA and EO 12114, acoustic transmissions associated with Alternative 2 would have less than significant effects on fish within the Study Area.

3.3.2.2.5 Endangered Species Act Determinations

Pursuant to the ESA, the SURTASS LFA sonar transmissions as described under Alternative 1 and Alternative 2, may affect, but are not likely to adversely affect, chum salmon (*Oncorhynchus keta*) (Columbia River ESU; Hood Canal Summer- run ESU), sockeye salmon (*Oncorhynchus nerka*) (Lake Ozette ESU; Snake River ESU), or coho salmon (*Oncorhynchus kisutch*) (Lower Columbia River ESU; Oregon Coast ESU), steelhead (*Oncorhynchus mykiss*) (California Central Valley DPS; Central California Coast DPS; Lower Columbia River DPS; Middle Columbia River DPS; Northern California-Coast DPS; Puget Sound DPS; Snake River Basin DPS; Upper Columbia River DPS; Upper Willamette River DPS); giant manta ray (*Mobula birostris*); oceanic whitetip shark (*Carcharhinus longimanus*); scalloped hammerhead shark (*Sphyrna lewini*); or Sakhalin sturgeon (*Acipenser mikadoi*). The Navy intends to engage in informal consultation with NMFS as required by section 7(a)(2) of the ESA.

3.4 Sea Turtles

3.4.1 Affected Environment

Although well adapted for life in the marine environment, sea turtles are air-breathing marine reptiles that rely partially on the terrestrial environment for nesting and hatching of their offspring. Habitat use by sea turtles is linked to life stage, with the majority of species of sea turtles found in the pelagic (i.e., offshore) environment during their juvenile stage (NOAA 2023b) and during trans-ocean migrations (Bowen and Karl 2007; Dellinger et al. 2022; Musick and Limpus 1997) before recruiting to neritic habitats as older juveniles. To a lesser extent, some species of sea turtles are either mainly pelagic (e.g. leatherback turtles [*Dermochelys coriacea*]) or mainly coastal during all life stages (Bjorndal 1997; Bolten et al. 2003; Walker and Parmenter 1990). The majority of sea turtle species would likely be present in the offshore environment of the Study Area.

Due to past exploitation and ongoing threats, such as bycatch and direct take, most sea turtle species currently occur in their former ranges in lower than historical numbers, particularly in the pelagic environment, where sea turtles are widely dispersed. Sea turtle population estimates are typically derived from nest counts, as this is the best scientific data and easy to collect relative to in-water surveys. However, population estimates based on nest counts often underestimate total population size unless demographic modeling of other age classes occurs (e.g., Casale and Heppell 2016), as nest counts are only representative of the nesting female population, and do not account for non-nesting females, males, or juveniles. Limited at sea estimates of sea turtle abundance and distribution exist where broad scale aerial and shipboard have been undertaken (DiMatteo et al. 2022), but even these models underestimate sea turtle populations, as smaller turtles are often not visible from survey platforms.

3.4.1.1 Sea Turtle Hearing and Sound Production

Limited data and information on sea turtle hearing and sound production exist. Sea turtles have no ear pinnae (external ear openings), as their middle ears are covered by a layer of fat that is overlain by a thick layer of skin on their external head surface called the tympanum. This layer of fat over the middle ear is a distinguishing feature of sea turtle ear morphology (Bartol and Musick 2003). Sea turtle ears are adapted for hearing underwater and in-air, with auditory structures that receive sound via bone conduction (Lenhardt et al. 1985), via resonance of the middle ear cavity (Willis et al. 2013), or via standard tympanic middle ear path (Hetherington 2008). Electrophysiological, behavioral, and morphological studies on hearing indicate that sea turtles hear LF sounds both in-water and in-air (Bartol and Ketten 2006b; Lavender et al. 2014; Lenhardt et al. 1985; Martin et al. 2012; Ridgway et al. 1969; Willis et al. 2013).

Hearing has been studied in four of the seven species of sea turtles. Hearing abilities have been studied with sub-adult, juvenile, and hatchling subjects in green turtles (*Chelonia mydas)* (Bartol and Ketten 2006a; Bartol and Ketten 2006b; Ketten and Bartol 2005; Piniak et al. 2016; Ridgway et al. 1969), Kemp's ridley turtles (*Lepidochelys kempii*) (Ketten and Bartol 2005), loggerhead turtles (*Caretta caretta*) (Bartol et al. 1999; Ketten and Bartol 2005; Lavender et al. 2014; Martin et al. 2012), and leatherback turtles (Eckert 2012; Harms et al. 2014). Due to similar anatomy among sea turtles, the results of studies on these species provide insight into hearing in all sea turtles. Only one study examined the auditory capabilities of an adult sea turtle, which was a loggerhead turtle (Martin et al. 2012). Hawksbill turtle (*Eretmochelys imbricate*) hearing has been studied to a lesser extent (Piniak et al. 2012), and no published studies to date have reported audiograms of olive ridley turtles (*Lepidochelys olivacea*).

The Navy compiled known data on sea turtle hearing and developed a composite audiogram (Figure 3-1) (U.S. Department of Navy 2025). Studies of hearing ability show that sea turtles' ranges of in-water hearing detection generally lie between 50 Hz and 1.6 kHz, with maximum sensitivity between 100 and 400 Hz, and that hearing sensitivity drops off rapidly at higher frequencies (Bartol and Ketten 2006b; Ketten and Bartol 2005; Piniak et al. 2012; Piniak et al. 2016; Popper et al. 2014).

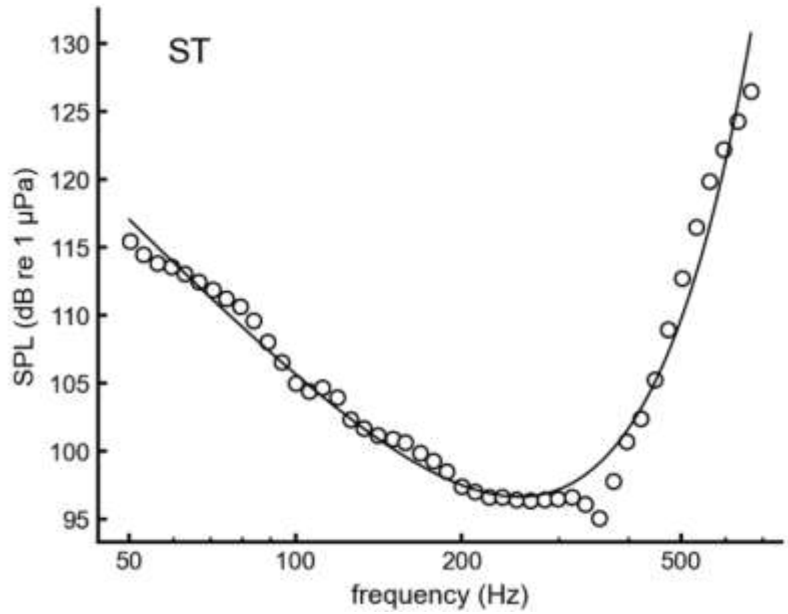

Figure 3-1. Composite Audiogram used in Sea Turtle Criteria and Thresholds (U.S. Department of Navy 2025)

The data points represent the median of interpolated thresholds from sea turtle underwater audiogram data. dB re 1 μPa = decibels referenced to 1 micropascals ; Hz = Hertz; SPL = sound pressure level ; ST = sea turtle Sources: (Bartol and Ketten 2006b; Dow Piniak et al. 2012; Martin et al. 2012; Piniak et al. 2016).

Very little is known about sea turtle sound production or how they use sound for communication or other purposes. Charrier et al. (2022) documented underwater sound production for the green turtle for the first time. Juvenile green sea turtles produced 10 distinct sounds that were associated with pulses, low amplitude calls, FM sounds, and squeaks; it was suggested that these sounds may be used for communication because the frequency bandwidth of sounds produced largely fell within the green turtle underwater hearing range (50 Hz to 1.6 kHz) (Charrier et al. 2022). Some croaks and squeaks were above the hearing range of green sea turtles (greater than 2 kHz), and Charrier et al. (2022) suggested that these sounds may not be fully heard by the turtles.

3.4.1.2 Threatened and Endangered Sea Turtles

There are seven recognized species of sea turtles worldwide (Bolten et al. 2003; Jelicich et al. 2022). Six species inhabit partial regions of the Pacific and Indian Oceans and would be expected to occur in some portion of the Study Area and as such are considered in this SEIS/OEIS (Table 3-6). For a full write-up for species, see Appendix C (Biological Resources Supplemental Information).

Table 3-6. Sea Turtle Species Potentially Occurring within the Study Area

Species	*ESA Status*		*Occurrence in Study Area*
	Threatened	*Endangered*	
Flatback turtle (*Natator depressus*)[1]	N/A	N/A	Within waters of Northern Australia
Green turtle (*Chelonia mydas)*	Central West Pacific DPS; Southwest Indian DPS	Central North Pacific DPS; East Indian-West Pacific DPS; North Indian DPS	Between 30 °N and 30 °S within the Study Area
Hawksbill turtle (*Eretmochelys imbricata)*	-	Throughout its range	Mainly in shallow subtropical and tropical nearshore waters less than 60 ft (18.3 m) deep throughout the whole Study Area
Leatherback turtle (*Dermochelys coriacea)*	-	Throughout its range	In temperate and tropical waters in the pelagic zone of the Pacific Ocean and the Northeast and Southeast Indian Ocean
Loggerhead turtle (*Caretta caretta*)	Southeast Indo-Pacific Ocean DPS; Southwest Indian Ocean DPS	North Indian Ocean DPS; North Pacific Ocean DPS	Throughout the whole Study Area in coastal to oceanic temperate, tropical, and subtropical waters
Olive ridley turtle (*Lepidochelys olivacea)*	All populations except Mexico's Pacific Coast breeding population[2]	-	In tropical to warm-temperate waters within a narrow temperature range of 72 to 82 °F (22 to 28 °C)

DPS = distinct population segment; ESA = Endangered Species Act; N/A = not applicable; °N = degrees North latitude; °S = degrees south latitude; ft = feet; m = meters; °F = degrees Fahrenheit; °C = degrees Celsius
[1]The flatback sea turtle is not further discussed. For more information on this species refer to the 2019 SEIS/SOEIS.
[2]Mexico's Pacific coast breeding populations are considered endangered. All other populations of olive ridley turtles are considered threatened. Mexico's Pacific coast breeding populations are outside of the Study Area and are not further discussed.

Sea turtles are highly migratory and generally utilize the waters of more than one country in their lifetime. The U.S. Fish and Wildlife Service (USFWS) and NMFS share federal jurisdiction over sea turtles that occur in U.S waters or nest on U.S. beaches. The USFWS has lead responsibility on the nesting beaches, while NMFS has lead responsibility in the marine environment. One sea turtle that occurs within the Study Area, the flatback turtle (*Natator depressus*), is not regulated by NMFS or the USFWS because its distribution is restricted to coastal waters off Australia, Papua New Guinea, Indonesia, and Timor-Leste (Kennett et al. 1997; Walker and Parmenter 1990), and NMFS has not elected to list this foreign species. The other five sea turtle species are found in U.S. waters or nest on U.S. beaches. All five are designated as either threatened or endangered under the ESA. The global populations of the ESA-listed green and loggerhead turtles have been divided into DPSs (NMFS and USFWS 2021; Seminoff et al. 2015). Only the DPSs that potentially occur within the Study Area are considered herein.

3.4.2 Environmental Consequences

This section evaluates how and to what degree the activities described in Chapter 2 could potentially effect sea turtles known to occur within the Study Area. The information below builds on the analyses previously conducted in the Navy's past NEPA work for SURTASS LFA Sonar, which are incorporated herein by reference. The only stressor analyzed is underwater SURTASS LFA sonar. All physical (vessel movement, passive sonar array movement, and entanglement) or other acoustic (underwater vessel sound and underwater HF/M3 sonar) stressors are not analyzed because, based on previous SURTASS LFA environmental analyses and best available science, negligible effects to sea turtles would be expected from these stressors. The potential effects analyzed for sea turtles due to SURTASS LFA sonar include the following: non-auditory effects, auditory effects, behavioral changes, masking, and physiological stress. The potential effects are discussed below.

3.4.2.1 Acoustic Stressor: SURTASS LFA Sonar

The information below builds on the analyses previously conducted in the SURTASS LFA environmental analyses, which are incorporated herein by reference. A summary of the research from the previous SURTASS LFA environmental analyses that examined the response of sea turtles to LFA sonar signals is included below. The remainder of this section will focus on research that has been published since the 2019 SEIS/SOEIS.

Studies on the effects of sound to sea turtles are lacking, and most of the available research has examined the effects of sounds of much longer duration or of different types (e.g., seismic airguns) than LFA sonar signals (McCauley et al. 2000). The lack of information on sea turtle hearing sensitivity to LFA sonar anthropogenic sound is additionally accompanied by a lack of population data on sea turtles in the open ocean. Therefore, it is not feasible to estimate the percentage of a species or DPS that might be exposed to SURTASS LFA sonar transmissions.

The Navy (2025) threshold factors are used below to create a more robust analysis of effects on sea turtles from the action alternatives (Table 3-7). The Navy (2025) developed mathematical functions that relate the sound exposure levels (SELs) for onset of TTS and AINJ to the frequency of the sonar sound exposure. Based on data from freshwater turtles, the SEL_{cum} threshold at the most sensitive frequency for TTS was 178 dB re 1 µPa^2-s, and for AINJ, the SEL_{cum} threshold was 198 dB re 1 µPa^2-s (U.S. Department of Navy 2025) .These SEL thresholds are 22 dB lower than those used in previous analyses. The SPL rms (unweighted) behavioral disturbance threshold was 175 dB re 1 µPa, which is based on sea turtle masking are used below.

Table 3-7. Summary of Sea Turtle Exposure Thresholds for Low-Frequency Sonar

Recoverable Injury	*TTS*	*AINJ*	*Masking*	*Behavior*
(N)[1] Low (I) Low (F) Low	178 SEL_{cum}	198 SEL_{cum}	(N) Low (I) Low (F) Low	175 SPL rms (unweighted)

N = near; I = intermediate; F = far; TTS = temporary threshold shift; AINJ = auditory injury; SEL_{cum} = cumulative sound exposure level (measured in decibel referenced to 1 micropascal squared per second; SPL rms = sound pressure level root mean squared (measured in decibels referenced to 1 micropascal).

[1] Popper et al. (2014) state that distances should not be defined due to many variables influencing the distance effects are experienced, but if distances must be applied these distances might include (N) = tens of meters from the source, (I) = hundreds of meters from the source, and (F) = thousands of meters from the source.

Reference: (Popper et al. 2014; U.S. Department of Navy 2025)

3.4.2.1.1 Non-Auditory Effects

There is limited data on the potential for anthropogenic sound to cause injury in sea turtles. Non-auditory effects include recoverable injury, mortality, and potential mortal injury (Popper et al. 2014). Recoverable injury includes injuries that are not likely to result in mortality (e.g., hair cell damage, minor hematoma). Potential mortal injury is defined as being able to possibly cause immediate or delayed death. Mortality is defined as immediate or delayed death.

Direct injuries to turtles from SURTASS LFA sonar are unlikely because of the relatively lower peak pressures and slower rise times than potentially injurious sources, such as impulsive sounds. The ANSI Sound Exposure Guideline technical report (Popper et al. 2014) also concluded that the risk of sea turtles experiencing mortality, potential mortal injury, or recoverable injury is low from exposure to LFA sonar from all distances analyzed (Table 3-7). Therefore, based on the operational characteristics of the SURTASS LFA sonar system and low potential for non-auditory injury, no reasonably foreseeable non-auditory effects on sea turtles are expected.

3.4.2.1.2 Auditory Effects

No studies have been conducted on hearing loss in sea turtles (Popper et al. 2014). Exposure to intense sound may result in hearing loss, typically quantified as threshold shift, which persists after cessation of the noise exposure. Threshold shift is a loss of hearing sensitivity at an affected frequency of hearing. This noise-induced hearing loss may manifest as TTS, if hearing thresholds recover over time, or AINJ, if hearing thresholds do not recover to pre-exposure thresholds. Given that sea turtles hear best underwater at 100 to 400 Hz (Bartol and Ketten 2006b; Ketten and Bartol 2005; Piniak et al. 2012; Piniak et al. 2016; Popper et al. 2014), there is the potential for diving sea turtles to experience auditory effects from exposure to SURTASS LFA sonar because the sonar would be within their known hearing range. The threshold for onset of TTS and AINJ are 178 and 198 dB re 1 μPa^2-s, respectively (Table 3-7).

To calculate the distance at which onset of TTS and AINJ might occur from exposure to SURTASS LFA sonar, the length of a nominal LFA transmission (average length of 60 sec) should be considered. If the assumption is made that all received levels are at the same received SPL (i.e., the animal and vessel remain at the same distance and depth from each other for an entire minute), the thresholds are lowered by approximately 18 dB (10 x $\log_{10}$[60 sec] = 17.8). This results in SPL thresholds for onset of TTS and AINJ of 160 dB re 1 µPa (rms) and 180 dB re 1 µPa (rms), respectively. Based on simple spherical spreading (20logR), sea turtles would need to be within 1,844 ft (562 m) or 184 ft (56 m) for an entire 60-sec SURTASS LFA sonar transmission to experience TTS or AINJ, respectively.

It is unlikely for sea turtles to be exposed to SURTASS LFA sonar transmissions to the extent where AINJ or TTS would occur because of both low probability of overlap and because sea turtles would likely swim away from the sound before hearing loss occurs. The LFA sonar source is active only 7.5 to 10 percent of the vessel operating time, and due to the large Study Area, overlap with a sea turtle during LFA operation is highly unlikely. During the LFA sonar's brief operating time, sea turtles would need to match the speed and direction of the moving vessel for 60 sec to experience AINJ or TTS. Sea turtles would be able to swim away from the region of effect while the mobile vessel is traversing and emitting LFA sonar. Additionally, the SURTASS LFA vessel travels at a faster speed than sea turtles swim (swimming speeds are typically less than 2 kt). This would lead to sea turtles only being exposed to the region of effect for the short period of time the vessel is in the immediate area of a sea turtle, as the sea turtle would not be able to keep pace with the vessel as it is traversing and emitting LFA sonar. Mitigation and monitoring protocols (Chapter 4) further protect sea turtles from auditory effects by observing for their presence and delaying or suspending SURTASS LFA sonar transmissions when a sea turtle enters the 2,000 yd LFA mitigation/buffer zone. The detection of a sea turtle in the zone would result in the delay or suspension of SURTASS LFA sonar transmissions at a distance greater than that required for the onset of TTS (1,844 ft [562 m]) or AINJ (184 ft [56 m]). Overall, potential auditory effects to sea turtles would be low from SURTASS LFA sonar exposure based on the mitigation and monitoring protocols, the mobility of sea turtles, and the length of uninterrupted, close proximity LFA exposure time (60 sec) required to cause AINJ or TTS.

3.4.2.1.3 Behavioral Changes

There is little information on the behavioral changes, or alterations of natural behavior patterns and avoidance, of sea turtles to acoustic disturbance. The behavioral response of a sea turtle to an anthropogenic sound would likely depend on the frequency, duration, temporal pattern, and amplitude of the sound as well as the animal's prior experience with the sound and the context in which the sound is encountered (i.e., what the animal is doing at the time of the exposure). Distance from the sound source and whether it is perceived as approaching or moving away may also affect the way a sea turtle responds to a sound.

There is potential for sea turtles to experience behavioral responses from exposure to SURTASS LFA sonar. The distance at which behavioral disturbance to sea turtles might occur from the exposure to SURTASS LFA sonar can be calculated using simple spherical spreading (20logR). Using the threshold of 175 dB re 1 µPa (U.S. Department of Navy 2025), sea turtles would need to be within 330 ft (100 m) to experience behavioral changes.

Kastelein et al. (2023) exposed hawksbill and green turtles to low-, mid-, and high- frequency sounds coupled to a pool, and found that mainly high-amplitude, LF anthropogenic sounds (200 Hz to 1 kHz) elicited swimming behavioral responses in sea turtles. Watwood et al. (2016) tagged green sea turtles with acoustic transponders and monitored them using acoustic telemetry arrays in Port Canaveral, Florida. Sea turtles were monitored before, during, and after a routine pierside submarine MF sonar test that utilized typical SLs, signals, and duty cycle. No significant long-term displacement was exhibited by the sea turtles in this study. Additionally, the authors noted that Port Canaveral is an urban marine habitat and that resident sea turtles may be less likely to respond due to habituation than non-native populations. Although not discussed in the article, most transmitted mid-sonar signals (1—10 kHz) may have been out of the hearing range of sea turtles (50 Hz—1.6 kHz), additionally limiting a response from turtles. Diaz et al. (2024) found that green sea turtles tagged with data loggers did not alter their behavior when exposed to vessel sound (between 200 and 400 Hz) in the field. Rather, the time budget that the turtles spent conducting a certain behavior linearly increased with the duration of vessel sound exposure, which ranged from 0 to 600 sec. For example, if a turtle was inactive on the seabed before exposure to vessel sound, they would remain on the seabed for a longer duration as vessel sound exposure time increased. The same results were experienced for turtles that were actively swimming before or during exposure to vessel sound – their swimming time increased.

Based on the limited behavioral response studies (BRS') of sea turtles, the Navy cannot rule out that if sea turtles were exposed to SURTASS LFA sonar anthropogenic sound, they may demonstrate some temporary behavioral responses (e.g., elicit swimming). All studies discussed in this section reported minimal behavioral effects. Additionally, mitigation and monitor protocols (Chapter 4) further protect sea turtles from behavioral effects by monitoring for their presence and delaying or suspending SURTASS LFA sonar transmissions when a sea turtle enters the 2,000 yd LFA mitigation/buffer zone. The detection of a sea turtle in the zone would result in the delay or suspension of SURTASS LFA sonar transmissions at a distance greater than that required for the onset of a behavioral change (330 ft [100 m]). Overall, potential auditory effects to sea turtles would be low from SURTASS LFA sonar exposure based on the mitigation and monitoring protocols and previous studies.

3.4.2.1.4 Masking

Masking occurs when one sound, distinguished as the "noise," interferes with the detection or recognition of other sounds or limits the distance over which other biologically relevant sounds, including those produced by prey, predators, or conspecifics, can be detected. Masking only occurs when the sound source is operating; therefore, masking effects stop immediately upon cessation of the sound-producing activity. Any sound above ambient noise and within an animal's hearing range may potentially cause masking.

There is limited data on underwater sound production by sea turtles. As reviewed in Section 3.4.1.1, sound production has only been documented for the green turtle and vocalization mainly fell within their hearing range (Charrier et al. 2022). Green turtle vocalization overlaps with the frequency range of SURTASS LFA sonar (100 to 500 Hz). Although Charrier et al. (2022) proposed that green turtle vocalization could be used in communication, this has not yet been confirmed. Sea turtles may rely more heavily on other senses, such as vision and magnetic orientation.

If it were to occur, masking would be temporary as each sonar transmission would only last an average of 60 sec (maximum of 100 sec). Additionally, there is no potential for masking during the 90 to 92.5 percent of the time that SURTASS vessels would be present within an area without actively transmitting LFA sonar. The ANSI Sound Exposure Guideline technical report (Popper et al. 2014) also concluded that there is a low risk of sea turtles experiencing masking from LFA sonar from all distances (Table 3-7). Overall, if sea turtles experience masking, it would be for short, intermittent periods of time, with minimal effects to sea turtles.

3.4.2.1.5 Physiological Changes

A stress response is a suite of physiological changes meant to help an organism mitigate the effect of a stressor. If the magnitude and duration of the stress response is too great or too long, then it can have negative consequences to the animal (e.g., decreased immune function, decreased reproduction).

Physiological stress is typically analyzed by measuring stress hormones, other biochemical markers, or vital signs.

Physiological stress responses have been observed in sea turtles during activities such as capture and handling (Gregory et al. 1996; Gregory and Schmid 2001), but no acoustic exposure studies have been conducted to determine the potential for a stress response from underwater sound. Without sufficient information, it is difficult to determine the potential for physiological stress from exposure to LFA sonar. In other circumstances, like capture and handling, sea turtles may experience a rapid release of stress hormones (e.g., cortisol) into their circulatory systems, which may cause responses such as increased oxygen uptake and blood chemistry changes (Gregory et al. 1996; Gregory and Schmid 2001; Milton and Lutz 2003). It is possible, though speculative, that these responses may be mirrored in cases of LFA sonar exposure. As stated earlier, given the operational profile of SURTASS LFA sonar and size of the Study Area, sea turtles have a low probability to be in proximity to SURTASS LFA sonar while it is transmitting, resulting in a very limited potential for a physiological stress response to occur.

3.4.2.2 Summary of Potential Effects on Sea Turtles

3.4.2.2.1 Sea Turtles Significance Determination

As stated in Section 3.1.1, a significance determination is only required for activities that may have reasonably foreseeable adverse effects on the human environment based on the significance factors in Table 3-1. LFA sonar transmissions from the Proposed Action could have a reasonably foreseeable adverse effect; thus requiring a significance determination.

A stressor is considered to have a significant effect on the human environment based on an examination of the context of the action and the intensity of the effect. The effects of SURTASS LFA sonar transmissions would be considered significant if: effects to sea turtles would be short-term or long-term changes well outside the natural range of variability of species' populations, their habitats, or the natural processes sustaining them; behavioral and stress responses would be repeated or permanent (e.g., AINJ from underwater noise, vessel strike resulting in mortality, a removal from or inability to access breeding, foraging, and/or rearing habitat); effects would affect any stage of a species' life cycle (i.e., breeding, feeding, growth, and maturity), alter population structure, genetic diversity, or other demographic factors, and/or cause morality beyond a small number of individuals, resulting in a decrease in population levels; displacement and stress responses would be short term or long term within and well beyond the Study Area; and/or sea turtle habitats would be degraded over the long term or permanently, such that the habitats would no longer possess the requirements to sustain the population. If the context of the action and intensity of the effect do not reach the criteria listed above, the effects of sonar transmissions would be considered less than significant.

3.4.2.2.2 Effects under the No Action Alternative

Under the No Action Alternative, the Navy would not conduct the proposed training and testing activities in the Study Area. SURTASS LFA sonar transmissions would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.4.2.2.3 Effects under Alternative 1 (Preferred Alternative)

Alternative 1, Preferred Alternative, is described in detail in Section 2.2.2.2. Under Alternative 1, SURTASS LFA sonar transmissions would increase baseline noise conditions within the Study Area. SURTASS LFA sonar would be operated for 1,100 hours annually.

The analysis of effects of sea turtles under Alternative 1, Preferred Alternative, are consistent with a “less than significant” determination since near negligible non-auditory and auditory effects are anticipated.

There would be minimal potential for non-auditory and auditory effects based on the following: operational characteristics of the SURTASS LFA sonar system (i.e., low peak pressures and slow rise times); low percent of time SURTASS LFA sonar is being transmitted; mitigation and monitoring protocols delaying/suspending SURTASS LFA sonar transmissions at a distance before AINJ or TTS are experienced; sea turtles needing to match the speed and direction of the moving vessel for a full 60 sec to experience AINJ or TTS; and sea turtles being highly mobile and having the ability to swim away from the sound source.

The most probable effects from Alternative 1, Preferred Alternative, would be masking, physiological stress, and behavioral reactions. These effects would be brief in nature as Alternative 1 would only increase the baseline noise conditions to sea turtles while a vessel is in close proximity while actively transmitting SURTASS LFA sonar (7.5 to 10 percent of vessel operating time). Additionally, the ANSI Sound Exposure Guideline technical report (Popper et al. 2014) predicts low behavioral and masking effects to sea turtles from LF sonar at all distances (Table 3-7).

Pursuant to NEPA and EO 12114, acoustic transmissions associated with Alternative 1 would have less than significant effects on sea turtles within the Study Area.

3.4.2.2.4 Effects under Alternative 2

Alternative 2 is described in detail in Section 2.2.2.3. Alternative 2 SURTASS LFA sonar anthropogenic sound would increase baseline noise conditions within the Study Area. Under Alterative 2, there would be a total of 2,490 hours of SURTASS LFA sonar transmission annually.

Although activities under Alternative 2 would occur at a slightly higher rate relative to Alternative 1, effects on sea turtles under Alternative 2 are not expected to be meaningfully different from those described under Alternative 1. Therefore, effects associated with sea turtles are the same as Alternative 1 with a “less than significant” determination.

Pursuant to NEPA and EO 12114, acoustic transmissions associated with Alternative 2 would have less than significant effects on sea turtles within the Study Area.

3.4.2.2.5 Endangered Species Act Determinations

Pursuant to the ESA, the SURTASS LFA sonar transmissions as described under Alternative 1 and Alternative 2, may affect, but are not likely to adversely affect, the green turtle, hawksbill turtle, leatherback turtle, loggerhead turtle, or olive ridley turtle. The Navy intends to engage in informal consultation with NMFS as required by section 7(a)(2) of the ESA.

3.5 Marine Mammals

Jurisdiction over marine mammals is maintained by NMFS and USFWS. NMFS maintains jurisdiction over whales, dolphins, porpoises, seals, and sea lions. USFWS maintains jurisdiction for other marine mammal species, including sea otters and dugongs, which both occur within the Study Area. Marine mammals are highly adapted animals, occurring in aquatic habitats ranging from freshwater rivers to the deep ocean. Most marine mammals are wholly aquatic, but some, such as pinnipeds, partially depend upon the terrestrial environment for hauling out for limited purposes that include birthing, molting, resting, and predator avoidance. The distribution of marine mammals is difficult to predict, as these highly mobile animals can travel long distances, with some species undergoing lengthy seasonal migrations. Due to their mobility, marine mammal distribution is characterized by irregular clusters (patches) of occurrence that frequently correlate with areas of high prey abundance.

Marine mammals are divided into four basic taxonomic groups: Mysticeti (baleen whales), Odontoceti (toothed whales), Pinnipedia (seals, sea lions, and walruses), Sirenia (manatees and dugongs), in addition to, Ursidae (polar bears) and Mustelidae (sea otters). Some of the marine mammal species that occur in the western/central North Pacific or Indian Oceans do not meet the criteria for co-occurrence with SURTASS LFA sonar activities, as these species occur outside of the Study Area boundaries, occur in inland waters, or occur in very shallow coastal waters where elevated sound from the proposed action would not reach. For these reasons the following marine mammal species are excluded from further consideration:

- Bowhead Whales (*Balaena mysticetus*)—Bowhead whales are limited to the Arctic and sub-Arctic regions in the Northern Hemisphere, with shorter migrations than most baleen whales; the Okhotsk Sea and Bering Chukchi-Beaufort Seas stocks are confined to the Okhotsk and Bering Seas, respectively (Citta et al. 2023; Citta et al. 2015; Ivashchenko and Clapham 2010). There has been one record of a calf in lower latitudes in Canadian waters; however, it is the only sighting of a bowhead within the eastern North Pacific (Towers et al. 2022). There are no known or documented sightings of this species within the Study Area.
- Beluga Whales (*Delphinapterus leucas*)—The Beaufort Sea, Eastern Chukchi Sea, and Cook Inlet stocks of belugas do not overlap the Study Area at all. The Sakhalin-Amur, Ulbansky, Tugursky, Udskaya, and Shelikhov stocks are all found in the northern part of the Okhotsk Sea, whereas the Anadyr, Bristol Bay, and Eastern Bering Sea stocks are all found within the northern parts of the Bering Sea (Hobbs et al. 2019). While both of these seas border the Study Area, both seas occur outside the Study Area, and there have been no documented sightings of belugas within the Study Area.
- Shallow-water Porpoises—The distribution of porpoise species, such as the Indo-Pacific finless porpoise (*Neophocaena phocaenoides*) and narrow-ridged finless porpoise (*Neophocaena asiaeorientalis*) are in shallow nearshore waters, where SURTASS LFA sonar is highly unlikely to be detectable.
- River Dolphins—Freshwater dolphin species, such as the Ganges River dolphin (*Platanista gangetica gangetica*), the Indus River dolphin (*Platanista gangetica minor*), and the baiji/Chinese river dolphin (*Lipotes vexillifer*), are restricted to riverine waters of the Ganges, Indus, and Yangtze Rivers, respectively. These river dolphins only occur in the main channels of these rivers, well inshore of where SURTASS LFA sonar would be detectable.
- Coastal Dolphins—Inshore and coastal delphinid species, such as the Irrawaddy dolphin (*Orcaella brevirostris*), Australian snubfin dolphin (*Orcaella heinsohni*), Indian Ocean humpback dolphin (*Sousa plumbea*), Indo-Pacific humpbacked dolphin (*Sousa chinensis*), Australian humpback dolphin (*Sousa sahulensis*), and Taiwanese humpbacked dolphin (*Sousa chinensis taiwanensis*), all occur in shallow, coastal waters near shore, where SURTASS LFA sonar is unlikely to be detectable.

- Sirenians—The dugong (*Dugong dugon*) is the only sirenian species that may occur within the Study Area. Dugongs occur in shallow inshore and coastal waters of the Indo-West Pacific in reefs and lagoons (Cleguer et al. 2020; Jefferson et al. 2015). Although dugongs have been sighted near reefs up to 36 mi (58 km) from shore in waters up to 120 ft (37 m) deep, such occurrences are very rare and considered atypical (Marsh et al. 2002), with mainly non migratory movements (Deutsch et al. 2022). Moreover, the water depths of the offshore reefs where dugongs have uncommonly been observed are too shallow for the use of SURTASS LFA sonar.
- Sea Otters (*Enhydra lutris*)—Sea otters are a coastal species and part of the Mustelid family, with adaptations to spend their lives in an aquatic environment. Sea otters are typically found in home ranges that are only a few km long and within a km of the shoreline (Davis and Bodkin 2021; Love 1992; Nickerson 1989; Tarjan and Tinker 2016). As sea otters rarely occur in offshore areas, they are unlikely to occur where SURTASS LFA sonar would be detectable.

A total of 43 marine mammal species could potentially occur in the Study Area, including eight pinniped species, 10 mysticete species, and 25 odontocete species (Section 3.5.1.2). All marine mammals are protected under the MMPA, and 11 of these species are listed under the ESA as either threatened or endangered. The populations of five of the ESA-listed species potentially occurring in the Study Area have been designated into DPSs. Only those DPSs occurring within the Study Area are included for assessment in this SEIS/OEIS. Information about the status, stocks, abundances, distribution, seasonality, diving, swim speeds, vocalizations, and hearing for each species is presented herein. This information represents the best available science on these species and stocks. For a full write-up for each marine mammals species, see Appendix C (Biological Resources Supplemental Information).

3.5.1 Affected Environment

3.5.1.1 General Background

3.5.1.1.1 Cetaceans

Cetaceans are comprised of two suborders, mysticetes (i.e., baleen whales) and odontocetes (i.e., toothed whales, dolphins, porpoises). Mysticetes are distinguished by their larger body size and baleen plates used to filter zooplankton (e.g., krill) and small fish from seawater. In contrast, odontocetes all have teeth that are used for aggression and feeding, which allows for a greater foraging diversity when compared to mysticetes. This SEIS/OEIS considers 35 cetacean species: 10 mysticetes and 25 odontocetes. Six of the mysticete species and two of the odontocete species that may occur within the Study Area are ESA-listed. For a full write-up for each species, see Appendix C (Biological Resources Supplemental Information).

3.5.1.1.2 Pinnipeds

Pinnipeds (i.e., sea lions, seals, and walruses) are globally distributed amphibious marine mammals with varying degrees of aquatic specialization (Berta 2018). Pinnipeds are taxonomically divided into three families: eared seals (family Otariidae), earless or true seals (family Phocidae), and walruses (family Odobenidae). Walruses are spatially limited to the Arctic polar regions beyond the Study Area; therefore, walruses are not considered herein.

Otariid and phocid pinnipeds differ morphologically, ecologically, and physiologically. Phocids, or "true" seals, have small front flippers and undulating their bodies in a caterpillar-like motion while on land. In the water, they use their back flippers to propel themselves. Otariids, or eared seals, can rotate their hind flippers when on land to "walk" on all fours and uses its large front flippers to propel themselves through the water. Phocids spend more time in the water than otariids, due to adaptations such as longer breath holds and deeper diving capabilities; however, both pinniped families have hearing capabilities in both air and water (Jefferson et al. 2015). Eight pinniped species are considered in this SEIS/OEIS, including two otariid and six phocid species. Of these species, three are listed under the ESA with DPSs that occur in the Study Area.

3.5.1.1.3 Marine Mammal Hearing

Since the primary effect of SURTASS LFA sonar on marine mammals would be acoustic effects, it is important to understand how they utilize the marine soundscape. Hearing is important to marine mammals for communication, foraging, and reproduction. Fully aquatic marine mammals, such as cetaceans, utilize sound perception as their primary sensory cue to obtain information underwater about their environment, as well as to coordinate social behaviors. Semi-aquatic marine mammals, such as pinnipeds and sea otters, utilize the air and water, with adaptations to hear in both environments. However, no in-air noise is anticipated from the Proposed Action; only in-water hearing is considered herein.

By considering known or suspected audible frequency range, auditory sensitivity, ear anatomy, and acoustic ecology, marine mammals have been divided into nine hearing groups (Table 3-8); however, sirenians are excluded herein, as dugongs are not likely to be present in the Study Area. These hearing groups and frequency ranges do not directly align with those presented in the 2019 SEIS/SOEIS.

Table 3-8. Marine Mammal Hearing Groups

Marine Mammal Hearing Groups[1]	*Genera (or Species) Included*
Very low frequency (VLF) cetaceans	Balaenidae: right whales and bowhead whale Balaenopteridae: fin whale, blue whale
Low frequency cetaceans (LF)	Balaenopteridae: common minke whale, Antarctic minke whale, sei whale, Bryde's whale, Omura's whale, Rice's whale, humpback whale Eschrichtiidae: gray whale Neobalaenidae: pygmy right whale
High frequency cetaceans (HF)	Most delphinid spp. (e.g., bottlenose dolphin, common dolphin, and pilot whales), beaked whales, sperm whales, and killer whales
Very high frequency cetaceans (VHF)	True porpoises, most river dolphin spp., pygmy/dwarf sperm whales, and oceanic dolphins (e.g., white-sided, Hector's)
Phocids carnivores in-water (PCW) and in-air (PCA)	True seals (e.g., harbor and gray seals; elephant seals; monk seals; Arctic and Antarctic ice seals)
Otariids and other non-phocid marine carnivores in-water (OCW) and in-air (OCA)	Otariid seals (e.g., sea lions and fur seals), walruses, sea otters, and polar bears

Reference: (U.S. Department of Navy 2025)
[1] In-air hearing groups (PCA, OCA) are distinguished, but are not considered herein since there is no in-air acoustic component to the Proposed Action.

Overall, direct measurements in mysticetes are limited. Studies have historically relied on anatomical evidence and modeling (Cranford and Krysl 2015, 2018; Houser et al. 2001; Parks et al. 2007; Tubelli et al. 2012), vocalizations (Au and Hastings 2008; Richardson et al. 1995; Wartzok and Ketten 1999), and behavioral responses (Dahlheim and Ljungblad 1990; Reichmuth 2007) to suggest that mysticetes are well adapted to LF hearing. Although auditory and vocalization frequency ranges do not always perfectly align, it is generally assumed that animals hear within the same frequency ranges that are used for vocalizations (Richardson et al. 1995). Mysticete functional hearing is believed to range from 7 Hz to 36 kHz (NMFS 2018; Southall et al. 2019b) with best hearing sensitivity from 20 Hz to 2 kHz (NMFS 2018).

However, there has been evidence supporting separating the mysticetes into two hearing groups, designated as very low-frequency (VLF) cetaceans and LF cetaceans (Houser et al. 2024; Southall et al. 2019b; U.S. Department of Navy 2025). Direct measurements of mysticete hearing have only recently been conducted on common minke whales (*Balaenoptera acutorostrata*), which found a higher upper hearing limit, between 45 and 90 kHz, than what was previously thought for LF mysticetes (Houser et al. 2024). Although there have been no direct measurements of hearing sensitivity in larger mysticetes (VLF hearing group), an audible frequency range of approximately 10 Hz to 30 kHz has been estimated from measured vocalization frequencies, observed reactions to playback of sounds, and anatomical analyses of the auditory system (Cranford and Krysl 2015; Houser et al. 2001). See the technical report titled *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase IV)* (U.S. Department of Navy 2025) for a complete description of marine mammal composite audiograms.

Unlike mysticetes, hearing sensitivities for approximately one-third of odontocete species have been directly measured (Southall et al. 2019b). Odontocetes hear a broader range of sound frequencies, with hearing ranges from 150 Hz to 160 kHz and 200Hz to 165 kHz, defined by HF cetaceans and VHF cetaceans, respectively. Odontocetes also utilize acoustic perception and sound production for communication, navigation, orientation, and prey location. These underwater communicative signals include tonal whistles, clicks, and pulsed calls. Additionally, odontocetes use echolocation, a form of biosonar, to sense their surrounding environment for prey and object location and navigation.

Semi-aquatic marine mammals, like pinnipeds and sea otters, have ears that function both on land and sea. Pinniped hearing is divided into two groups: phocids and otariids. Phocids exhibit the more extensive hearing range of the two groups of pinnipeds, particularly in HF ranges, as their ears are better adapted to underwater hearing (Jefferson et al. 2015). The potential exists for pinnipeds to perceive and be affected by exposure to underwater LF sonar transmissions Phocid species have demonstrated an extended frequency range, especially into high frequencies, as compared to otariid species (Hemilä et al. 2006; Kastelein et al. 2009; Reichmuth et al. 2013). The underwater functional hearing ranges of phocid and otariid species is 40 Hz to 90 kHz and 60 Hz to 68 kHz, respectively (NMFS 2024). Phocid ears are better equipped for underwater hearing, hence the larger frequency hearing range (Hemilä et al. 2006; Kastak and Schusterman 1998; Mulsow and Reichmuth 2010; Reichmuth et al. 2013).

3.5.1.2 Protected Marine Mammals in the Study Area

The humpback whale and false killer (*Pseudorca crassidens*) 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.

Table 3-9Table 3-9 contains basic life history information for marine mammal species that may be present in the Study Area. For a full write-up for each species, please see Appendix C (Biological Resources Supplemental Information).

Table 3-9. Summary of Marine Mammal Species Within the Study Area

Species	*ESA Listing Status*	*Stocks and Population Estimates*	*Habitat and Range*	*Dive and Swim Behavior*	*Hearing Group*
Mysticetes					
Antarctic Minke Whale (*Balaenoptera bonaerensis*)	N/A	Entire Population: 515,000 (IWC 2023d)	Oceanic species, found in waters beyond the continental shelf break.	Dive durations ranged 9.7 to 10.8 min; long dives separated by 1.3 to 3.5 min of shallow submergence (Leatherwood et al. 1981). Swim speeds have not been quantified.	LF
Blue Whale (*Balaenoptera musculus*)	Endangered	Hawaiian waters: 133 (CV=1.09) (Bradford et al. 2017; Carretta et al. 2023)	Oceanic subpolar to tropical waters; found in open ocean waters.	Foraging dives average 140 m and 7.8 min, and non-foraging dives average 67.6 m and 4.9 m (Croll et al. 2001).	VLF
Bryde's Whale (*Balaenoptera edeni*)	N/A	Western North Pacific (WNP) Ocean: 41,000 (IWC 2023c) Hawaiian waters: 791 (CV=0.29) (Carretta et al. 2024)	Tropical and warm (greater than 61.3 °F [16.3 °C]) temperate waters year-round (Kato and Perrin 2018). Believed to migrate seasonally toward the lower latitudes in winter and to high latitudes in summer (Kato and Perrin 2018).	Can dive to depths around 1,000 ft (300 m) (Kato and Perrin 2018). 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). Swim speeds are between 1.1 and 3.8 kt (1.3 and 4.5 miles per hour [mph]), some as fast as 10 to 14 kt (11.5 to 16 mph) (Kato and Perrin 2018).	LF
Common Minke Whale (*Balaenoptera acutorostrata*)	N/A	WNP: 27,000 (CV=0.16) (Allison et al. 2014) J-stock: 5,247 whales (Song 2016) Hawaiian Exclusive Economic Zone (EEZ): 438 (CV=1.05) in the summer (Barlow 2003; Bradford et al. 2021; Rankin and Barlow 2005).	Found in tropical to polar coastal/neritic and inshore waters; more infrequently in pelagic waters. Migration pathways are not well known; higher latitudes to feed in summer and return to lower latitudes to breed and calve in winter (Víkingsson and Heide-Jørgensen 2015).	Short dives around 2 to 3 min and long dives around 4 to 6 min (Christiansen et al. 2015). Dives 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 recorded was 4.5 kt (5 mph) (Stern 1992).	LF

Species	*ESA Listing Status*	*Stocks and Population Estimates*	*Habitat and Range*	*Dive and Swim Behavior*	*Hearing Group*
Fin Whale (*Balaenoptera physalus)*	Endangered	Hawaii stock: 203 (CV=0.99) (Carretta et al. 2021).	Distributed in all oceans, from tropical to polar oceanic waters; 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).	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).	VLF
Gray Whale (*Eschrichtius robustus*)	Endangered: WNP DPS	WNP DPS: 290 (Cooke 2018)	Found in shallow coastal waters as far south as southern China in the WNP.	Shallow divers; maximum known dive depth is 560 ft (170 m) with maximum dive duration of 26 min (Swartz 2018).	LF
Humpback Whale (*Megaptera novaeangliae*)	Endangered: WNP DPS	Central North Pacific (CNP) Ocean stock: 21,808 whales (CV=0.04) (Barlow et al. 2011) WNP DPS: 1,000 (Calambokidis et al. 2008) Hawaii DPS: 10,103 (Calambokidis et al. 2008)	CNP stock with feeding areas from southeast Alaska to the Alaskan Peninsula. Hawaii DPS whales migrate and feed throughout the entire North Pacific. The WNP stock, CNP stock, and the CA-OR-WA stock all have Hawaii DPS whales within their respective feeding ground region. Only one breeding area, West Australia, has been identified in the western Indian Ocean (NOAA 2016).	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).	LF
North Pacific Right Whale (*Eubalaena japonica*)	Endangered	No population estimate, but likely under 1,000 whales (Wade et al. 2011)	Occur in the Sea of Okhotsk and southeastern Bering Sea; rare occurrences in Sea of Japan and North Pacific waters.	Estimated dive depths up to 82 ft (25 m) (Thode et al. 2017) and dive durations ranging from 41 sec to 12 min (Crance et al. 2017).	LF

Species	*ESA Listing Status*	*Stocks and Population Estimates*	*Habitat and Range*	*Dive and Swim Behavior*	*Hearing Group*
Omura's Whale (*Balaenoptera omurai*)		No global or regional abundances available.	Strong tendency toward a coastal and neritic water distribution; there are several pelagic water records. No information is available on their migratory behavior.	Swim speeds and dive behavior have not yet been documented.	LF
Sei Whale (*Balaenoptera borealis*)	Endangered	Hawaii stock: 391 (CV=0.90) (Bradford et al. 2017; Carretta et al. 2023)	Occur in temperate, oceanic waters of all oceans. Migratory species, seasonally traveling between low latitude calving grounds and high latitude foraging grounds (Jefferson et al. 2015).	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).	LF
Odontocetes					
Baird's Beaked Whale (*Berardius bairdii*)	N/A	Off the Pacific Coast of Japan: 3,596 (CV=0.82) (Sasaki et al. 2023) Eastern Sea of Japan: 1,468 (Miyashita 1990)	Occur in the North Pacific, in the Bering and Okhotsk Seas and off the coast of California (Kasuya 1986; Yack et al. 2013). Migrate to the coastal waters of the WNP and the Southern Sea of Okhotsk in the summer (Ohizumi et al. 2003). Inhabit deep waters; abundant in areas of steep topographic relief, such as shelf breaks and seamounts (Dohl et al. 1983; Kasuya 1986).	Average dive durations at 15.5 min (Barlow 1999). Max depth: 5,830 ft (1,777 m), with deep dives (greater than 3,280 ft [1,000 m]), followed by several 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). Speeds of 2.7 and 2.9 kt (3.1 and 3.3 mph) (Stimpert et al. 2014).	HF
Common Bottlenose Dolphin (*Tursiops truncatus*)	N/A	WNP Northern Offshore stock: 100,281 (Kasuya and Perrin 2017; Miyashita 1993)	Worldwide distribution in temperate to tropical waters (Wells and Scott 2018). Found in coastal waters and in diverse habitats from rivers	Dive times as long as 10 min (Ridgway 1986). Offshore dolphins performed long (greater than 272 sec) and deep (greater than 653 ft [199 m]) dives	HF

Species	***ESA Listing Status***	***Stocks and Population Estimates***	***Habitat and Range***	***Dive and Swim Behavior***	***Hearing Group***
		WNP Southern Offshore Japan: 40,769 (Kanaji et al. 2018) Japanese Coastal stock: 3,516 (Kanaji et al. 2018) WNP stock: 168,792 (Miyashita 1993) Hawaii pelagic population: 24,669 (CV=0.57) (Carretta et al. 2024)	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). Year-round calving season, with peaks in early spring through early fall (Wells and Scott 2018). No known breeding grounds.	(Fahlman et al. 2023). Max dive depth: 1,760 ft (535 m) (Ridgway 1986). Sustained swim speeds between 2 and 10 kt (2 and 11.5 mph), speeds recorded as high as 29 kt (62 mph) (Lockyer and Morris 1987).	
Common Dolphin (*Delphinus delphis delphis*) and Indo-Pacific Common Dolphin (*Delphinus delphis tropicalis*)	N/A	No global or regional abundances available.	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). Most common in the coastal waters of the Pacific Ocean, often within 110 mi (180 km) of land (Jefferson et al. 2015).	Dive depths between 30 and 656 ft (9 and 200 m), most dives occurring to 30 to 160 ft (9 to 50 m) (Evans 1994). Max dive depth: 846 ft (258 m) (Evans 1971). Swim speeds at 3.1 kt (3.6 mph), with max speeds of 8.75 kt (10 mph) (Evans 1971).	HF
Cuvier's Beaked Whale (*Ziphius cavirostris*)	N/A	Hawaii stock: 4,431 (CV=0.41) (Bradford et al. 2021)	The most cosmopolitan of all beaked whales. Except for the high Arctic and Antarctic waters, widely distributed in tropical to polar oceanic waters of all oceans and major seas, including the Sea	Mean depth recorded for foraging dives: 3,878 ft (1,182 m) (Barlow et al. 2020). Dive durations between 20 and 87 min (avg: 30 min) (Baird et al. 2004; Jefferson et al. 1993). Swim speeds between 2.7 and	HF

Species	***ESA Listing Status***	***Stocks and Population Estimates***	***Habitat and Range***	***Dive and Swim Behavior***	***Hearing Group***
			of Japan and Sea of Okhotsk (Heyning and Mead 2009; Jefferson et al. 2008). No data published on breeding and calving grounds.	3.3 kt (3.1 and 4 mph) (Houston 1991).	
Dall's Porpoise (*Phocoenoides dalli*)	N/A	WNP *truei* subspecies: 178,157 (CV=0.23) (Kasuya and Perrin 2017) Sea of Japan *dalli:* 173,638 (CV=0.21) (Kasuya and Perrin 2017) *Dalli* types (WNP): 162,000 (Kasuya and Perrin 2017; Miyashita 1991)	Found exclusively in the North Pacific Ocean and adjacent seas from Baja California and Japan in the south up to the Bering Sea in the north. Oceanic species; found in deep, in areas where deep water comes close to shore (Jefferson et al. 2015). Distribution and seasonal movement is poorly understood (Jefferson et al. 2015).	Relatively deep divers, up to 900 ft (275 m), as long as 8 min (Hanson et al. 1998; Ridgway 1986). Fast swimmers, avg speeds between 1.3 and 11.7 kt (1.5 and 13.5 mph) (Croll et al. 1999). Can reach speeds of 30 kt (35 mph) for quick bursts (Leatherwood and Reeves 1983).	VHF
Dwarf Sperm Whale (*Kogia sima*) and Pygmy Sperm Whale (*Kogia breviceps*) [1]	N/A	*K. sima* Hawaii stock: 53,421 (CV=0.63); *K. breviceps* Hawaii stock: 42,083 (CV=0.64) (Bradford et al. 2021) *Kogia* spp. in Southwest Indian Ocean: 683 (Laran et al. 2017)	Distributed worldwide, in temperate to tropical deep waters; 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).	Dwarf sperm whales exhibited a maximum dive time of 43 min (Breese and Tershy 1993). Swim speeds vary, averaging 3 kt (3.5 mph), reaching up to 5.9 kt (7 mph) (Scott et al. 2001).	VHF
False Killer Whale (*Pseudorca crassidens*)	Endangered: Main Hawaiian	Northwestern Pacific: 16,668 (CV=0.26) (Miyashita 1993)	Found worldwide in tropical to warm temperate zones in deep waters (Chivers et al.	Shallow dives had a mean duration of 103 sec and a mean maximum depth across	HF

Species	***ESA Listing Status***	***Stocks and Population Estimates***	***Habitat and Range***	***Dive and Swim Behavior***	***Hearing Group***
	Islands (MHI) Insular stock	Hawaii pelagic stock: 5,528 (CV=0.35) MHI Insular False Killer Whale (IFKW): 138 (CV=0.08) Northwestern Hawaiian Islands stock: 477 (CV=1.71) (Carretta et al. 2024)	2010; Martien et al. 2011; NOAA 2012a).	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).	
Fraser's Dolphin (*Lagenodelphis hosei*)	N/A	Hawaii: 40,960 (CV=0.70) (Bradford et al. 2021)	Oceanic species, found tropical and subtropical waters, in deep waters (3,280–11,000 ft [1,000–3,500 m]), and in areas where deep water approaches the coast (Croll et al. 1999; Dolar 2009; Jefferson et al. 2015). Breeding areas and calving seasonality not been confirmed.	Feed at two depth horizons: at least 820 ft (250 m) and at least 1,640 ft (500 m) depth (Robison and Craddock 1983). Swim speeds between 2 and 4 kt (2 to 4.5 mph) (Alling 1986).	HF
Harbor Porpoise (*Phocoena phocoena*)	N/A	Global population: at least 675,000 (Jefferson et al. 2015)	Found in cold temperate and sub-arctic neritic waters of the Northern Hemisphere (Jefferson et al. 1993). Frequently found in coastal waters; may occur in adjacent shallow and deep offshore waters (Gaskin 1992). Show seasonal movement that may be related to oceanographic changes (Gaskin 1992; Heimlich-Boarn et al. 1998; Read and Westgate 1997). Migration data suggest seasonal movements are	Dive times between 0.7 and 1.7 min, a max duration of 5.3 min (Westgate et al. 1995). Mean dive depths from 46 to 144 ft (14 to 44 m), max dive depth of 741 ft (226 m) (Westgate et al. 1995). Avg dive rate was 44 dives per hour and avg depth 79 ft (24 m) (Linnenschmidt et al. 2013). Max swim speeds from 9.0 to 12.0 kt (10.5 to 14 mph) (Gaskin et al. 1974). Mean horizontal/surface swim speed of 1.2 kt (1.4 mph) (van Beest et al. 2018).	VHF

Species	*ESA Listing Status*	*Stocks and Population Estimates*	*Habitat and Range*	*Dive and Swim Behavior*	*Hearing Group*
			discrete and not temporally coordinated migrations (Read and Westgate 1997).		
Indo-Pacific Bottlenose Dolphin (*Tursiops aduncus*)	N/A	Japanese waters: 218 (Wang 2018)	Warm temperate to tropical waters of the Indian Ocean and southwestern Pacific Ocean; coastal species, occurring predominantly over the continental shelf, in shallow coastal and inshore waters (Cribb et al. 2013; Jefferson et al. 2015). Breeding areas and calving seasonality not been confirmed.	Dive depths and durations thought to be less than 700 ft (200 m) and from 5 to 10 min. Swim speeds range from 0.8 to 2.2 kt (1 to 2.5 mph); bursts of higher speeds can reach 8.6 to 10 kt (10 to 11.5 mph). (Wang 2018).	HF
Killer Whale (*Orcinus orca*)	N/A	Hawaii stock: 161 (CV=1.06) (Bradford et al. 2021)	Cosmopolitan species found in all the world's oceans, in cold-areas of high productivity and in high latitude coastal areas (Forney and Wade 2006; Leatherwood and Dalheim 1978). Individual populations known to migrate between high and low latitude waters (Dahlheim et al. 2008; Durban and Pitman 2012; Matthews et al. 2011).	Resident ecotypes: mean maximum dive depths of 463 ft (141 m) (Baird et al. 2005). Transient ecotypes: short dives (less than 16 ft [5 m]) lasted less than a minute, deep dives (52 and 160 ft [16 and 50 m]) lasted 3 to 7 min (Miller et al. 2010). Average swim speeds of 3.1 kt (3.5 mph) (Williams and Noren 2009).	HF
Longman's Beaked Whale (*Indopacetus pacificus*)	N/A	Hawaii EEZ abundance: 2,550 (CV=0.67) (Bradford et al. 2021)	Distributed in tropical waters of the Indo-Pacific Oceans (Jefferson et al. 2008; Pitman 2018). Rare in the eastern Pacific and Indian Oceans; more common in the western	Diving information is limited. Two dive duration periods: short durations (11 to 18 min) and long durations (20 to 33 min) (Anderson et al. 2006). No data available on swim speeds.	HF

Species	*ESA Listing Status*	*Stocks and Population Estimates*	*Habitat and Range*	*Dive and Swim Behavior*	*Hearing Group*
			Pacific and Indian Oceans; a preference for warmer waters in western ocean basins (Pitman 2018). Seasonal movements unknown.		
Melon-Headed Whale (*Peponocephala electra*)	N/A	Pacific coast of Japan population (WNP): 56,213 (Kanaji et al. 2018) Hawaiian Islands stock: 40,647 (CV=0.74) (Bradford et al. 2021)	Pelagic tropical and subtropical waters worldwide; associated with oceanic islands and archipelagoes (Brownell Jr et al. 2009; Jefferson and Barros 1997). Rarely found nearshore, unless in deep coastal waters (Jefferson et al. 2015). Breeding areas and seasonal movements of not been confirmed.	Two modes of foraging dives: less than 328 ft (100 m); foraging dives ranged from 490 to 1,600 ft (150 to 500 m); durations were as long as 39 min, averaged 10 min (Joyce et al. 2017). No swim speeds available.	HF
Mesoplodon Beaked Whales	N/A	Hawaii stock Blainville's beaked whales: 1,132 (CV=0.99) (Bradford et al. 2021)	With the exception of cold, polar waters, *Mesoplodon* beaked whales distributed in all of the world's oceans in deep (greater than 6,562 ft [2,000 m]) pelagic waters. For information on specific spp. of *Mesoplodon* distribution, see Appendix C (Biological Resources Supplemental Information).	Information only quantified for Blainville's beaked whales. Averaged 7.5 min dive durations during social interactions (Baird et al. 2004). Non-foraging dives reached 1,150 ft (350 m), lasting 40 min; foraging dives between 2,000 and 6,200 ft (600 and 1,900 m), with durations between 30 and 70 min (Joyce et al. 2017). Horizontal swim speeds of 0.4 to 0.8 kt (0.5 to 1 mph), with a max rate of 4.4 kt (5 mph) (Schorr et al. 2009).	HF
Northern Right Whale Dolphin	N/A	No global or regional abundances available.	Oceanic species in temperate to subarctic regions of the	Dives as long as 6 min, up to 660 ft (200 m) deep where their	HF

Species	*ESA Listing Status*	*Stocks and Population Estimates*	*Habitat and Range*	*Dive and Swim Behavior*	*Hearing Group*
(*Lissodelphis borealis*)			North Pacific, in deeper waters from the outer continental shelf to the oceanic region, and from 34 to 54 °N and 118 to 145 °W (Jefferson et al. 2015). Exhibit inshore-offshore movements seasonally in some areas (Lipsky 2018).	prey of choice (e.g. small fish and cephalopods) is present (Leatherwood and Walker 1979). Swim speeds average around 14 kt (16 mph), with short bursts reaching up to 19 kt (22 mph) (Lipsky 2018).	
Pacific White-sided Dolphin (*Lagenorhynchus obliquidens*)	N/A	No global or regional abundances available.	Found in pelagic areas, with a primarily cold temperate distribution across the North Pacific (Black 2009; Jefferson et al. 2015). Distributed within continental shelf and slope waters within 100 nm (185 km) of shore, often moving into coastal and inshore waters. No breeding grounds known; distribution linked to water temperatures and prey abundance (Rechsteiner 2012).	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 swimming as fast as 15 kt (17 mph) for 2 sec intervals; mean travel speed of 4.1 kt (5 mph) (Black 1994; Lang and Daybell 1963).	HF
Pantropical Spotted Dolphin (*Stenella attenuata*)	N/A	Pacific coast of Japan (WNP stock): 130,002 (Kanaji et al. 2018) Hawaii Pelagic: 67,313 (CV=0.27) (Carretta et al. 2024)	Throughout tropical and sub-tropical waters from 40 °N to 40 °S in the Pacific and Indian Oceans. Typically oceanic; can be found close to shore in areas where deep water approaches the coast (Jefferson et al. 2015).	Dive to at least 560 ft (170 m); most dives between 160 and 328 ft (50 and 100 m) for 2 to 4 min (Stewart 2018). Swim speeds of 2 to 5.6 kt (2 to 6.5 mph); bursts up to 12 kt (14 mph) (Jefferson et al. 2015; Scott and Chivers 2009).	HF
Pygmy Killer Whale (*Feresa attenuata*)	N/A	Hawaii population: 10,328 (CV=0.75) (Bradford et al. 2021)	Sighted in oceanic tropical and subtropical waters of all oceans (Donahue and	Rehabilitated adults with dives as deep as 1,210 ft (368 m), as long as 9 min (Pulis et al. 2018). In	HF

Species	*ESA Listing Status*	*Stocks and Population Estimates*	*Habitat and Range*	*Dive and Swim Behavior*	*Hearing Group*
			Perryman 2009). Hawaii population with high site fidelity; considered to be a resident population (McSweeney et al. 2009). No data on seasonal migration patterns or the locations of breeding or calving grounds.	Hawaiian waters median swim speeds of 1.5 kt (1.7 mph) and 1.7 kt (2 mph) recorded (Baird et al. 2011).	
Risso's Dolphin (*Grampus griseus*)	N/A	Pacific Coast of Japan (WNP stock): 143,374 (CV=0.69) (Kanaji et al. 2018) Hawaii stock: 6,979 (CV=0.29) (Carretta et al. 2024)	Inhabit deep oceanic and continental slope waters from the tropics through the temperate regions (Baird 2009; Jefferson et al. 1993). Predominantly at steep shelf-edge habitats, rarely in waters below 50 °F (10 °C) (Baird 2009). Known to calve year-round. No data on breeding grounds are available.	Dive times up to 30 min (Jefferson et al. 2015); median dive time of 5.6 min (Rone et al. 2022). Time spent at surface between foraging dives: 1 to 3 min; most foraging dives to shallow water depths (less than 300 ft [90 m]) (Arranz et al. 2018). Swim speeds: 3 to 4 kt (3.5 to 5 mph) (Kruse et al. 1999).	HF
Rough-toothed Dolphin (*Steno bredanensis*)	N/A	Pacific Coast of Japan (WNP stock): 5,002 (CV=1.24) (Kanaji et al. 2018) Hawaii stock: 83,915 (CV=0.49) (Carretta et al. 2024)	Oceanic tropical and warm-temperate waters worldwide; in deep, offshore waters that lack major upwelling (Jefferson 2018). Seasonal movements and breeding areas unconfirmed. High site-fidelity (Baird et al. 2008).	Dives up to 100 to 230 ft (30 to 70 m), with durations from 0.5 to 3.5 min (Ritter 2002; Watkins et al. 1987). Median dive depth of 222 ft (67.5 m) and duration of 3.1 min (Shaff and Baird 2021). Swim speeds vary from 3.0 to 8.6 kt (3.5 to 10 mph) (Ritter 2002; Watkins et al. 1987).	HF
Sato's Beaked Whale (*Berardius minimus*)	N/A	No global or regional abundances available.	Distribution between 40 °N and 60 °N, and 140 °E and 160 °W (Morin et al. 2017; Yamada et al. 2019). Hypothesized to utilize	Diving and acoustic behaviors have not yet been quantified or studied for Sato's beaked whales. However, they are hypothesized to have similar diving and	HF

Species	*ESA Listing Status*	*Stocks and Population Estimates*	*Habitat and Range*	*Dive and Swim Behavior*	*Hearing Group*
			habitat similar to Baird's beaked whales, which are found on or near the continental slope and oceanic seamounts in cold-temperate waters.	acoustic behaviors to Baird's beaked whales (Brownell Jr and Kasuya 2021).	
Short-finned Pilot Whale (*Globicephala macrorhynchus*)	N/A	Hawaii stock: 19,242 (CV=0.23) (Carretta et al. 2024) WNP Northern stock: 20,884 WNP Southern stock: 31,396 (Kanaji et al. 2018)	Occur from nearshore to pelagic and tropical to warm-temperate waters; considered nomadic, although resident populations are known to occur in the Hawaiian Islands (Olson 2018).	Considered deep divers; bimodal dive behaviors; frequent deeper dives to a max depth of 3,343 ft (1,019 m) (Aguilar Soto et al. 2008). Durations as long as 20 min (Alves et al. 2013) Traveling speeds between 4 and 5 kt (5 to 6 mph)(Norris and Prescott 1961).	HF
Sperm Whale (*Physeter macrocephalus*)	Endangered	Global estimate: 844,761 (CV=0.209) (Whitehead and Shin 2022) WNP stock: 102,112 (CV=0.155) (Muto et al. 2021) Hawaii stock: 5,707 (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).	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).	HF
Spinner Dolphin (*Stenella longirostris*)	N/A	Hawaii Island: 665 (CV=0.09) (Carretta et al. 2024)	Pantropical, occurring in tropical and subtropical oceanic waters from about 40 °S to 40 °N (Jefferson et al. 2015). Found in coastal regions of Hawaii, the eastern Pacific, Indian Ocean, and off Southeast Asia, usually	Can dive up to 2,000 ft (600 m) deep (Perrin 2018b). Dive durations are unknown. Known for their aerial behavior, 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). Swim	HF

Species	***ESA Listing Status***	***Stocks and Population Estimates***	***Habitat and Range***	***Dive and Swim Behavior***	***Hearing Group***
			resting in the shallow waters of bays of oceanic islands and atolls (Perrin 2018b). Various geographical forms exist (Jefferson et al. 2015).	speeds that rarely exceed 5 to 5.98 kt (6 to 7 mph) (Norris et al. 1994).	
Striped Dolphin (*Stenella coeruleoalba*)	N/A	Hawaii pelagic : 64,343 (CV=0.28) (Carretta et al. 2024) Northern Offshore stock: 497,725; Southern Offshore stock: 52,582; Japanese Coastal stock: 19,631 (Kasuya and Perrin 2017; Miyashita 1993)	Common in tropical and warm-temperate oceanic waters between 50 °N and 40 °S (Jefferson et al. 2015). Found in coastal waters in areas with narrow continental shelves or where deep waters are found close to shore. Occurrences associated with oceanographic fronts or circulation features in many upwelling regions.	Dive times are unknown. Based on preferred prey, may be diving between 700 and 2,300 ft (200 and 700 m) to feed (Archer 2009). Average swim speeds of 6.10 kt (7 mph) (Lafortuna et al. 1993).	HF
Pinnipeds					
Bearded Seal (*Erignathus barbatus*)	Threatened	Okhotsk Sea population: 95,000 (Cameron et al. 2010; Fedoseev 2000) Bering Sea population: 301,836 (Conn et al. 2014; Muto et al. 2021) Pacific population: at least 250,000 (Kovacs 2016)	Discontinuous circumpolar distribution, from 80 °N in the Arctic, to south at 45 °N into subarctic areas of Hokkaido. Inhabit shallow continental shelf waters that are restricted to seasonal sea ice. Seasonal distribution limited by distribution of benthic prey. Rely on sea ice for pupping in mid-March to early May; migrate north with the retreating ice and return south again in fall and winter as the ice advances (Jefferson et al. 2015).	Most dives shallow, with avg depth of 79 ft (24 m) deep and a max depth of 1,280 ft (391 m). Avg durations short (i.e., 6.6 min) with a max of 24 min (Hamilton et al. 2018). Bi-modal dive behavior, peak diving activities shallower than 33 ft (10 m) and from 160 to 230 ft (50 to 70 m) (Gjertz et al. 2000). Swim speeds in pups ranged from 0.97 kt (1 mph) in the smallest pup studied, up to 1.7 kt (2 mph) (Watanabe et al. 2009).	PCW

Species	*ESA Listing Status*	*Stocks and Population Estimates*	*Habitat and Range*	*Dive and Swim Behavior*	*Hearing Group*
Harbor Seal (*Phoca vitulina*)	N/A	Worldwide population: between 610,000 and 640,000 (Bjørge et al. 2010) Aleutian Islands: 5,588 (Muto et al. 2021)	Widespread in coastal areas of the continental shelf and slope; in bays, rivers, estuaries, and intertidal areas. Found in temperate and polar regions in the Northern Hemisphere, from the Aleutian Islands across to the Commander Islands, Russia, down south to Kamchtaka through the Kuril Islands to Hokkaido, Japan. Considered non-migratory.	Dives as deep as 1,580 ft (480 m) and as long as 35.3 min (Eguchi and Harvey 2005). Most dives within the upper 160 ft (50 m) of the water column; deepest dive on record was to 2,070 ft (630 m), lasting between 20 and 25 min (Rosing-Asvid et al. 2020).) Estimated avg swim speeds 5.83 kt (6.7 mph) (Davis et al. 1991).	PCW
Hawaiian Monk Seal (*Neomonachus schauinslandi*)	Endangered	Hawaii stock: 1,564 (CV=0.05)	Only occur throughout the subtropical waters of the Hawaiian Archipelago and Johnson atoll; may be found in shelf waters, slope, and bank habitats.	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. 2017).	PCW
Northern Fur Seal (*Callorhinus ursinus*)	N/A	Global population: 1.29 million (Gelatt et al. 2015) Western Pacific stock: 503,609 (Gelatt et al. 2015; Kuzin 2014)	Widely distributed in pelagic waters across the North Pacific Ocean from 35 °N northward to the Bering Sea, including the Sea of Okhotsk and the Sea of Japan (Jefferson et al. 2015). Seals from Tyuleny Island, the Commander Islands, and Kuril Islands migrate southward into the Sea of Japan and into Pacific waters off the eastern	Average dives time around 1.24 min to average depths of 57.4 ft (17.5 m) (Sterling and Ream 2004). Shallow dives to 70 ft (20 m) deep, lasting less than 1 min,; deeper dives to 460 ft (140 m) lasted 2 to 5 min in duration (Kooyman et al. 1976). Routine migration swim speeds were 1.54 kt (1.8 mph); during foraging, swim speeds averaged between 0.48 and	OCW

Species	*ESA Listing Status*	*Stocks and Population Estimates*	*Habitat and Range*	*Dive and Swim Behavior*	*Hearing Group*
			side of Japan (Gentry 2009; Horimoto et al. 2017; Horimoto et al. 2016).	1.23 kt (0.6 and 1.4 mph) (Ream et al. 2005).	
Ribbon Seal (*Histriophoca fasciata*)	N/A	Sea of Okhotsk population: 181,179 (Chernook et al. 2014) Bering Sea population: 184,000 (Conn et al. 2014; Muto et al. 2021) Total North Pacific population: 365,000 (Lowry 2016)	Distribution limited to the northernmost Pacific Ocean and Arctic Ocean including the Chukchi Sea; predominant occurrences in the Bering Sea and Sea of Okhotsk (Fedoseev 2000; Jefferson et al. 2015). Associated with the southern edge of the pack ice from winter through early summer (Fedoseev 2000). During the summer months, more pelagic, with a broader distributional range and less associated with the sea ice (Jefferson et al. 2015).	Diving patterns tied to season; tendency for dive depths to increase as the ice edge expands south, closer to the continental shelf break (Boveng et al. 2013). During spring, dives tend to be shallower, to depths of 230 to 300 ft (70 to 100 m). When not tied to sea ice, deeper dives, up to 1,600 ft (500 m); rarely dive past 2,000 ft (600 m) (Boveng et al. 2013). Dive duration data are unavailable for ribbon seals.	PCW
Ringed Seal (*Pusa hispida*)	Endangered: Arctic subspecies Threatened (foreign): Okhotsk subspecies	Arctic: 158,507 (Conn et al. 2014; Muto et al. 2021)	Continuous, circumpolar Arctic distribution with isolated populations outside of the Arctic.	Dive behavior is driven by prey presence. Across individual seals, median dive durations were 10 min, with a maximum duration of 26.4 min.	PCW
Spotted Seal (*Phoca largha*)	Threatened (foreign): Southern DPS	Global: 640,000 (Boveng 2016)	Occur in cold temperate and polar waters of the North Pacific and Arctic Oceans. They are found either in the open ocean or in pack-ice habitats throughout the year.	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).	PCW

Species	*ESA Listing Status*	*Stocks and Population Estimates*	*Habitat and Range*	*Dive and Swim Behavior*	*Hearing Group*
Steller Sea Lion (*Eumetopias jubatus*)	Endangered: Western DPS	U.S. Western stock: 49,837 (Young et al. 2024)	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)	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).	OCW

avg = average; CNP = Central North Pacific; CV = coefficient of variation; DPS = Distinct Population Segment; EEZ = Exclusive Economic Zone; ESA = Endangered Species Act; FM = frequency-modulated; ft = feet; HF = high-frequency; Hz = Hertz; IFKW = Insular False Killer Whale; kHz = kilohertz; kt = knots; LF = low-frequency; m = meter; min = minutes; max = maximum; MHI = Main Hawaiian Islands; mph = miles per hour; N/A = not applicable; OCW = otariids and other non-phocid carnivores in-water; PCW = phocid carnivores in-water; SL = source level; SPL = sound pressure level; WNP = Western North Pacific; VHF = very high-frequency; VLF = very low-frequency; °C = degrees Celsius; °E = degrees East longitude; °F = degrees Fahrenheit; °N = degrees North latitude; °S = degrees South latitude; °W = degrees West longitude

[1] Differentiation between the dwarf sperm whale (*Kogia sima*) and pygmy sperm whale (*Kogia breviceps*) is difficult to determine at-sea; therefore, data for both species are typically combined.

3.5.2 Environmental Consequences

This section evaluates how and to what degree the activities described in Chapter 2 potentially affect marine mammals known to occur within the Study Area. The information below builds on the analyses conducted in the Navy's past work for SURTASS LFA, which are herein incorporated by reference. The only stressor analyzed is the acoustic stressor: underwater LFA and HF/M3 sonar noise. All physical (vessel movement, passive sonar array movement, and entanglement) or other acoustic stressors (underwater vessel sound) are not analyzed because adverse effects to marine mammals from these stressors are not reasonably foreseeable (Section 3.1.3).

In this analysis, marine mammal species are grouped together based on similar biology (e.g., hearing) or behaviors (e.g., feeding or expected reaction to stressors) when most appropriate for the discussion. In addition, species are grouped based on their taxonomic relationship as follows: mysticetes (baleen whales), odontocetes (toothed whales), and pinnipeds (seals and sea lions). Based on acoustic thresholds and criteria developed with NMFS, effects from sound sources as acoustic stressors will be quantified at the species or stock level as is required pursuant to authorization of the proposed actions under the MMPA.

3.5.2.1 Acoustic Stressor: SURTASS LFA and HF/M3 Sonar Transmissions

When exposed to sonar, marine mammals may experience auditory effects (i.e., AINJ and TTS), behavioral change, acoustic masking, or physiological stress (Atkinson et al. 2015; Clark et al. 2009; Nowacek et al. 2007; Southall et al. 2019b). Underwater sounds have also been implicated in strandings of marine mammals as a non-auditory effect. Additionally, sonar could affect critical habitats of ESA-listed marine mammals within the Study Area by altering the key biological and/or physical features for which critical habitat has been designated. Details and information on these types of effects and the associated conclusions provided in previous SURTASS LFA environmental analyses (U.S. Department of Navy 2007a, 2012, 2017, 2019) are incorporated by reference herein except as addressed below in summaries of best available science that may pertain or be pertinent to effects associated with the Proposed Action. A Quantitative Effects Analysis (Appendix D, Acoustic Effects Analysis) considers the following consequences from acoustic stressors of the Proposed Action on marine mammals.

3.5.2.1.1 Non-auditory Effects

Non-auditory injury (i.e., physical trauma) refers to the effects on the tissues or organs of an animal due to exposure to pressure waves. Several mechanisms of acoustically induced tissue damage (non-auditory) have been proposed. Nowacek et al. (2007) and Southall et al. (2007) reviewed potential types of non-auditory injury to marine mammals from active sonar transmissions. These types of injuries include direct acoustic effect on tissue, indirect acoustic effect on tissue surrounding a structure, and acoustically mediated bubble growth within tissues from supersaturated dissolved nitrogen gas.

No new studies of non-auditory injury to marine mammals have been published since the 2019 SEIS/SOEIS that are relevant to LFA sonar. SURTASS LFA sonar is not expected to lead to marine mammal strandings via any scientifically documented mechanisms either physiologically or behaviorally. No known strandings have occurred coincident to SURTASS LFA sonar transmission, and no studies indicate strong avoidance reactions to SURTASS LFA sonar would occur. Therefore, due to the operational characteristics, particularly the lower frequencies (100 to 500 Hz), in which SURTASS LFA sonar operates and the low potential for non-auditory injury, non-auditory effects would not be expected to occur.

The Navy evaluated the areas where SURTASS LFA sonar transmissions were with the spatial and temporal overlap of reported strandings and found no individual marine mammals have stranded in the vicinity of SURTASS LFA sonar activities. No injured or disabled marine mammals were observed during or immediately after any SURTASS LFA sonar activities. Rather, some stranding events of marine mammals that have occurred within regions of the Study Area have been suggested to have occurred due to natural disaster and individual mammal underlying health conditions; although the reasons are not completely known (NOAA 2023a; Shazuli 2023). The transmission of SURTASS LFA sonar, a non-impulsive sound, would only occur for a short period of time (duration of each continuous-frequency sound transmission within the wavetrain is no longer than 10 sec in the frequency range of 100 to 500 Hz), and these operating characteristics are the same as in past years. Therefore, based on historical data, strandings from SURTASS LFA sonar are not expected.

3.5.2.1.2 Hearing Loss and Auditory Effects

Hearing loss has only been studied in a few species of marine mammals, although hearing studies with terrestrial mammals may also be informative in the absence of studies in marine mammals. Several studies have been conducted, focusing on the relationships among the amount of threshold shift and the level, duration, and frequency of the stimulus (NMFS 2018; Southall et al. 2019b; U.S. Department of Navy 2017). These studies typically use threshold shifts of 6 dB to represent the upper limit of noise exposure. The amount of threshold shift measured usually decreases with increasing recovery time—the amount of time that has elapsed since a noise exposure. If the threshold shift eventually returns to zero (i.e., the hearing threshold returns to the pre-exposure value), it is considered a TTS. If the threshold remains elevated compared to the pre-exposure value, the remaining threshold shift is considered AINJ.

Figure 3-2 shows two hypothetical scenarios: one that completely recovers, a TTS, and one that does not completely recover, leaving AINJ. By definition, TTS is a function of the recovery time; therefore, comparing the severity of noise exposures based on the amount of induced TTS can only be done if the recovery times are also taken into account. For example, a 20 dB threshold shift measured at 24 hour post-exposure indicates a more hazardous exposure than one producing 20 dB of threshold shift measured at only 2 min after exposure because the former exposure would have likely resulted in much higher than 20 dB threshold shift if it had been measured shortly after exposure (e.g., 2 min).

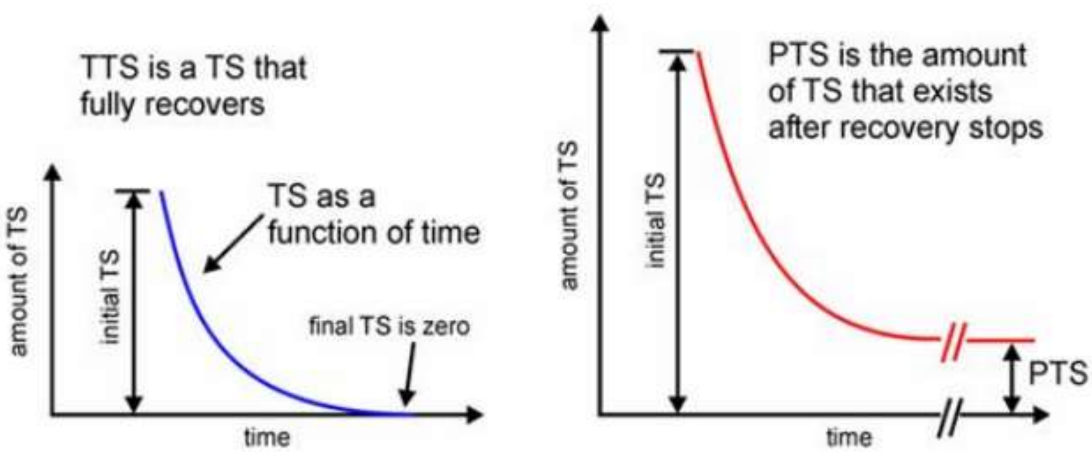

Figure 3-2. Two Hypothetical Threshold Shifts (TS)

TS can result in a temporary threshold shift (TTS) or a permanent threshold shift (PTS)—now referred to as auditory injury (AINJ)

Studies have revealed that intense noise exposures may also cause auditory system injury, such as neural degeneration, that does not result in permanent AINJ; hearing thresholds return to normal after the exposure, but there is injury nonetheless. Kujawa and Liberman (2009) found that noise exposures sufficient to produce a TTS in neural thresholds of 40 dB, measured 24 hour post-exposure, resulted in acute loss of nerve terminals and delayed degeneration of the cochlear nerve in mice. Lin et al. (2011) found a similar result in guinea pigs, that a TTS in auditory evoked potential of up to approximately 50 dB, measured 24 hour post-exposure, resulted in neural degeneration. These studies indicate that exposures producing high levels of TTS (40 to 50 dB measured 24 hour post-exposure) can still result in some degree of AINJ.

The best available data are used for the analysis of potential auditory effects and, when necessary, protective assumptions are implemented that aim to provide the greatest protection to marine mammals. The detailed descriptions and information on auditory effects provided in previous documentation for SURTASS LFA sonar (U.S. Department of Navy 2007b, 2012, 2017, 2019) are incorporated by reference herein.

Using best available science, the Navy has defined hearing groups, developed auditory weighting functions, and identified the received levels, or acoustic threshold levels, above which individual marine mammals are predicted to experience changes in their hearing sensitivity (AINJ or TTS) for acute, incidental exposure to underwater sound (U.S. Department of Navy 2025).

Within the generalized hearing ranges of marine mammals, the ability to hear sounds varies with frequency, as demonstrated by examining audiograms of hearing sensitivity (Houser et al. 2024; NMFS 2024; Southall et al. 2019b; U.S. Department of Navy 2025). To reflect higher noise sensitivities at particular frequencies, auditory weighting functions were developed for each functional hearing group that reflected the best available data on hearing ability (composite audiograms), susceptibility to noise-induced hearing loss, effects of noise on hearing, and data on equal latency (Figure 3-3). Essentially, the weighting functions capture the frequency-dependent nature of the effects of noise. These weighting functions are applied to individual sound received levels to reflect the susceptibility of each hearing group to noise-induced threshold shifts, which is not the same as the range of best hearing.

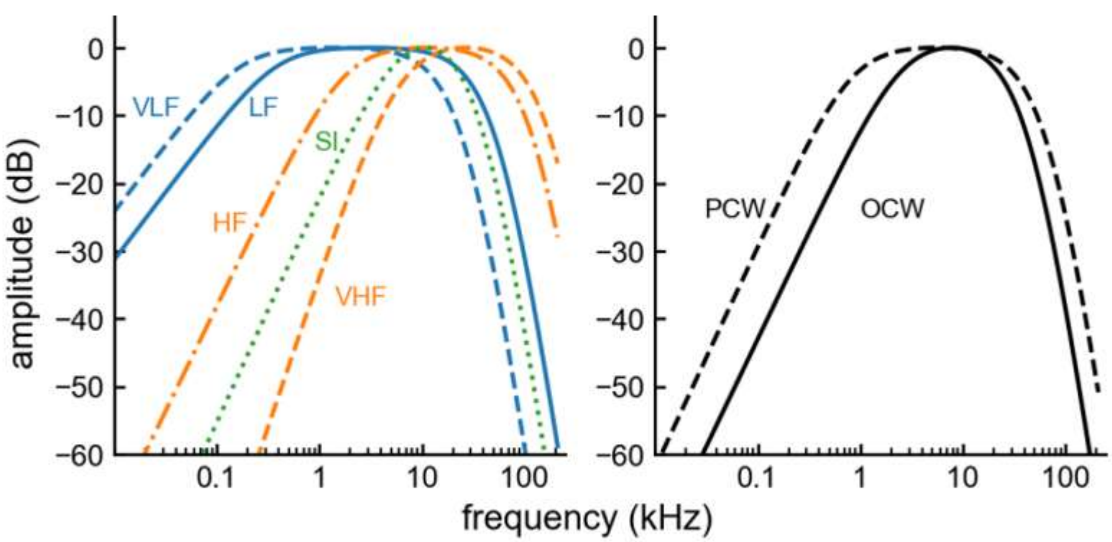

Figure 3-3. Navy Phase IV Auditory Weighing Functions for (A) Cetaceans and Sirenians and (B) Pinnipeds in-water

The Navy (U.S. Department of Navy 2025) defined acoustic threshold levels at which AINJ is predicted to occur for each hearing group for impulsive and non-impulsive signals. LFA sonar is a non-impulsive source, as its signals do not have the high peak pressure with rapid rise time and decay—a characteristic of impulsive sounds. Instead, the pressure (i.e., intensity) of the sonar transmission is consistent throughout the signal. The acoustic threshold levels for non-impulsive sounds are defined as the cumulative SEL over a 24-hour period with the appropriate frequency weighting for each hearing group (Figure 3-3; Table 3-10). The cumulative SEL metric considers both received level and duration of exposure over the duration of the activity within a 24-hour period. A 20 dB offset was chosen to estimate AINJ onset criteria from TTS onset criteria for non-impulsive sources. A summary of the cumulative sound exposure acoustic thresholds for AINJ and TTS are provided (Table 3-10).

Table 3-10. AINJ and TTS Acoustic Threshold Levels for Marine Mammals Exposed to Non-Impulsive Sounds Underwater

Hearing Group	*TTS Onset (SEL weighted)*	*AINJ Onset (SEL weighted)*
Very low frequency cetaceans	177 dB SEL	197 dB SEL
Low frequency cetaceans	177 dB SEL	197 dB SEL
High frequency cetaceans	181 dB SEL	201 dB SEL
Very high frequency cetaceans	161 dB SEL	181 dB SEL
Phocids carnivores (in-water)	175 dB SEL	195 dB SEL
Other marine carnivores (in-water)	179 dB SEL	199 dB SEL

AINJ = auditory injury; TTS = temporary threshold shift; SEL = sound exposure level
Reference: (U.S. Department of Navy 2025)

3.5.2.1.3 Behavioral Change

The primary potential effect on marine mammals from exposure to sonar associated with the Proposed Action would be expected to be behavioral responses, which do not necessarily constitute significant changes in biologically important behaviors. The National Research Council (2003) noted that an action or activity becomes biologically significant to an individual animal when it affects the ability of the animal to grow, survive, and reproduce, wherein an effect on individuals can lead to population-level consequences and affect the viability of the species. The terms "significant response" or "significant behavioral response" are used in describing behavioral observations from field or captive animal research that may rise to the level of "harassment" under the MMPA for military readiness activities. Under the MMPA, for military readiness activities, such as Navy training and testing, behavioral “harassment” is defined as “any act that disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing 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.” (16 U.S.C. § 1362(18)(B)(ii)). Due to the nature of behavioral response research to date, in many cases, it is not possible to ascertain if observed reactions would lead to an abandonment or significant alteration of natural behavior patterns.

Researchers have compiled and evaluated data on extensively studied species as models of how short-term changes in behavior may accumulate to indirectly affect fitness through individual survival and reproduction (Maresh et al. 2014; New et al. 2014; Robinson et al. 2012; Southall et al. 2021). The responses of mysticetes to sonar depend on the characteristics of the signal, behavioral state of the animal, sensitivity and previous experience of an individual, and other contextual factors including distance of the source, movement of the source, physical presence of vessels, time of year, and geographic location (Goldbogen et al. 2013; Harris et al. 2019; Harris et al. 2015; Martin et al. 2015; Miller et al. 2022; Sivle et al. 2015).

A literature review and analysis conducted by Gomez et al. (2016) found that behavioral response in cetaceans was best explained by the interaction between sound source type (e.g., continuous, sonar, seismic/explosion) and hearing group. SLs received by the animal were not part of the model best explained by the data. More severe behavioral responses were associated with the type of source transmitting the acoustic energy, highlighting the importance of context of exposure in effects analysis.

BRS' have been conducted over a variety of contextual and behavioral states, helping to identify which factors, beyond the received level of the sound, may lead to a response. Observed reactions during BRS have not been consistent across individuals based on received sound levels alone, and likely were the result of complex interactions between these contextual factors. None have used an LFA (less than 1 kHz) sound source; therefore, their applicability to determining potential behavioral responses to the Proposed Action is limited. Nevertheless, these data can inform the analysis of marine mammal response to sonar, generally. Southall et al. (2016) provided an overview of the Southern California BRS (SOCAL-BRS). This study summarized the suite of recent field experiments studying cetacean responses to simulated or actual active military sonars in the 1 to 8 kHz frequency range. Several of these studies are discussed later, but a common theme is the context-dependent nature of behavioral responses (e.g., (Friedlaender et al. 2016; Goldbogen et al. 2013; Miller et al. 2014)). The response of a marine mammal to an anthropogenic sound may depend on the frequency, duration, temporal pattern and amplitude of the sound as well as the animal's prior experience with the sound and their behavioral state (i.e., what the animal is doing and their energetic needs at the time of the exposure) (Ellison et al. 2012). The distance from the sound source and whether it is approaching or moving away can also affect the way an animal responds to a sound (Wartzok et al. 2003).

3.5.2.1.3.1 Mysticetes (VLF and LF Hearing Group)

The responses of mysticetes to sonar is highly dependent upon the characteristics of the signal, the behavioral state of the animal, the particular sensitivity and previous experiences of an individual, and other contextual factors, including distance of the source, movement of the source, and the physical presence of vessels in addition to the sonar (Goldbogen et al. 2013; Harris et al. 2015; Martin et al. 2015; Miller et al. 2022; Sivle et al. 2015). BRSs have been conducted over a variety of contextual and behavioral states, helping to identify which contextual factors may lead to a response beyond just the received level of the sound. Observed reactions during BRSs have not been consistent across individuals based on received sound levels alone, indicating that reactions are governed by the sound and contextual factors.

Baleen whales are hypothesized to react more strongly to LF sounds that overlap with their vocalization range. One series of studies was undertaken in 1997–1998 pursuant to the Navy's Low-Frequency Sound Scientific Research Program (LFS SRP). The frequency bands of LF sonars used were between 100 and 500 Hz, with received levels between 115 and 150 dB re 1 µPa. Exposures occurred on foraging grounds (fin whales and blue whales [*Balaenoptera musculus*]), on breeding grounds (humpback whales), and along migratory routes (gray whales [*Eschrichtius robustus*]). These studies found short-term responses to LF sound by some individual fin and humpback whales, including changes in vocal activity and avoidance of the source vessel, while other fin, humpback, and blue whale individuals did not respond at all. When the source was in the path of migrating gray whales, they changed course up to 1 mi (2 km) to avoid the sound, but when the source was outside their path, little response was observed (Clark and Fristrup 2001; Croll et al. 2001; Fristrup et al. 2003; Miller et al. 2000; Nowacek et al. 2007). These responses were short-lived across all individuals, and animals returned to their normal activities within tens of minutes after initial exposure (Clark and Fristrup 2001). The context of an exposure scenario is important for determining the probability, magnitude, and duration of a response (Ellison et al. 2012; Southall et al. 2021).

No other BRSs have used a LF sound source with mysticetes, however BRS' in using mid-frequency active (MFA) sonar can give general insight into potential behavioral reactions to sonar. Surface feeding blue and humpback whales did not show a change in behavior in response to MF simulated and real sonar sources with received levels between 90 and 179 dB re 1 µPa, but deep feeding and non-feeding whales showed temporary reactions including cessation of feeding, reduced initiation of deep foraging dives, generalized avoidance responses, and changes to dive behavior (DeRuiter et al. 2017; Goldbogen et al. 2013; Sivle et al. 2015). These findings indicate that the behavioral state of the animal plays a role in the type and severity of a behavioral response. In fact, when the prey field was mapped as a covariate in similar models, the response to sonar when blue whales exhibited deep-feeding behaviors was more apparent, reinforcing the need for contextual variables to be included when assessing behavioral responses (Friedlaender et al. 2016). However, even when responses did occur, blue whales returned to their previous behavior after the sound exposure ended (Goldbogen et al. 2013). This work was further expanded by measuring behavioral responses of blue whales to operational, real-world-context, MFA sonar (Southall et al. 2019a). More than 50 percent of blue whales in deep-feeding behavior responded, whereas no changes in behavior were identified in shallow-feeding blue whales.

Southall et al. (2023) observed behavioral changes ranging from mild to moderate severity in fin whales in controlled exposure experiments to MF sonar (3.5–4.1 kHz). Overall, responses were more dependent on the exposure received levels, rather than the contextual aspect of exposure (e.g. exposure presence, type, proximity and received levels; environmental factors). Higher received levels were associated with deeper and longer dives, more lunges, higher ascent pitch, greater roll, and greater start heading. All of these variables were evidence of greater foraging, suggesting that foraging success in fin whales was not negatively compromised.

Humpback whales were found to be responsive during and after sonar exposure by exhibiting a reduction in lunge rates, as compared to blue and fin whales (Harris et al. 2019). Humpback whales in an Australian BRS responded to a 2 kHz tone stimulus by changing their course during migration to move more offshore and surfaced more frequently (Dunlop et al. 2013). Humpback whales in the Norwegian Sea Mammals and Sonar Safety (3S) BRS may have habituated slightly between a first and a second sonar exposure (Sivle et al. 2015).

Several humpback whales have been observed during aerial or visual surveys during Navy training events involving sonar; no avoidance or other behavioral responses were ever noted, even when the whales were observed within 3 mi (5 km) of a vessel with active (or possibly active) sonar with maximum received levels estimated to be between 135 and 161 dB re 1 µPa (Mobley 2011; Mobley et al. 2012; Mobley and Pacini 2012; Mobley and Milette 2010; Smultea et al. 2009). In fact, one group of humpback whales approached a vessel with active sonar so closely that the sonar was shut down and the vessel slowed. The whales continued approaching and swam under the bow of the vessel (U.S. Department of Navy 2011). Another group of humpback whales continued heading towards a vessel with active sonar (estimated median received level of 143 dB re 1 µPa) as the vessel was moving away for almost 30 min.

That group was observed producing active surface behaviors (e.g., pec slaps, tail slaps, breaches); however, these are very common behaviors in competitive groups during the breeding season and were not considered to have occurred in response to the sonar (Mobley et al. 2012). LF signals of the Acoustic Thermometry of Ocean Climate (ATOC) sound source were also not found to affect dive times of humpback whales in Hawaiian waters (Frankel and Clark 2000).

One of the strongest baleen whale responses to sonar was observed in a common minke whale in the 3S BRS; the whale was exposed to naval sonar in the 1 to 4 kHz frequency range and responded at 146 dB re 1 µPa by strongly avoiding the sound source (Kvadsheim et al. 2017; Sivle et al. 2015). Although the minke whale increased its swim speed, directional movement, and respiration rate, none of these were greater than rates observed in baseline behavior. Their dive behavior remained similar to baseline dives. A minke whale tagged in the SOCAL-BRS study also responded by increasing its directional movement, but the whale maintained its speed and dive patterns (Kvadsheim et al. 2017). In addition, in Phase 2 of the 3S BRSs, a minke whale demonstrated some of the same avoidance behavior during the controlled ship approach with no sonar, indicating at least some of the avoidance response was due to vessel presence rather than sonar (Kvadsheim et al. 2017).

Based on bottom-mounted hydrophone data off the coast of the Pacific Missile Range Facility (PMRF), Martin et al. (2015) recorded a decrease in the frequency of minke whale calls during periods of Navy training involving sonar relative to the periods before training, and calling increased again in the days after training was completed. The responses of individual whales could not be assessed, so it was unknown whether the decrease in calling density indicated that the animals left the range or simply ceased calling. Similarly, minke whale acoustic detections off Jacksonville, Florida were reduced or ceased altogether during periods of sonar use (Norris et al. 2012; U.S. Department of Navy 2013a), especially in instances of sonar with an increased ping rate (Charif et al. 2015). Durbach et al. (2021) found direct evidence of horizontal movements of minke whales in the vicinity of PMRF in response to MF sonar (around 3 kHz) activity in the area. Overall, minke whale movement was faster and more directed during sonar than at baseline, the mean direction of movement changed consistently away from sonar-producing ships, and calling responses ceased during sonar exposure. Additionally, off the coast of the PMRF, minke whales exhibited faster swim speeds when exposed to Navy sonar (Helble et al. 2023).

Opportunistic passive acoustic-based studies have also detected behavioral responses to MF sonar. Blue whales exposed to MF sonar in the Southern California Bight were less likely to produce LF calls usually associated with feeding behavior, beginning at received levels of 110–120 dB re 1 µPa (Melcon et al. 2012); however, without visual observations, it is unknown whether there was another factor that contributed to the reduction in foraging calls, such as the presence of conspecifics. Risch et al. (2012) and Risch et al. (2014) determined that humpback whale songs produced in the Stellwagen Bank National Marine Sanctuary (NMS) were reduced concurrent with an Ocean Acoustic Waveguide Remote Sensing experiment occurring 120 mi (200 km) away. They concluded that the reduced song was a response to this experiment. However, Gong et al. (2014) analyzed the same data set while also looking at the presence of herring in the region, and they found that the change in song rate could be explained by natural causes. Risch et al. (2014) pointed out that the results of Risch et al. (2012) and Gong et al. (2014) are not contradictory but rather highlight the principal point of their original paper that behavioral responses depend on many factors, including range to source, received level above background sound level, novelty of signal, and differences in behavioral state.

Some studies have examined responses to underwater tones or alarms intended to serve as deterrents. Migrating mysticetes sometimes responded by changing their route away from the deterrent (Dunlop et al. 2013; Frankel and Stein 2020; Watkins and Schevill 1975) or not at all (Harcourt et al. 2014; Morton and Symonds 2002; Pirotta et al. 2016). Other behavioral responses caused by acoustic alarms and deterrents include reduced foraging dives, path predictability and reoxygenation rates, as well as increased swim speeds and dive durations (Boisseau et al. 2021; Nowacek et al. 2004).

Although some strong responses have been observed in mysticetes to sonar, for the most part mysticete responses appear to be fairly moderate across all received levels. While some responses, such as cessation of foraging or changes in dive behavior, could result in short-term effects, in nearly all cases behavior returned to normal either immediately or within a few minutes after the signal stopped. Mysticete responses also seem to be highly influenced by behavioral state, contextual factors, and signal characteristics rather than just received levels alone. No significant behavioral responses by mysticetes, such as panic, stranding, or other severe reactions, have been observed during monitoring of actual training exercises (Smultea et al. 2009; U.S. Department of Navy 2014; Watwood et al. 2012).

Based on previous findings (U.S. Department of Navy 2019) and updated studies, the behavioral responses of mysticetes can occur at a range of received levels and may or may not rise to the level of biologically significant effects. Sonar use associated with the Proposed Action could occur anywhere in the western North Pacific or Indian Oceans, and use would be spread over multiple vessels. Additionally, no other studies have been conducted with LF sonars or other non-impulsive sources that utilize frequency bands similar to SURTASS LFA sonar that could be used to supplement the Navy's LFS SRP results.

3.5.2.1.3.2 Odontocetes (HF and VHF Hearing Groups)

Odontocetes are classified as having HF and VHF hearing. While BRS have been conducted on odontocete species, the focus has been on beaked whale responses to active sonar transmissions or controlled exposure playback of simulated sonar on various military ranges (Claridge et al. 2009; Henderson et al. 2015; McCarthy et al. 2011; Miller et al. 2012; Moretti et al. 2009; Southall et al. 2014; Southall et al. 2013; Southall et al. 2015; Southall et al. 2012; Southall et al. 2011; Tyack et al. 2011). Beaked whales appear to be sensitive to sound exposure.

Observed reactions by Blainville's (*Mesoplodon densirostris*), Cuvier's (*Ziphius cavirostris*), and Baird's (*Berardius bairdii*) beaked whales to MF sonar sounds have included cessation of clicking, termination of foraging dives, changes in direction to avoid the sound source, slower ascent rates to the surface, and other unusual dive behaviors (Boyd et al. 2008; DeRuiter et al. 2013b; Miller et al. 2015; Southall et al. 2011; Stimpert et al. 2014; Tyack 2008). A similar response was observed in a northern bottlenose whale (*Hyperoodon ampullatus*), which conducted the longest and deepest dive on record for that species after sonar exposure and continued swimming away from the source for over seven hours (Miller et al. 2015). Responses occurred at received levels between 95 and 150 dB re 1 µPa. These exposures occurred within 0.6–5 mi (1–8 km) of the focal animal, within a few hours of tagging the animal, and with one or more boats within a few km to observe responses and record acoustic data; all of these variables could also have a strong effect on response. One Cuvier's beaked whale was incidentally exposed to Navy sonar located over 62 mi (100 km) away, and DeRuiter et al. (2013b) did not detect similar responses at comparable received levels. Received levels from the MFA sonar signals from the controlled and incidental exposures were calculated as 84–144 and 78–106 dB re 1 µPa, respectively, indicating that context of the exposures (e.g., source proximity, controlled source ramp-up) may have been a significant factor in the responses to the simulated sonars (DeRuiter et al. 2013b). Under controlled exposure experiments using sonar signals (1–2 kHz or 3.4–3.9 kHz, 1 sec duration) on 12 northern bottlenose whales, Wensveen et al. (2019) found that whales started exhibiting avoidance behaviors at a variety of distances, ranging from 0.4 to 13.5 NM, with received levels of 117–126 dB re 1 µPa.

For eight tagged Cuvier's beaked whales on the Southern California Offshore Range, long-term tagging work has demonstrated that longer duration dives, once considered a behavioral response to sonar DeRuiter et al. (2013b), actually fell within the normal range of dive durations Schorr et al. (2014). However, the longer inter-deep dive intervals found by both studies could indicate a response to sonar. DeRuiter et al. (2013b) determined that in dives following sonar exposure, tagged Cuvier's beaked whales ceased gliding and swam with almost continuous strokes. Williams et al. (2017) noted that in normal deep dives or during fast swim speeds, beaked whales and other marine mammals use strategies to reduce their stroke rates, including leaping or wave surfing when swimming and interspersing glides between bouts of stroking when diving. This change in swim behavior was modeled and found to increase metabolic costs about 30.5 percent and increase the amount of energy expended on fast swim speeds from 27 to 59 percent of their overall energy budget. This repartitioning of energy was detected in the model up to 1.7 hours after the single sonar exposure. Therefore, while the overall post-exposure dive durations were similar, more metabolic energy was used (Williams et al. 2017).

On Navy ranges, beaked whales appear to move off-range during sonar use and return only after the sonar transmissions have stopped, sometimes taking several days to return (Claridge et al. 2009; Henderson et al. 2015; Joyce et al. 2020; Manzano-Roth et al. 2016; McCarthy et al. 2011; Moretti et al. 2009; Stanistreet et al. 2022; Tyack et al. 2011). Data from passive acoustic recordings during active sonar naval exercises showed that Cuvier's beaked whales, sperm whales (*Physeter macrocephalus*), and other unidentified *Mesoplodont* species reduced their echolocation clicks during and after training exercises, suggesting that the whales ceased foraging in the area due to avoidance (Stanistreet et al. 2022). At the Navy's Atlantic Undersea Test and Evaluation Center range, five of seven tagged Blainville's beaked whales were displaced between 17 and 42 mi (28 and 68 km) after sonar exposure, and they returned to the range two to four days after exercises ceased (Joyce et al. 2020). Off the coast of the PMRF, Blainville's beaked whales routinely occur. Henderson et al. (2016) noted that Blainville's group vocalization rates decrease during multi-day training events in the vicinity of PMRF; however, these beaked whales still remained on the range to forage throughout the year, possibly indicating that the desire to remain in a preferred foraging habitat is outweighed by effects of the sound.

Tyack et al. (2011) hypothesized that beaked whale responses to sonar may represent an anti-predator response. Vocalizations of a potential predator—a killer whale (*Orcinus orca*)—were played back to a Blainville's beaked whale. This exposure resulted in a similar, but more pronounced, reaction than that elicited by sonar playback, which included longer inter-dive intervals and a sustained straight-line departure of more than 12 mi (20 km) from the area (Allen et al. 2014; Tyack et al. 2011). Isojunno et al. (2016) and Isojunno et al. (2020) found that sperm whales ceased foraging in response to killer whale sound playbacks. This anti-predator hypothesis was also tested by playing back killer whale vocalizations to long-finned pilot whales (*Globicephala melas*), sperm whales, and even other killer whales, to determine responses by both potential prey and conspecifics (Miller et al. 2011; Miller et al. 2012). Results varied from no response by killer whales to an increase in group size and attraction to the source in pilot whales (Miller et al. 2012). Responses by the same groups of pilot whales, killer whales, and sperm whales have also included horizontal avoidance, changes in behavioral state, and changes in dive behavior (Miller et al. 2011; Miller et al. 2012). Received level thresholds at the onset of avoidance behavior were generally higher for pilot whales (mean: 150 dB re 1µPa) and sperm whales (mean: 140 dB re 1µPa) than for killer whales (mean: 129 dB re 1µPa) (Antunes et al. 2014; Miller et al. 2014; Miller et al. 2012).

A close examination of tag data from the 3S BRS Norwegian groups showed that responses seemed to be behaviorally or signal-frequency mediated. For example, killer whales only changed their dive behavior when doing deep dives at the onset of 1–2 kHz sonar (sweeping across frequencies), but they did not change their dive behavior if they were deep diving during 6–7 kHz sonar exposure (sweeping across frequencies). Additionally, the killer whales did not change their dive behavior if they were conducting shallow dives at the onset of either type of sonar. Similarly, long-finned pilot whales and sperm whales performed normal deep dives during 6–7 kHz sonar exposure. During the 1–2 kHz sonar exposure, the long-finned pilot whales conducted fewer deep dives, and the sperm whales performed shorter and shallower dives (Sivle et al. 2012). Additionally, separation of a killer whale calf from its group during exposure to MF sonar playback was observed (Miller et al. 2011).

Sperm whales stopped foraging in response to the 1–2 kHz sonar signal at received levels of 131 to 165 dB re 1 µPa; however, there was no change in foraging in response to the 6–7 kHz signals (Isojunno et al. 2016). Pilot whales were also more likely to respond to lower received levels during 6–7 kHz sonar exposures when they were not feeding, but they were more likely to respond at higher received levels during 1–2 kHz sonar exposures when they were not feeding. Furthermore, short-finned pilot whales (*Globicephala macrorhynchus*) exposed to a 38 kHz downward-facing echosounder did not change their dive and foraging behavior during exposure periods, although the animals' heading variances increased, and fewer deep dives were conducted (Quick et al. 2017). In contrast, killer whales were more likely to respond to either sonar type when exhibiting non-feeding behaviors than feeding behaviors (Harris et al. 2015). These results further demonstrate that the behavioral state of the animal mediates the likelihood of a behavioral response, as do the characteristics (e.g., frequency) of the sound source itself.

Other responses during BRSs included: (1) the synchronization of pilot whale surfacings with sonar pulses during one exposure, possibly as a means of mitigating the sound (Wensveen et al. 2015) and (2) mimicry of the sonar with whistles by pilot whales (Alves et al. 2014; Courts et al. 2020), false killer whales (DeRuiter et al. 2013a), and Risso's dolphins (*Grampus griseus*) (Smultea et al. 2012). In contrast, another study found that melon-headed whales (*Peponocephala electra*) had "minor transient silencing" (a brief, non-lasting period of silence) after each 6−7 kHz signal, and (in a different oceanographic region) pilot whales had no apparent response to a 6−7 kHz signal (DeRuiter et al. 2013a). The probability of detecting delphinid vocalizations (i.e., whistles, clicks, and buzzes) increased during periods of sonar relative to the period prior to sonar in the Marine Autonomous Recording Units at the Jacksonville Range Complex, while there was no effect of sonar to the probability of detecting sperm whale clicks (Charif et al. 2015; U.S. Department of Navy 2013b).

In addition, killer whale sighting data from the 3S BRS was used to compare the presence or absence of whales from other years against the period with sonar. Kuningas et al. (2013) found a strong relationship between the presence of whales and the abundance of herring and a weak relationship between the presence of whales and sonar activity. Baird et al. (2014; 2017; 2013) tagged four shallow-diving odontocete species (rough toothed dolphins [*Steno bredanensis*], pilot whales, bottlenose dolphins, and false killer whales) in Hawaii in waters west of the PMRF before Navy training events. None of the tagged animals demonstrated a large-scale avoidance response to MF sonar as they moved on or near the range, in some cases even traveling towards areas of higher noise levels while estimated received

SPLs varied from 130–168 dB re 1 µPa and distances from sonar sources ranged between 2 and 58.7 mi (3.2 and 94.4 km). However, one pilot whale did have reduced dive rates (from 2.6 dives per hour before exposure to 1.6 dives per hour after exposure) and deeper dives (from a mean of 406 to 879 ft [124 to 268 m]) during a period of sonar exposure. These examples demonstrate that responses can be varied, are often contextually and behaviorally driven, and can be species- and exposure-specific.

Behavioral responses to a variety of sound sources have been studied in harbor porpoises (*Phocoena phocoena*), including tones with 1–2 kHz and 6–7 kHz sweeps with and without harmonics (Kastelein et al. 2014) and 25 kHz with and without sidebands (Kastelein et al. 2015a; Kastelein et al. 2015b). Responses were different depending on the source. For example, harbor porpoises responded to the 1–2 kHz upsweep at 123 dB re 1 µPa, but they did not respond to the downsweep or the 6–7 kHz tonal at the same level (Kastelein et al. 2014). When measuring the same sweeps for a startle response, the 50 percent response threshold was 133 dB and 101 dB re 1 µPa for 1–2 kHz and 6–7 kHz sweeps, respectively, when no harmonics were present, and the 50 percent response decreased to 90 dB re 1 µPa for 1–2 kHz sweeps with harmonics present (Kastelein et al. 2014).

Behavioral responses by odontocetes to sonar appear to run the full gamut from no response at all to responses that could potentially lead to long-term consequences for individual animals (e.g., mother-calf separation). This is likely partially due to the fact that this taxonomic group is broad and includes some of the most sensitive species (e.g., beaked whales and harbor porpoises) as well as some of the least sensitive species (e.g., bottlenose dolphins). This is also the only group for which both field BRSs and captive controlled exposure experiments have been conducted, leading to the assessment of both contextually-driven responses and dose-based responses.

This wide range in both exposure situations and individual and species sensitivities makes reaching general conclusions difficult. Additionally, all the experiments done on odontocetes have used MF to HF sound sources, outside of the frequency range for the Proposed Action. However, it does appear as though exposures in close proximity, with multiple vessels that approach the animal, lead to higher-level responses in most odontocete species regardless of the received level or behavioral state. In contrast, in more "real-world" exposure situations, with distant sources moving in variable directions, behavioral responses appear to be driven by behavioral state, individual experience, or species-level sensitivities. These responses may also occur in correlation with received levels, such that the likelihood of a response would increase with an increase in received levels. However, these "real-world" responses are more likely to be short-term, lasting the duration of the exposure or even shorter as the animal assesses the sound and (based on prior experience or contextual cues) determines a threat is unlikely. Therefore, while odontocete behavioral responses to SURTASS LFA sonar will vary across species, populations, and individuals, they are not likely to lead to long-term consequences or population-level effects.

3.5.2.1.3.3 Pinnipeds (PCW and OCW Hearing Groups)

Pinnipeds are divided into two hearing groups for in water which include phocid carnivores in-water (PCW) and otariids and other non-phocid marine carnivores in-water (OCW). BRS on pinnipeds are not as extensive compared to cetaceans. Different responses displayed by captive and wild phocid seals to sound judged to be "unpleasant" or "threatening" have been reported, including habituation by captive seals (they did not avoid the sound) and avoidance behavior by wild seals (Götz and Janik 2010). Captive seals received food (reinforcement) during sound playback. Wild seals were exposed opportunistically. These results indicate that motivational state (e.g., reinforcement via food acquisition) can be a factor in whether or not an animal tolerates or habituates to novel or unpleasant sounds. Another study found that captive hooded seals (*Cystophora cristata*) reacted to 1–7 kHz sonar signals, in part with displacement (i.e., avoidance) to the areas of least SPL, at levels between 160 and 170 dB re 1 µPa (Kvadsheim et al. 2010); however, the animals adapted to the sound and did not show the same avoidance behavior upon subsequent exposures.

Captive harbor seals (*Phoca vitulina*) responded differently to three signals at 25 kHz with different waveform characteristics and duty cycles. The seals responded to the FM signal at received levels over 137 dB re 1 µPa by hauling out more, swimming faster, and raising their heads or jumping out of the water, but they did not respond to the continuous wave or combination signals at any received level (tested up to 156 dB re 1 µPa) (Kastelein et al. 2015a). Captive California sea lions (*Zalophus californianus*) were exposed to MF sonar at various received levels (125–185 dB re 1 µPa) during a repetitive task (Houser et al. 2013). Behavioral responses included a refusal to participate, hauling out, an increase in respiration rate, and an increase in the time spent submerged. Young animals (less than two years old) were more likely to respond than older animals. Dose-response curves were developed both including and excluding those young animals. The majority of responses below 155 dB re 1 µPa were changes in respiration; over 170 dB re 1 µPa, more severe responses began to occur, such as hauling out or refusing to participate. Many of the most severe responses came from the younger animals.

LF signals of the ATOC sound source centered at 75 Hz, with received levels between 118 and 137 dB re 1 µPa, were not found to overtly affect northern elephant seal dives (*Mirounga angustirostris*) (Costa et al. 2003). However, the sounds did produce subtle effects that varied in direction and degree among the individual seals, again illustrating the equivocal nature of behavioral effects and consequent difficulty in defining and predicting them.

Similar to the other taxonomic groups assessed, pinniped behavioral responses to sonar and other active acoustic sources seem to be mediated by the contextual factors of the exposure, including the proximity of the source, the characteristics of the signal, and the behavioral state of the animal. However, all pinniped BRS have been conducted in captivity, so while these results may be broadly applied to real-world exposure situations, such application must be done with caution. Based on exposures to other sound sources in the wild (e.g., impulsive sounds and vessels), pinnipeds are not likely to respond strongly to Navy sonar that is not in close proximity to the animal or approaching the animal.

3.5.2.1.4 Masking

Masking occurs when one sound, distinguished as the "noise," interferes with the detection or recognition of another sound. The quantitative definition of masking is the amount in dB an auditory detection or discrimination threshold is raised in the presence of a masker (Erbe et al. 2016). Masking can effectively limit the distance over which a marine mammal can communicate, detect biologically relevant sounds, and echolocate. Masking only occurs in the presence of the masking noise and does not persist after the cessation of the noise. Masking can lead to vocal changes (e.g., Lombard effect, increasing amplitude, or changing frequency) and behavior changes (e.g., cessation of foraging, leaving an area) to both signalers and receivers, in an attempt to compensate for noise levels (Erbe et al. 2016).

Masking as a result of LFA sonar with relatively low duty cycles is unlikely for most marine mammals, as sonar tones occur over a relatively short duration and narrow bandwidth that does not overlap with vocalizations for most species. While dolphin vocalizations can occur in the same bandwidth as MFA sonar, the duty cycle of most LFA and MFA sonars are low enough that delphinid whistles might be masked only a small percentage of the time they are whistling, so masking by sonar would not likely have any short- or long-term consequences. LFA sonar could overlap with mysticete vocalizations. For example, in the presence of LFA sonar, humpback whales were observed to increase the length of their songs (Fristrup et al. 2003; Miller et al. 2000), possibly due to the overlap in frequencies between the whale song and the LFA sonar.

The detectability of a signal amidst noise may also be affected by the temporal and spectral properties of the signal. Cunningham et al. (2014) conducted masking experiments where the signals included complex parameters (amplitude-modulated [AM], FM, and harmonic structures) that are typical for natural animal signals. The ability of the sea lion and harbor seal to detect these complex signals was far better than predicted, indicating that complex features of naturally occurring sounds increase detectability over simple stimuli.

Animals may be able to counteract masking by involuntarily increasing the SL of their vocalizations in the presence of noise, known as the Lombard vocal response. For example, humpback whale sound level of songs increases by 0.53 dB/1 dB increase in background noise levels (Guazzo et al. 2020). Minke whales increased their boing call intensity and decreased their variance of boing call SLs in the presence of increased background noise (Helble et al. 2020). The SLs of vocalizations of killer whales and beluga whales have been shown to increase as the level of ship noise in the environment increased (Holt et al. 2011; Scheifele et al. 2005). Another mechanism may be to increase their calling rate or change the call structure, as demonstrated by gray whales when exposed to vessel sound (Dahlheim and Castellote 2016). Changes in call structure included increased SL, more FM calls, and an increased number of pulses per call. Migrating humpback whales off Australia increased the amplitude of their social calls by 0.9 dB for every 1 dB increase in wind-created ambient noise (Dunlop et al. 2014). It was previously thought that increasing call amplitude in bottlenose dolphins may come with an increased metabolic cost (Holt et al. 2015); however, it has been found the Lombard response to noise does not represent large direct energetic cost to bottlenose dolphins (Pedersen et al. 2020).

Masking is less likely or is expected to be less impactful when the noise is intermittent, such as low-duty cycle sonars or impulsive noise, compared to when the noise is continuous, such as vessel sound. This is because for intermittent noise, the signal of interest can be detected during the quiet periods between noise events. This is often called “dip” or “gap” listening. The effect of masking on communication space is often modeled using constant-amplitude noise, whereas many anthropogenic sources contain gaps or fluctuations in the noise. Studies have shown that the signal duration, duty cycle, masker level, and fluctuations should be considered when modeling the effect of noise on signal detection (Branstetter and Finneran 2008; Branstetter et al. 2013; Kastelein et al. 2021; Sills et al. 2017; Trickey et al. 2010).

Spatial release from masking occurs when a noise and signal are separated in space, resulting in a reduction or elimination of masking (Holt and Schusterman 2007; Popov et al. 2020). The relative position of sound sources can act as one of the most salient cues that allow the listener to segregate multiple sounds in a complex auditory scene. Many sounds are emitted from a directional source that is spatially separated from biologically relevant signals. Under such conditions, minimal masking will occur, and existing models of masking will overestimate the amount of actual masking. Marine mammals have excellent sound source localization capabilities (Branstetter and Mercado 2006; Byl et al. 2019; Renaud and Popper 1975) and directional hearing (Accomando et al. 2020; Au and Moore 1984; Mooney et al. 2008; Popov and Supin 2009) which likely combine to aid in separating auditory events and improving detection. Dunlop (2019) found that modeled communication spaces were reduced in the presence of wind-dominated and vessel-dominated noises, likely to avoid signal masking. Spatial release from masking has been empirically demonstrated using behavioral methods in a harbor seal a California sea lion, three harbor porpoises, and a bottlenose dolphin (Holt and Schusterman 2007; Kastelein et al. 2021; Popov et al. 2020), where maximal spatial release from masking was 19, 12, 14.5, and 24 dB for each species respectively. The spatial positions of the receiver and noise source are often considered in terms of distance but the relative angles between the vocalizing and/or listening animal and the noise source are also important to consider when estimating masking effects.

The effect of pulsed and continuous 1-2 kHz active sonar on sperm whale echolocation clicks was modeled by von Benda-Beckmann et al. (2021), who found that the presence of upper harmonics in the sonar signal increased masking of clicks produced in the search phase of foraging compared to buzz clicks produced during prey capture. Different levels of sonar caused varied levels of masking (120 to 160 dB re 1 μPa^2) based on click level, whale orientation, and prey target strength. Continuous active sonar resulted in a greater percentage of time that echolocation clicks were masked compared to pulsed active sonar. This means that sonar could reduce the ability of sperm whales to find prey under certain conditions. However, echoes from prey are most likely spatially separated from the sonar source, and so spatial release from masking would be expected.

The potential for masking from SURTASS LFA sonar signals is limited for a number of reasons. First, the typical SURTASS LFA sonar signal is not a constant tone but consists of a sequence of sound transmissions (waveforms) that vary in frequency and duration. Continuous-frequency waveforms have durations of no longer than 10 sec. Waveforms with varying frequencies (FM waveforms) have limited bandwidths (30 Hz). Therefore, within the frequency range in which masking is possible, the effect would be limited because animals that use this frequency range typically use signals with greater durations and bandwidths. Thus, only a portion of the frequency band for the animal's signal is likely to be masked by the SURTASS LFA sonar transmissions. Furthermore, when SURTASS LFA sonar is in use, the source is active only 7.5 to 10 percent of the time, with a maximum 20 percent duty cycle, which means that for 90 to 92.5 percent of the time, there is no potential for masking. Therefore, within the area in which energetic masking is possible, any effect of SURTASS LFA sonar transmissions would be minimal because of the limited bandwidth and intermittent nature of the signal, and the fact that animals that use this frequency region typically produce signals with greater bandwidth that are repeated for many hours.

3.5.2.1.5 Physiological Stress

Atkinson et al. (2015) reviewed the physiology of the stress response in marine mammals. There has been broadened research into marine mammal responses to environmental stressors and linking these responses to costs at the individual level that may have repercussions at the population level (Maresh et al. 2014; New et al. 2014; Robinson et al. 2012). Factors potentially affecting an animal's response to a stressor include its life history stage, sex, age, reproductive status, overall physiological and behavioral plasticity, and whether they are naïve or experienced with the sound (e.g., prior experience with a stressor may result in a reduced response due to habituation) (Finneran and Branstetter 2013; St. Aubin and Dierauf 2001). Because there are many unknowns regarding the occurrence of acoustically-induced stress responses in marine mammals, the Navy assumes in its effect analysis that any physiological response (e.g., hearing loss or injury) or significant behavioral response is also associated with a stress response.

A limited amount of research has been conducted on stress responses resulting from sound exposure. Belugas demonstrated no catecholamine response to the playback of oil drilling sounds (Thomas et al.

1990), but they showed an increase in catecholamines following exposure to impulsive sounds produced from a seismic water gun (Romano et al. 2004). A bottlenose dolphin exposed to the same seismic water gun signals did not demonstrate a catecholamine response (Romano et al. 2004), but it did demonstrate an elevation in aldosterone, a hormone that has been suggested as being a significant indicator of stress in odontocetes (St. Aubin and Geraci 1989). Additionally, bottlenose dolphins exposed to 800 Hz pure-tone impulsive sound for 30 min at three different SLs (0, 120, and 180 dB re 1 µPa) showed an increase in physiological stress responses 30 min post-exposure; all three responses indicate that sound can be a physiological stressor for cetaceans, even if little to no behavioral changes are observed (Yang et al. 2021).

A young beluga's heart rate was observed to increase during exposure to noise, with increase dependent on frequency band of noise and duration of exposure, with a sharp decrease to normal or below-normal levels upon cessation of the exposure (Lyamin et al. 2011). A captured beluga whale showed a two-phase heart rate response to noise exposures (frequencies of 19 to 38 kHz, levels of 150 to 160 dB). The heart rate response was indicative of changes in response to stress or emotionally negative external stimuli in terrestrial mammals and humans (Bakhchina et al. 2017). After one year of captivity, the beluga whale showed no response to the same or more intense noise exposures, indicating habituation within the dolphinarium. Elmegaard et al. (2021) found that harbor porpoises initially responded to sonar 6–9 kHz sonar sweeps with bradycardia, or a decreases heart rate; however, the porpoises rapidly habituated to the stimuli. Kvadsheim et al. (2010) measured the heart rate of captive hooded seals during exposure to sonar signals, and they found an increase in the heart rate of the seals during exposure periods versus control periods when the animals were at the surface. When the animals dove, the normal dive-related bradycardia was not affected by the sonar exposure.

It is unknown how chronic exposure to acoustic stressors may affect marine mammals. Opportunistic comparison of levels of stress-related hormone metabolites in North Atlantic right whale (*Eubalaena glacialis*) feces collected before and after the events of 11 September 2001 showed a decrease in metabolite levels corresponding to lower levels of ambient noise due to reduced ship traffic (Rolland et al. 2012). Additionally, in the Pacific northwest, gray whale fecal glucocorticoid metabolites (fGC) concentrations increased alongside increased vessel activity (Lemos et al. 2022). These results indicate the difficulty in teasing out factors that are dominant in exerting influence on the secretion of stress hormones, including the separate and additive effects of vessel presence and vessel sound. Nevertheless, the presence of the vessels themselves cannot be ruled out as potentially contributing to the reduction in fecal cortisol metabolites in North Atlantic right whales or in fGC metabolites in gray whales. Collectively, these results demonstrate the difficulty in interpreting the sparse amount of available information on acute stress responses to sound in marine mammals.

Atkinson et al. (2015) highlighted the need for long-term monitoring of individuals to better understand natural life-history influences on variations in stress responses and develop baselines that can be used for comparison. Since marine mammals are air-breathers that live in an underwater, oceanic environment, there appear to be significant modifications of physiological health mediators, resulting in unexpected observations, as compared to terrestrial mammals (Atkinson et al. 2015). For example, where a terrestrial animal may start breathing heavily as part of a stress response, a marine mammal may have decoupled that response to conserve oxygen for underwater survival. More research is needed to begin to understand the potential for physiological stress in marine mammals during noise exposure scenarios.

3.5.2.1.6 Effects on Critical Habitat

Of the marine mammals that have been listed as threatened or endangered under the ESA, critical habitat has been designated within the Study Area for two species, the Main Hawaiian Islands (MHI) Insular DPS of the false killer whale and the Hawaiian monk seal (*Neomonachus schauinslandi*). The key biological and/or physical features of the marine neritic and pelagic critical habitat for the two species/DPSs under consideration are described in Appendix C (Biological Resources Supplemental Information).

3.5.2.1.6.1 Main Hawaiian Island Insular DPS of False Killer Whales

The three physical features of the false killer whale critical habitat are island-associated habitat, waters free of pollutants, and habitat free of anthropogenic noise at a level that would cause masking, long-term habitat avoidance, or abandonment in false killer whales. SURTASS LFA sonar activities would not affect the island-associated habitat features of bathymetry and productivity. Productivity is a cascading process regulated principally by available sunlight and nutrient concentrations at the lower trophic levels. Thus, the physical features of island-associated habitat and pollutant-free habitat for the false killer whale would not be affected by the transmission of SURTASS LFA sonar.

The transmission of SURTASS LFA sonar may affect the physical feature of an anthropogenic-noise free environment of the false killer whale critical habitat, potentially causing masking, long-term habitat avoidance, or abandonment to occur. Portions of the false killer whale habitat are located within the CSR for SURTASS LFA sonar, so effects to critical habitat within that region would not be expected.

However, a portion of the critical habitat lies beyond the spatial extent of the CSR (Section 4.4.1). When deploying and transmitting LFA sonar, the Proposed Action would temporarily add to the ambient noise level in the frequency band in which SURTASS LFA sonar operates (100 to 500 Hz), but the effect on the overall noise levels in the ocean would be minimal, particularly given the short periods of operation of SURTASS LFA sonar (nominal 60-sec duration wavetrain every 10 min). With HF/M3 monitoring and associated SURTASS LFA source shutdown protocol in areas outside the CSR, false killer whales would be detected before entering the mitigation zone, defined by a received level of 180 dB (rms). Therefore, at no time would the sound field generated by the Proposed Action be greater than 180 dB (rms) within critical habitat when false killer whales are present. The ambient noise would be expected to return to normal prior to entry of false killer whales. The hearing and echolocation ability of false killer whales have been studied with captive animals (e.g., Kloepper et al. 2010; Yuen et al. 2005). Best sensitivity is found between 16 and 24 kHz, with echolocation clicks centered around 40 kHz. While SURTASS LFA sonar would introduce anthropogenic noise into false killer whale critical habitat, the limited received levels that false killer whales may experience from the Proposed Action would only temporarily cause masking and not cause long-term habitat avoidance/abandonment, therefore SURTASS LFA sonar is not likely to adversely affect the critical habitat.

The availability of prey species (i.e., large pelagic fish and squid) for false killer whales is the one biological feature of the critical habitat for the MHI Insular DPS of the false killer whale. The Navy has determined that no mortality of marine invertebrates (including squid that would be prey for false killer whales) is expected to occur from exposure to SURTASS LFA sonar, nor are population-level effects likely. Thus, marine invertebrate prey species would not reasonably be affected by the Proposed Action. Marine fishes, however, may be affected by exposure to SURTASS LFA sonar transmissions, but they would be affected only if they are located within close proximity (less than 0.54 NM [1 km]) to the transmitting sonar source. The Navy's analysis indicates a minimal to negligible potential for an individual fish to experience non-auditory or auditory effects or a stress response from exposure to SURTASS LFA sonar transmissions. A low potential exists for minor, temporary behavioral responses or masking effects to an individual fish when SURTASS LFA sonar is transmitting, but no potential is estimated for effects to the fitness of a species or population-level consequences to fish stocks. Since it is highly unlikely that a significant percentage of any prey stock would be in sufficient proximity during SURTASS LFA sonar transmissions to experience such effects, there is minimal potential for SURTASS LFA sonar to affect prey fish stocks. Thus, no adverse effects are reasonably expected on the quantity, quality, and availability of prey fishes as the result of exposure to SURTASS LFA sonar activities. As a result, SURTASS LFA sonar activities are not likely to affect the biological features of the MHI Insular DPS of the false killer whale's designated critical habitat.

3.5.2.1.6.2 Hawaiian Monk Seal

Deployment and use of SURTASS LFA sonar results in no physical alterations to the marine environment other than the addition of ephemeral sound energy to the oceanic ambient noise environment when the sonar is transmitting. However, the power level of SURTASS LFA sonar to which the critical habitat may be exposed would be low (less than 180 dB re 1 µPa [rms]). No SURTASS LFA sonar transmissions would occur in the waters of Penguin Bank, the only part of the Hawaiian Monk Seal's critical habitat outside of the CSR. When deployed and transmitting, transmissions from SURTASS LFA sonar would temporarily add to the ambient noise level in the frequency band in which SURTASS LFA sonar operates (100 to 500 Hz), but the effect on the overall noise levels in the ocean would be minimal. The addition of a small percentage to the ambient noise environment of the ocean, from the transmissions of SURTASS LFA sonar, would have no effect on the relevant physical features of the designated critical habitat.

The remaining potential for critical habitat effects associated with SURTASS LFA sonar activities would be to biological features of the habitat, namely to the availability and density of prey. The Hawaiian monk seal's prey is comprised of common fishes and invertebrates (i.e. squids, octopuses, eels, and crustaceans), similar to the MHI Insular false killer whale's (IFKW) preferred prey species. For the same reasons listed above in Section 3.5.2.1.6.1, invertebrates and fish are unlikely to experience population-level consequences from SURTASS LFA sonar transmissions. No adverse effects as a result of the Proposed Action are reasonably expected to reduce the prey quantity or quality within the Hawaiian monk seal's critical habitat. Therefore, SURTASS LFA sonar activities are not likely to affect the biological features of the designated critical habitat.

3.5.2.2 Quantitative Effects Analysis

The Navy performed a quantitative analysis to estimate the number of times that marine mammals could be affected by the Proposed Action. The Navy's quantitative analysis to determine effects on marine mammals uses the NAEMO to produce initial estimates of the number of animals that may experience these effects; these estimates are further refined by considering animal avoidance of sound-producing activities and implementation of procedural mitigation measures. The steps of this quantitative analysis are described below, which considers the following:

- criteria and thresholds used to predict effects from SURTASS LFA sonar;
- marine mammal behavioral response criteria;
- the density and spatial distribution of marine mammals; and
- the influence of environmental parameters (e.g., temperature, depth, salinity) on sound propagation when estimating the received sound level on the animals.

A detailed explanation of this analysis is provided in 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 Navy 2024b).

3.5.2.2.1 Methods for Analyzing Effects

3.5.2.2.1.1 Criteria and Thresholds Used to Estimate Effects

See the technical report titled *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis* (U.S. Department of Navy 2025) for detailed information on how the criteria and thresholds were derived.

Animals are not equally sensitive to noise at all frequencies. To capture the frequency-dependent nature of the effects of noise, auditory weighting functions are used (Figure 3-3). For parameters used to generate the functions and more information on weighting function derivation, see Navy (2025)).

Auditory weighting functions are mathematical functions that are used to emphasize frequencies where animals are more susceptible to noise exposure and de-emphasize frequencies where animals are less susceptible. The functions may be thought of as frequency-dependent filters that are applied to a noise exposure before a single, weighted sound level is calculated. They are based on a generic band pass filter and incorporates species-specific hearing abilities to calculate a weighted received sound level in units SPL or SEL. Due to the band pass nature of auditory weighting functions, they resemble an inverted "U" shape with amplitude plotted as a function of frequency. The flatter portion of the plotted function, where the amplitude is closest to zero, is the emphasized frequency range (i.e., the pass-band), while the frequencies below and above this range (where amplitude declines) are de-emphasized.

Defining the TTS and AINJ exposure functions (Figure 3-4.) requires identifying the weighted exposures necessary for TTS and AINJ onset from sounds produced by LFA sonar. The criteria used to define TTS from non-impulsive sources (e.g., sonar) determines TTS onset as the SEL necessary to induce 6 dB of threshold shift. An SEL 20 dB above the onset of TTS is used in all hearing groups of marine mammals underwater to define the AINJ threshold (Southall et al. 2007).

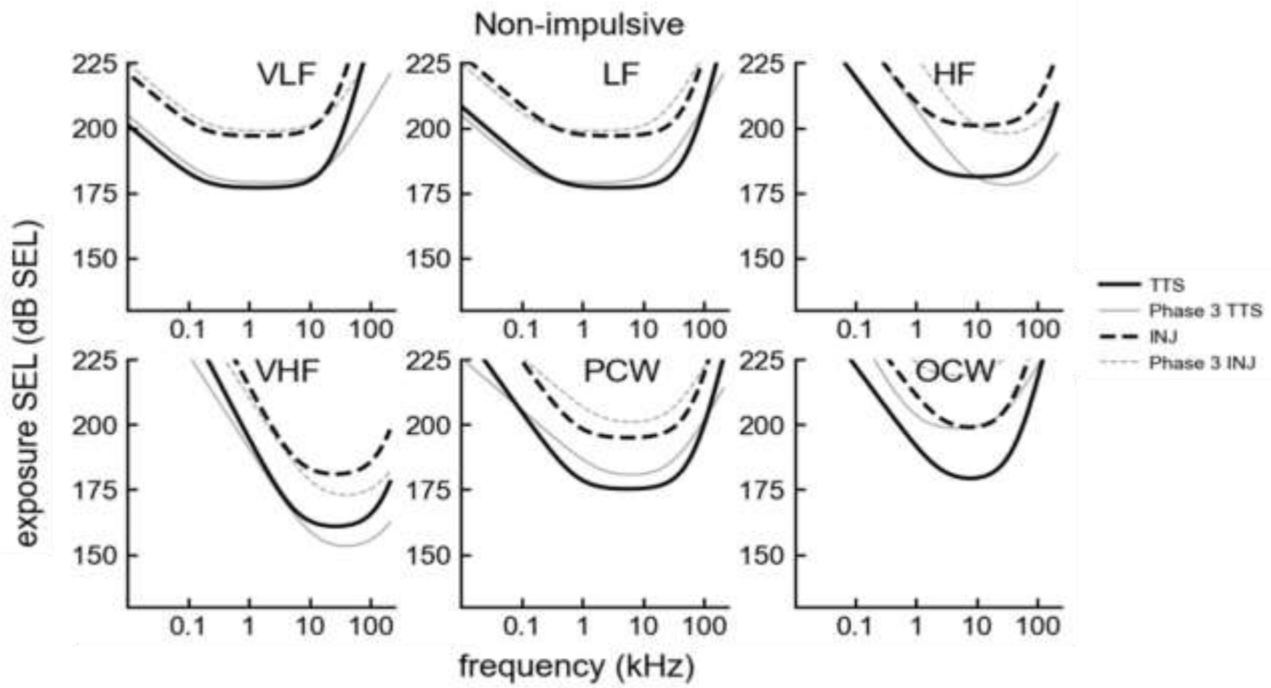

Figure 3-4. TTS and AINJ exposure functions for sonars and other (non-impulsive) active acoustic sources.

"Phase 3" refers to the third phase (circa 2017) of the U.S. Navy's programmatic approach to environmental compliance at sea for ranges and operating areas. The bold TTS and INJ functions displayed in this Figure are consistent with those used for the Navy's Phase 4. Additional information can be found in the Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (U.S. Department of Navy 2025).

3.5.2.2.1.2 Marine Mammal Behavioral Response Criteria

Behavioral response criteria are used to estimate the number of animals that may exhibit a behavioral response to sonar. See the *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis* (U.S. Department of Navy 2025) for detailed information on how the Behavioral Response Functions were derived. Developing the new behavioral criteria involved multiple steps. All peer-reviewed published BRS conducted both in the field and on captive animals were examined in order to understand the breadth of behavioral responses of marine mammals to sonar.

The data from the behavioral studies were analyzed by looking for significant responses, or lack thereof, for each experimental session. Due to the nature of behavioral response research to date, it is not currently possible to ascertain the types of observed reactions that would lead to an abandonment or significant alteration of a natural behavior pattern. Therefore, the Navy has developed a methodology to estimate the possible significance of behavioral reactions and effects on natural behavior patterns.

Behavioral response severity is described herein as "low", "moderate", or "high." These are derived from the Southall et al. (2021) severity scale. This severity scale, updated since the 2019 SEIS/SOEIS, breaks out behavioral responses by changes that may affect survival, feeding, and reproduction. Low severity responses are those behavioral responses that fall within an animal's range of typical (baseline) behaviors and are unlikely to disrupt an individual to a point where natural behavior patterns are significantly altered or abandoned. Moderate severity responses could become significant over a longer duration. High severity responses are those with possible immediate consequences to growth, survival, or reproduction.

For each group, a biphasic behavioral response function was developed using the best available data and Bayesian dose response models developed at the University of St. Andrews (Figure 3-5). The behavioral response function base probability of response on the highest SPL rms received level. For more information on how these behavioral response function were developed, see *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis* (U.S. Department of Navy 2025).

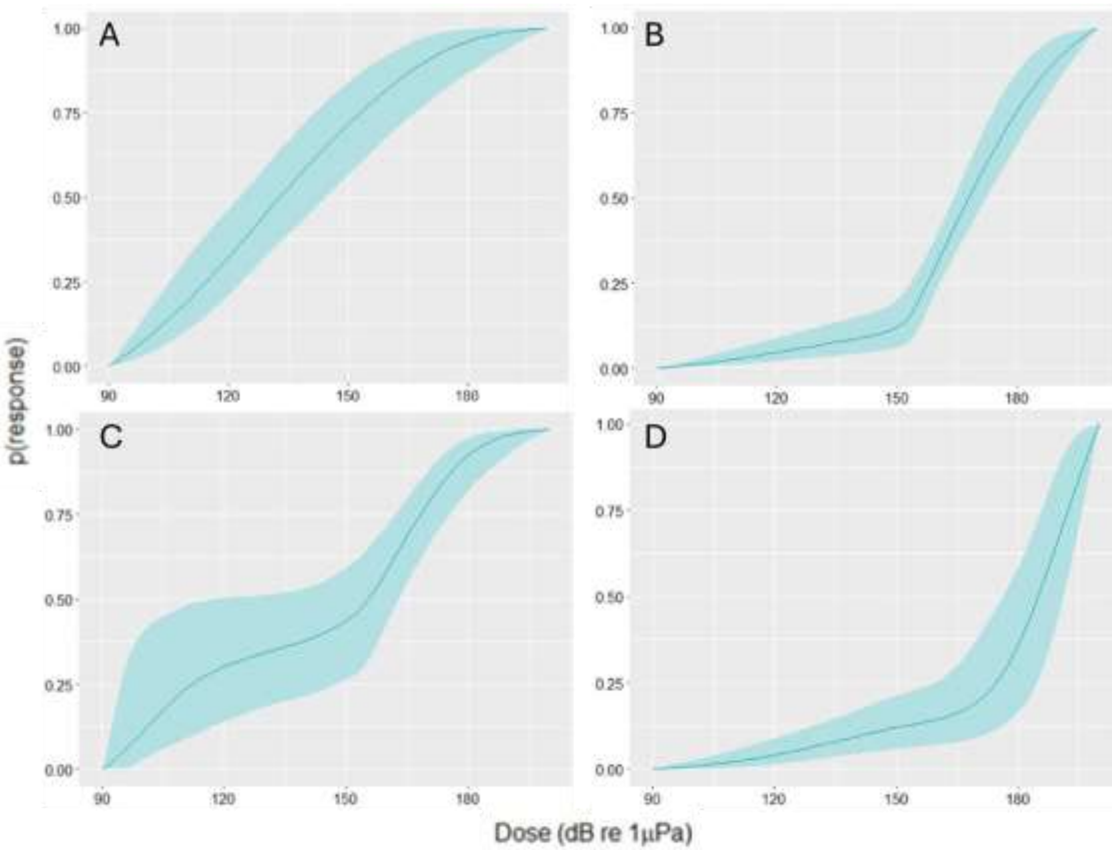

Figure 3-5. Phase IV Biphasic Behavioral Response Function for (A) Sensitive Species (beaked whales and harbor porpoises) (B) Odontocetes (C) Pinnipeds (in-water) and (D) Mysticetes.

3.5.2.2.1.3 Marine Mammal Density

A quantitative analysis of effects on a species requires data on their abundance and distribution in the potentially affected area. The most appropriate metric for this type of analysis is density, which is the number of animals present per unit area. To characterize the marine species density for large areas, such as the Study Area, the Navy compiled data from several sources. The Navy developed a protocol to select the best available data sources based on species, area, and time (season). The resulting database called the Navy Marine Species Density Database (NMSDD) includes seasonal density values for every marine mammal species present within the Study Area (U.S. Department of Navy 2025). Additional information on density derivation for each species can be found in the *Navy Marine Species Density*

Database for the Surveillance Towed Array Sensor System Low Frequency Active Sonar Systems technical report (U.S. Department of Navy 2024c).

3.5.2.2.1.4 The Navy's Acoustic Effects Model

The NAEMO calculates sound energy propagation from sonar during naval activities and the sound received by animat dosimeters (i.e., virtual representations of marine mammals distributed in the area around the modeled naval activity that each records its individual sound "dose"). The model bases the distribution of animats over the Study Area on the density values in the NMSDD and distributes animats in the water column proportional to the known time that species spend at varying depths.

The model accounts for environmental variability of sound propagation in both distance and depth when computing the received sound level on the animats. The model conducts a statistical analysis based on multiple model runs to compute the estimated effects on animals. The number of animats that exceed the thresholds for effects is tallied to provide an estimate of the number of marine mammals that could be affected.

Assumptions in the Navy model intentionally err on the side of overestimation when there are unknowns. Naval activities are modeled as though they would occur regardless of proximity to marine mammals (i.e., mitigation is not accounted for in the model) and without any avoidance of the activity by the animal. The final step of the quantitative analysis of acoustic effects is to consider the implementation of mitigation and the possibility that marine mammals would avoid continued or repeated sound exposures. Unlike other Navy at-sea projects modeled using NAEMO, SURTASS LFA sonar propagation is run to 621 mi (1,000 km) to account for the nature of the source parameters (i.e., high SL, LF).

The model estimates the effects caused by individual SURTASS LFA sonar events. During any individual modeled event, effects on individual animats are considered over 24-hour periods. The animats do not represent actual animals, but rather, they allow for a statistical analysis of the number of instances that marine mammals may be exposed to SLs resulting in an effect. Therefore, the model estimates the number of instances in which an effect threshold was exceeded over the course of a year, but it does not estimate the number of individual marine mammals that may be affected over a year (i.e., some marine mammals could be affected several times, while others would not experience any effect). A detailed explanation of NAEMO is provided in the 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 Navy 2024b).

All previous iterations of SURTASS LFA sonar modeling were done using the Marine Acoustics, Inc. software: Acoustic Integration Model (AIM). The Navy elected to transition modeling for SURTASS LFA to NAEMO, as it is the Navy-wide approved acoustic effect model for all at-sea projects. For this SEIS/OEIS, NAEMO was used to quantify estimated acoustic exposures to marine mammals. AIM, as described in the 2019 SEIS/SOEIS, and NAEMO are similar in many ways (both models represent each marine species as independent virtual animals called "animats"), but there are differences:

- Source parameters modeled in NAEMO accurately reflect operational parameters, based on validation from system subject matter experts, and the SL and duty cycle are higher than those used in AIM;

- NAEMO uses the range-dependent Comprehensive Acoustic Simulation System/Gaussian Ray Bundle (CASS-GRAB) for propagation modeling while AIM uses the range-dependent Navy standard parabolic equation (PE);
- NAEMO models propagation at 5° bearing resolution, AIM uses a 90° resolution;
- NAEMO models to a maximum 500 km distance extent for SURTASS LFA modeling, while AIM models to a 100 dB transmission loss cutoff;
- NAEMO distributes animats and runs simulations for all unique species-stock density layers while AIM used three representative densities for modeling and scales simulation output based on species-stock density for final results;
- Animats are horizontally stationary in NAEMO, while AIM simulates animat movement;
- NAEMO mathematically approximates animal avoidance to sound, while AIM's animal movement did not factor avoidance;
- NAEMO calculates behavioral effect using the maximum SPL an animat is exposed to, while AIM uses a single ping equivalent (SPE) metric.

Animat avoidance of high SLs was incorporated into NAEMO, with marine mammal avoidance thresholds based on their sensitivity to behavioral response. This process reduces the SEL, defined as the accumulation for a given animat (i.e., a virtual animal), by reducing the received SPLs of individual exposures based on a spherical spreading calculation from sources on each unique platform in an event. The onset of avoidance was based on the behavioral response functions. Some species that are less sensitive to behavioral response (i.e., most odontocetes and mysticetes) had less reduction in AINJ due to avoidance than in the prior analysis, leading to higher AINJ estimates. A detailed explanation of animat avoidance in NAEMO is provided in the 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 Navy 2024b).

3.5.2.2.1.5 Ranges to Effects

A range-to-effect is the distance from the location where a source is used to the farthest distance at which an effect would be expected to occur (i.e., the distance at which the probability of a given species experiencing a given adverse acoustic effect drops below a given threshold). Ranges to effects are utilized to help predict effects from acoustic sources and assess the benefit of mitigation zones. The values of the ranges-to-effects depends on the following parameters:

1. Source bin parameters: frequency, sound level, pulse length, pulse interval
2. Source exposure parameters: duration of sonar
3. Source origin: latitude, longitude, depth, time of year
4. Source directionality: bearing
5. Species' dive profile
6. Species-effect criteria

For more information on how the range-to-effects is built into NAEMO, see the 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 Navy 2024b). The ranges to effects for SURTASS LFA sonar are detailed in Appendix D (Acoustic Effects Analysis).

3.5.2.3 Summary of Potential Effects to Marine Mammals

3.5.2.3.1 Marine Mammal Significance Determination

As stated in Section 3.1.1, a significance determination is only required for activities that may have reasonably foreseeable adverse effects on the human environment based on the significance factors in Table 3-1. LFA sonar from the Proposed Action could have a reasonably foreseeable adverse effect; thus requiring a significance determination.

A stressor is considered to have a significant effect on the environment based on an examination of the context of the action and the intensity of the effect. The effects of SURTASS LFA sonar would be considered significant if: the effects to marine mammals would be short or long term and well outside the natural range of variability of species' populations, their habitats, or the natural processes sustaining them; behavioral and stress responses would be repeated, and hearing threshold shifts would be permanent; actions would affect any stage of a species' life cycle (i.e., breeding, feeding, growth, maturity, reproduction), alter population structure, genetic diversity, or other demographic factors, and/or cause mortality beyond a number of individuals, resulting in a decrease in population levels displacement, and behavioral or stress responses would be short or long term within and beyond the Study Area; and/or marine mammal habitat would be degraded long term or permanently, such that the habitats would no longer sustain current population levels. If the context of the action and intensity of the effect do not reach the criteria listed above, the effects of sonar transmissions would be considered less than significant.

3.5.2.3.2 Effects Under the No Action Alternative

Under the No Action Alternative, the Navy would not conduct the proposed training and testing activities in the Study Area. SURTASS LFA sonar transmissions would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment either would remain unchanged or slightly improve after cessation of ongoing training and testing activities.

3.5.2.3.3 Effects Under Alternative 1 (Preferred Alternative)

Alternative 1 (Preferred Alternative) is described in detail in Section 2.2.2.2. Under Alternative 1, SURTASS LFA sonar transmissions would increase baseline noise conditions within the Study Area. SURTASS LFA sonar would be operated for 1,100 hours annually.

The analysis of the effects of SURTASS LFA sonar anthropogenic sound to marine mammals under Alternative 1, Preferred Alternative, are consistent with a "less than significant" determination since minor non-auditory effects, auditory effects and physiological stress are anticipated; and minor masking and short-term behavioral reactions are anticipated.

Non-auditory effects would not be expected based on the following: marine mammals are mobile and can quickly swim out of the region of brief exposure; the low percent of time SURTASS LFA sonar would be transmitted (7.5 to 10 percent of vessel operating time); and the mitigation protocols delaying/suspending SURTASS LFA sonar transmissions at a sufficient distance to prevent or minimize AINJ and TTS (Chapter 4).

The most probable effects from Alternative 1 would be auditory effects, physiological stress, masking, or behavioral reactions. Marine mammals would be moderately affected by SURTASS LFA sonar transmissions only if a vessel was within close proximity to an individual while actively transmitting SURTASS LFA sonar. As stated above, marine mammals are able to swim away from the vessels, which would limit their exposure to SURTASS LFA sonar transmissions. Additionally, marine mammals may express moderate behavioral reactions in close proximity to the SURTASS LFA sonar. Mitigation protocols should delay/suspend SURTASS LFA sonar transmissions at a sufficient distance before animals are close enough to express moderate reactions.

Although potential adverse effects on certain marine mammal species from military readiness activities may include behavioral responses, or injury to individuals, those injuries are not expected to lead to long-term consequences for populations.

Pursuant to NEPA and EO 12114, acoustic transmissions associated with Alternative 1 (Preferred Alternative) would have less than significant effects on marine mammals within the Study Area. The use of SURTASS LFA sonar, as described under Alternative 1, would be expected to result in minor to moderate avoidance responses of animals over short and intermittent periods of time.

3.5.2.3.4 Effects Under Alternative 2

Alternative 2 is described in detail in Section 2.2.2.3. Under Alternative 2, SURTASS LFA sonar transmissions would increase baseline noise conditions within the Study Area. There would be a total of 2,490 hours of SURTASS LFA sonar transmission annually.

Although activities under Alternative 2 would occur at a slightly higher rate relative to Alternative 1, effects on marine mammals under Alternative 2 are not expected to be meaningfully different from those described under Alternative 1. Therefore, effects associated with marine mammals are the same as Alternative 1 with a “less than significant” determination.

Pursuant to NEPA and EO 12114, acoustic transmissions associated with Alternative 2 would have less than significant effects on marine mammals within the Study Area.

3.5.2.3.5 Endangered Species Act Determinations

Based on the potential co-occurrence of marine mammals and LFA sonar under Alternative 1 and Alternative 2, the activities may affect the North Pacific right whale (*Eubalaena japonica*) (NPRW), gray whale (Western North Pacific [WNP] stock), blue whale, pygmy blue whale (*Balaenoptera musculus brevicauda*), fin whale, humpback whale (WNP DPS), sei whale (*Balaenoptera borealis*), sperm whale, false killer whale (MHI Insular stock), Hawaiian monk seal, Steller sea lion (*Eumetopias jubatus*) (Western DPS), ringed seal (*Pusa hispida*), bearded seal (*Erignathus barbatus*), and spotted seal (*Phoca largha*) (Southern DPS) as defined by the ESA. LFA sonar would have no effect on designated critical habitat for Hawaiian monk seal or MHI IFKW, because the acoustic transmissions are not expected to occur in the critical habitat or affect the essential features of the critical habitat.

3.5.2.3.6 Marine Mammal Protection Act Determinations

An LOA is being sought in accordance with the MMPA from NMFS for the use of LFA sonar transmissions as described under the Preferred Alternative (Alternative 1). The use of SURTASS LFA sonar is expected to result in Level A and Level B harassment of certain marine mammals. The Proposed Action is not expected to cause significant disruptions, such as mass haul outs or abandonment of breeding, which would result in significantly altered or abandoned behavior patterns. However, the use of LFA sonar transmissions may still result in harassment under the MMPA.

3.6 Marine Protected Habitats

3.6.1 Affected Environment

Habitat can be defined as the resources and conditions present in an area that support a plant or animal. Habitats in the marine environment are protected to conserve and manage natural and cultural resources. Protected marine and aquatic habitats have defined boundaries and may be created under various federal, state, or international legal authority. Habitats are protected for a variety of reasons, including intrinsic ecological value, biological importance to protected marine species or taxa, management of fisheries, and cultural or historic significance. Marine and aquatic habitats protected under U.S. legislation or EOs, including marine protected areas (MPAs), marine national monuments (MNMs), NMSs, and EFH, are described in this section. Many of the MPAs in the Study Area were considered when developing geographic mitigations, as described in Section 4.4.2.

3.6.1.1 Marine Protected Areas

The term “marine protected area” is generalized and is used to describe specific regions of the marine and aquatic environments that have been set aside for protection by individual nations within their territorial waters, as well as a small number of internationally-recognized MPAs. National MPAs vary based on each nation’s legal definitions. International waters (i.e., the high seas or global commons) comprise 61 percent of the global oceans, but only 1.44 percent is considered internationally protected (Figure 3-6) (Protected Planet 2023). While MPAs are hard to define internationally, in global and U.S. water, the term is broadly used to achieve two goals: (1) habitat protection, and (2) fisheries management and protection (McCay and Jones 2011).

The variation in names and uses of MPAs globally has led to confusion over what the term means. In the U.S., an MPA is defined by EO 13158 as “any area of the marine environment that has been reserved by Federal, State, territorial, tribal, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein." Internationally, an MPA is defined by the International Union for Conservation of Nature (IUCN) and the Convention on Biological Diversity (CBD) as “a geographically defined area, which is designated or regulated and managed to achieve specific conservation objectives” (CBD 2011).

MPAs are considered an effective conservation tool to manage fisheries, preserve habitat and biodiversity, and enhance the aesthetic and recreational value of marine areas. MPAs vary in purpose, managing agencies, management approaches, level of protection, and restrictions on human uses. Although different entities provide different objectives for protection, MPAs are implemented to achieve two broad objectives: (1) conserving biodiversity and (2) supporting a sustainable ocean economy (Grorud-Colvert et al. 2021). Many MPAs are multi-use areas, while others allow only restricted uses within the designated MPA boundaries.

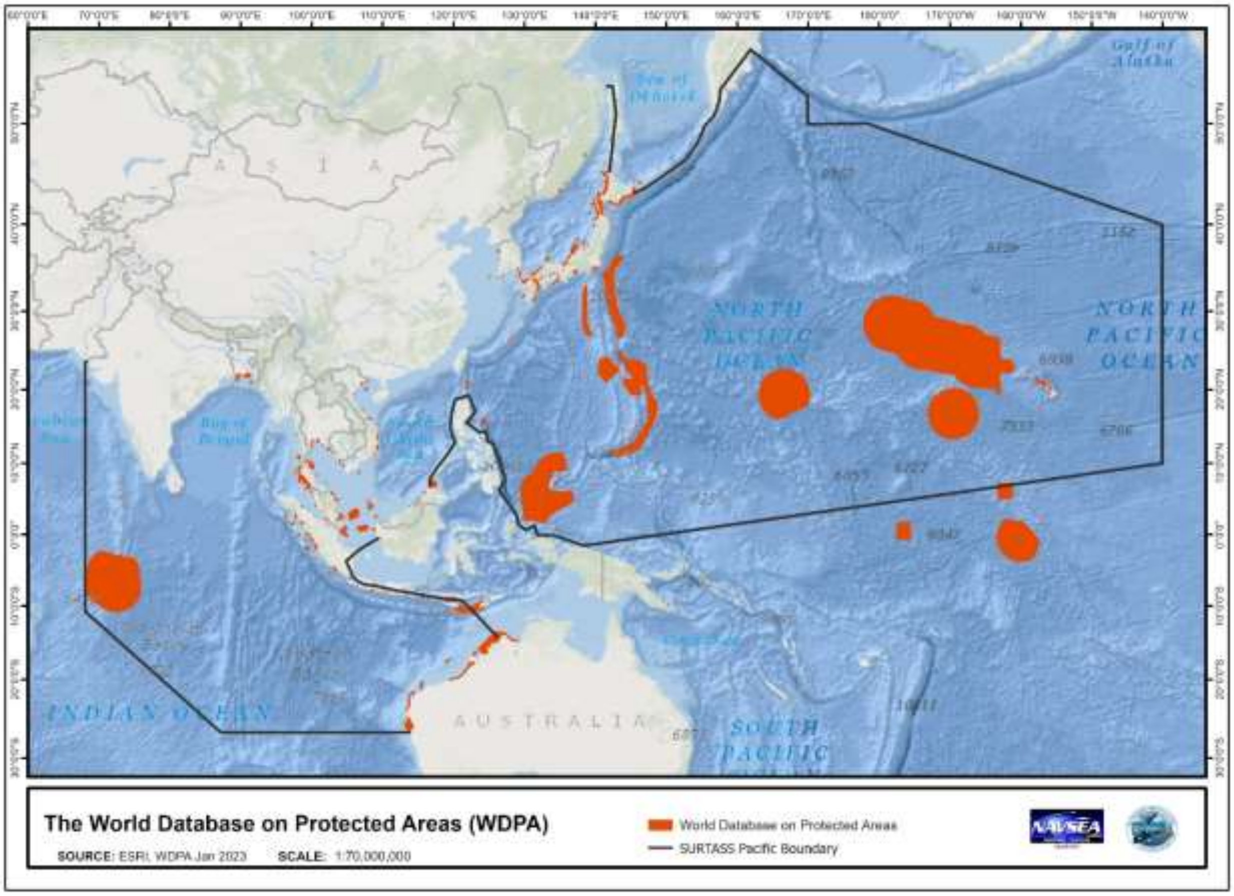

Figure 3-6. Marine Protected Areas within the Study Area

3.6.1.1.1 U.S. Marine Protected Areas

In the U.S., MPAs have conservation or management purposes, defined boundaries, permanent protection status, and some legal authority to protect marine or aquatic resources. In practice, U.S. MPAs are defined marine and aquatic geographic areas where natural and/or cultural resources are given greater protection than areas in the surrounding waters. U.S. MPAs span a range of habitats, including the open ocean, coastal areas, inter-tidal zones, estuaries, as well as the Great Lakes. MPAs vary widely in purpose, legal authority, agencies, management approaches, level of protection, and restrictions on human uses (NMPAC 2009). Currently, Federal, State, territorial, and tribal agencies manage nearly 1,000 MPAs in the U.S. and its territories (NMPAC 2023). National Oceanic and Atmospheric Administration manages NMSs, MNMs, fishery management zones, and, in partnership with states, national estuarine research reserves. MPAs, which includes details on NMSs and MNMs, were discussed in detail in Chapter 3 of the 2019 SEIS/SOEIS (U.S. Department of Navy 2019). The information from the previous SEIS/SOEIS remains pertinent and valid and is incorporated herein by reference. The following discussion relates to information and changes on MPAs within the Study Area since 2019.

By 2020, 26 percent of U.S waters were in some type of MPA, and 3 percent were in the most highly protective “no take” category of the National MPA System (Wenzel et al. 2020). Three of the largest MPAs within the U.S. System – the Papahānaumokuākea MNM, Mariana Trench MNM, and the Pacific Remote Islands MNM – are located in the western and central North Pacific Ocean, all overlapping with the Study Area. These are the only MNMs found within the Study Area. The only portions of the Pacific Remote Islands MNM that overlap with the Study Area are Wake Atoll, Johnston Atoll, and a portion of Kingman Reef and Palmyra Atoll; the remaining areas are outside of the Study Area. Navy activities within MNMs are conducted in accordance with the requirements of the monument's presidential authorization, but the Antiquities Act specifics that no consultation is required by Federal agencies in association with MNMs.

Two NMSs overlap with the Study Area: Hawaiian Islands Humpback Whale NMS and Papahānaumokuākea NMS. The Hawaiian Islands Humpback Whale NMS was designated in 1992 to protect humpback whales and their habitat in Hawaii. It encompasses submerged lands and waters surrounding the Main Hawaiian Islands from the shoreline to the 600 ft isobath; an estimated half of the North Pacific population of humpback whales use these waters for calving and breeding from late fall through spring (ONMS 2010) . The sanctuary resources are comprised of humpback whales and their habitat. No other marine biota occurring in the waters of the sanctuary are included.

An extension of the Papahānaumokuākea MNM has been designated as an NMS (90 Federal Register [FR] 4856, January 16, 2025). Papahānaumokuākea NMS encompasses the existing Papahānaumokuākea MNM entirely, spanning 582,570 square miles of the waters in and around Hawaii. Sanctuary resources include biological and physical resources in the NMS; those of concern for the Proposed Action are sea turtles and marine mammals and their habitat.

A Notice of Intent for the scoping and consideration of the draft EIS to designate the Pacific Remote Islands MNM as an NMS has been published (88 FR 23624, April 18, 2023).

3.6.1.2 Essential Fish Habitat

EFH was discussed in detail in Chapter 3 of the 2019 SEIS/SOEIS (U.S. Department of Navy 2019). The information from the previous SEIS/SOEIS remains pertinent and valid and is incorporated herein by reference. The following discussion relates to information and changes on EFH within the Study Area since 2019.

The Western Pacific Fishery Management Council (WPFMC) prepared Amendment 5 to the Hawai'i Archipelago Fishery Ecosystem Plan (FEP) and Amendment 5 to the Mariana Archipelago FEP (84 FR 2767, February 8, 2019). The Mariana Archipelago is inclusive of both Guam and the CNMI. These amendments by NMFS, as recommended by the WPFMC, reclassified the Coral Reef Ecosystem (all life stages), certain bottom fish, precious coral, and some crustacean management unit species as Ecosystem Component Species (ECS). There have been no other Amendments to EFH designations since 2019 within the Study Area. A full description of the species and management groups for which EFH is designated within the Study Area is provided in Chapter 3 of the 2019 SEIS/SOEIS (U.S. Department of Navy 2019).

3.6.2 Environmental Consequences

Marine habitats are protected for a variety of reasons including: intrinsic ecological value; biological importance to specific marine species or taxa, which are often also protected by federal or international agreements; management of fisheries; and cultural or historic significance. The potential effects to MPAs – which includes NMS and MNMs – and EFH are described in this section.

As discussed above, the one stressor of the Proposed Action is the transmission of LF sound. There is no potential for physical or chemical alterations of the water or substrate from sound transmissions. There is a potential for SURTASS LFA sonar to temporarily add to the ambient noise levels when it is transmitting (Section 3.2.1). Increases in ambient noise levels would only occur during SURTASS LFA sonar transmissions and within the narrow bandwidth of the signal.

3.6.2.1 Marine Protected Areas

The only potential for increased ambient noise levels in MPAs associated with the Proposed Action is if SURTASS LFA sonar use occurred near an MPA. Papahānaumokuākea and Pacific Remote Islands MNMs are both in coastal waters that would be encompassed by the CSR; Papahānaumokuākea and Marianas Trench MNMs are both designated as OBIAs. Sound levels would not exceed 180 dB re 1 µPa (rms) within any of these areas. Therefore, there is little to no potential for effects to the three MNMs (Papahānaumokuākea, Mariana Trench, and the Pacific Remote Islands) under either action alternative.

SURTASS LFA sonar transmissions has the potential to affect the biological resources within the Hawaiian Islands Humpback Whale NMS and Papahānaumokuākea NMS, particularly marine mammals and sea turtles. SURTASS LFA sonar has minimal temporary effects on the quantity or quality of the physical environment in both NMSs; and minor to no effects on birds, fishes, abiotic habitat, vegetation, and invertebrate marine life. Of these biological resources, only marine mammals, specifically mysticetes as they relate to these sanctuaries, may be affected by SURTASS LFA sonar.

The only resource in the Hawaiian Islands Humpback Whale NMS with the potential to be affected by the Proposed Action is humpback whales. Effects from SURTASS LFA sonar on mysticetes, including humpback whales, are detailed in Section 3.5.2.1. Only Penguin Bank in the Hawaiian Islands Humpback Whale NMS is located outside of the CSR for SURTASS LFA sonar. Penguin Bank has been designated as an OBIA (Section 4.4.2), with an effective period from November through April. As a result, SURTASS LFA sonar transmissions cannot exceed 180 dB re 1 µPa (rms) year-round in any part of the Hawaiian Islands Humpback Whale NMS except Penguin Bank, which is protected from November through April. The Navy additionally agreed that SURTASS LFA would be operated in a manner such that sound fields would not exceed received levels of 145 dB re 1 µPa (rms) (SPL) in Hawaii state waters.

The only resources with the potential to be affected by the Proposed Action are the biological resources in the Papahānaumokuākea NMS, particularly sea turtles and marine mammals. Effects from the SURTASS LFA sonar on sea turtles and marine mammals are outlined in Section 3.4.2 and Section 3.5.2, respectively. As previously discussed, marine mammals or sea turtles exposed to LFA sonar transmissions may experience auditory effects (i.e., AINJ and TTS), behavioral changes, acoustic masking, or physiological stress. There is no evidence that LFA sonar directly causes non-auditory effects or strandings of marine mammals.

Due to the application of the full suite of mitigation measures that are employed during SURTASS LFA sonar transmission (Chapter 4), there is low expectation of AINJ (MMPA Level A harassment) to any marine mammals or stocks. The analysis results show that the potential for TTS occurring is low; the most likely response, if any, following exposure to SURTASS LFA sonar transmissions is behavioral responses, which vary in magnitude by species.

Based on the analysis provided in Sections 3.4.2 and 3.5.2 any sea turtle or marine mammal, including humpback whales that may experience behavioral reactions or TTS resulting from SURTASS LFA sonar would be transitory, infrequent, and non-cumulative; and effects are not expected to decrease overall individual fitness or result in long-term population-level effects. AINJ resulting from SURTASS LFA sonar would also be infrequent and are not expected to result in long-term population-level effects within either Sanctuaries. Therefore, the Proposed Action would not have effects on the overall fitness of humpback whales or their habitat within the Hawaiian Islands Humpback whale NMS or of marine mammals and sea turtles or their habitat within the Papahānaumokuākea NMS.

3.6.2.2 Essential Fish Habitat

In recognition of the critical importance that habitat plays in all life stages of fish and invertebrate species, the MSFCMA, as amended, protects habitat essential to the production of federally managed marine and anadromous species within the U.S. Exclusive Economic Zone (EEZ). A full description of the species and management groups for which EFH is designated within the Study Area is provided in Chapter 3 of the 2019 SEIS/SOEIS (U.S. Department of Navy 2019). Adverse effects to EFH are defined as "any impact that reduces quality and/or quantity of EFH"; adverse effects include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality and/or quantity of EFH (50 CFR §600).

The one stressor of the action alternatives is the transmission of LF sound. There is no potential for physical or chemical alterations of the water or substrate from sound transmissions. In addition, there is no potential for loss of, or injury to, benthic organisms or prey species since they have little or no sensitivity to LF sound. Therefore, the Navy has considered whether the previous determination of no adverse effects on EFH made for the Navy's 2001 FOEIS/EIS for SURTASS LFA sonar is still valid based on best available science and the determination remains unchanged. There is little to no potential for effects on EFH from either action alternative and thus, the quality nor quantity of EFH would not be reasonably affected and no adverse effects on any type of EFH is expected from exposure to SURTASS LFA sonar activities as described in Alternatives 1 or 2.

3.6.2.3 Summary of Potential Effects on Marine Protected Habitats

3.6.2.3.1 Marine Protected Habitat Significance Determination

As stated in Section 3.1.1, a significance determination is only required for activities that may have reasonably foreseeable adverse effects on the human environment based on the significance factors in Table 3-1. Acoustic stressors from the Proposed Action could have a reasonably foreseeable adverse effect; thus requiring a significance determination.

A stressor is considered to have a significant effect on the environment based on an examination of the context of the action and the intensity of the effect. The effects of SURTASS LFA sonar would be considered significant if a measurable or anticipated degree of change in the environment of marine protected habitats would be substantial and highly noticeable compared to existing conditions, and/or acoustic effects would contribute to an increased noise level and would cause short-term alterations to marine protected habitats. If the context of the action and intensity of the effect do not reach the criteria listed above, the effects of sonar transmissions would be considered less than significant.

3.6.2.3.2 Effects Under the No Action Alternative

Under the No Action Alternative, the Navy would not conduct the Proposed Action activities in the Study Area. SURTASS LFA sonar transmissions would not be introduced into the marine environment, and there would be no changes to marine protected habitats. Baseline conditions of the existing environment either would remain unchanged or slightly improve after cessation of ongoing SURTASS LFA sonar transmissions.

3.6.2.3.3 Effects Under Alternative 1 (Preferred Alternative)

Alternative 1, Preferred Alternative, is described in detail in Section 2.2.2.2. Under Alternative 1, SURTASS LFA sonar transmissions would increase baseline noise conditions within the Study Area. SURTASS LFA sonar would be operated for a maximum of 1,100 hours annually across a maximum of four vessels. It is expected that under Alternative 1 there would be minimal potential for marine environment effects.

The analysis of the effects of SURTASS LFA sonar transmissions to marine protected habitats under Alternative 1, Preferred Alternative, are consistent with a “less than significant” determination since SURTASS LFA sonar will be introduced for a short period of time, thereby only temporarily increasing the ambient noise levels within marine protected habitats. Marine protected habitats will return to their previous conditions after SURTASS LFA sonar transmissions have ceased.

Pursuant to NEPA and EO 12114, acoustic transmissions associated with Alternative 1 (Preferred Alternative) would have less than significant effects on marine protected habitats within the Study Area, especially with incorporation of mitigation measures described in Chapter 4.

3.6.2.3.4 Effects under Alternative 2

Alternative 2 is described in detail in Section 2.2.2.3. Under Alternative 2, SURTASS LFA sonar transmissions would increase baseline noise conditions within the Study Area. There would be a total of 2,490 hours of SURTASS LFA sonar transmission annually.

Although activities under Alternative 2 occur at a slightly higher rate relative to Alternative 1, effects on marine protected areas under Alternative 2 are not expected to be meaningfully different from those described under Alternative 1. Therefore, effects associated with marine mammals are the same as Alternative 1 with a “less than significant” determination.

Pursuant to NEPA and EO 12114, acoustic transmissions associated with Alternative 2 would have less than significant effects on marine protected habitats within the Study Area, especially with incorporation of mitigation measures described in Chapter 4.

3.6.2.3.5 National Marine Sanctuaries Act Determination

In accordance with Section 304 (d) of the National Marine Sanctuaries Act (NMSA), federal agencies are required to consult with the Office of National Marine Sanctuaries on actions internal or external to a Sanctuary that are likely to destroy, cause the loss of, or injure any sanctuary resource. The Navy is still evaluating based on the effects of SURTASS LFA sonar the extent of consultation necessary under Section 304(d) of the NMSA.

3.7 Economic Resources

The Proposed Action occurs in open-ocean areas, so it has the potential to interact with economic activities taking place in these locations, such as fishing, diving, and whale watching. The Proposed Action would not occur in the Savu Sea, Indonesia where subsistence harvest of fish and whales occurs (Mustika 2006; Porter and Lai 2017). There are no subsistence hunting areas authorized under the MMPA within the Study Area. The following section discusses the economic activities that may take place concurrently with the Proposed Action, which includes commercial fishing, recreational and commercial diving, and whale watching.

3.7.1 Affected Environment

3.7.1.1 Commercial Fisheries

Global commercial fisheries were discussed in detail in Chapter 3 of the 2012 SEIS/SOEIS (U.S. Department of Navy 2012) and the 2017 SEIS/SOEIS (U.S. Department of Navy 2017). The information from the previous SEIS/SOEISs remain pertinent and valid and is incorporated herein by reference. The following discussion relates to information on the global commercial fisheries since 2017 within the Study Area.

3.7.1.1.1 Global Fisheries Production

Global fishery statistics are compiled by the Food and Agriculture Organization of the United Nations. In 2020, a total of 86.9 million tons (78.8 million metric tons) of marine fishes, crustaceans, mollusks, and other aquatic animals (e.g., cnidarians) were caught globally (FAO 2022). There was a 6.8 percent decrease in global marine catches from 2018 to 2020 largely due to the coronavirus disease 2019 pandemic (FAO 2022). In 2020, 89 percent of the global fisheries and aquaculture production of aquatic animals were for direct human consumption.

3.7.1.1.1.1 Trends of the Top Fish Producing Countries

In 2020, seven countries within the Study Area were among the top 10 worldwide marine fishery-producing nations (Table 3-11). China was the top harvester and exporter of aquatic products (e.g., fish, mollusks) for the world (Table 3-11). China's fishery harvest and production decreased by 18.2 percent from 2015 to 2020 due to a catch reduction policy that was implemented by China in 2016 in efforts to reduce their total catch so fisheries would be restored within their EEZ (Cao et al. 2017; FAO 2022). Further decreases of harvest and production are expected for China with the continuation of their catch reduction policy through 2025 (FAO 2022). The northwest Pacific Ocean, which is defined by the FAO to include northwest Pacific waters from north of the Philippines to the coast of Russia in the Western Bering Sea, continues to be the most productive fishing area in the world. Fishing in this region accounted for 24 percent of the total marine catches in 2020 (FAO 2022; 2023). FAO noted there is a continued increasing trend in tropical marine fishery landings, such as in the Indian Ocean (FAO 2022). Temperate ocean fisheries have mainly been stable over the last decade (FAO 2022).

Table 3-11. Top Worldwide Fishing Nations in 2020 Found within the Study Area

Country	*Total 2020 Marine Capture Production in million tons (million metric tons)*	*Overall Worldwide Rank*
China	12.97 (11.77)	1
Indonesia	7.09 (6.43)	2
Russian Federation	5.28 (4.79)	4
U.S.A.	4.66 (4.23)	5
India	4.09 (3.71)	6
Vietnam	3.61 (3.27)	7
Japan	3.45 (3.13)	8
Philippines[1]	1.94 (1.76)	11
Thailand	1.68 (1.52)	12
Malaysia	1.52 (1.38)	13
Republic of Korea	1.50 (1.36)	14

[1] The Philippines is the only other country within the top 14 rank that is outside of the Study Area but may fish within the Study Area. The other countries that fall within the top 14 worldwide fishing nations occur within the Atlantic Ocean or Southeastern Pacific Ocean.
Reference: FAO (2022)

In 2020, the majority of species harvested were finfish (e.g., Pacific sardines [*Sardinops sagax*], Japanese anchovy [*Engraulis japonicus*], mackerel scads [*Decapterus* spp.]) (FAO 2022). The main species harvested in the Study Area was the finfish skipjack tuna (*Katsuwonus pelamis*) with 3,116 thousand tons (2,827 thousand metric tons) harvested in 2020 (FAO 2022). Some of the highest levels of catches of tuna and tuna-like species occurred over the last 20 years during 2019 and 2020 (FAO 2022). Cephalopod catches have almost continually increased from 2000 to 2020 (FAO 2022).

The total number of fishing vessels in the world was estimated at 4.1 million in 2020, with 2.5 million (62 percent) of those vessels powered by engines (FAO 2022). 81 percent of global motorized fishing vessels are less than 39 ft (12 m) in length, with only five percent of the world's fishing fleet comprised of vessels in excess of 78 ft (24 m) (FAO 2022). The Asian fishing fleet is the largest, with 2.68 million vessels, of which about 71 percent are motorized. The statistics for the Asian fishing fleet are similar to the global fleet, with about 82 percent of fishing vessels under 39 ft (12 m) in length, 12 percent of vessels from 39 to 78 ft (12 to 24 m) long, and six percent of vessels at least 78 ft (24 m) in length (FAO 2022).

3.7.1.2 Recreational and Commercial Diving

Recreational or sport diving is underwater diving for leisure or recreation. Commercial diving is underwater diving for industrial, construction, engineering, maintenance, scientific research, or other commercial work for which the diver is paid, with diving being secondary to the underwater work (46 CFR Part 197.204). Recreational divers typically use scuba equipment and rebreathers while commercial divers can use an array of breathing systems, such as scuba equipment or surface-supplied breathing systems (BLS 2022). Generally, recreational diving occurs in waters with a maximum depth of 130 ft (40 m), beyond which safety issues such as oxygen toxicity and nitrogen narcosis significantly increase (Bennett and Cibis 2022). Specialized skills and diving equipment (including gas mixtures) are needed for technical and commercial diving at water depths beyond 130 ft (40 m) (Bradley 2023; Mitchell and Doolette 2013).

In the U.S., commercial divers are governed by industry and government safety and health regulations (e.g., the Occupational Safety and Health Administration governs commercial diving safety in U.S. waters [29 CFR Part 1910]). Outside of the U.S., other countries within the Study Area also govern commercial divers, including but not limited to Japan and Australia (Kamae 2020; AS/NZS 2015). The underwater sites, such as fixed oil or gas platforms, where commercial divers work are well marked on nautical charts. If work is being conducted on a structure not charted, a notice to mariners is published so that all ships, boats, and maritime traffic are aware of the location of the underwater diving work. As such, the health and safety of commercial divers is ensured by regulations and safety requirements under which these professionals work.

Recreational diving, including snorkeling, primarily occurs in coastal waters at known recreational dive sites that have shipwrecks, sunken aircraft, reefs, and oil and gas platforms. These popular sites are well documented. For instance, the locations of oil and gas rigs and platforms are charted on nautical charts and other maps. In 2018, as many as 365 offshore rigs operated off the coast of Asia, and there were 11 oil rigs off the coast of Australia (Statista 2018). Most shipwrecks are also well documented, as are the coastal locations of reefs, caves, or other natural dive sites. For example, off the coast of India there are 64 known shipwrecks, but not all shipwrecks are within the recreational diving depth (Tripati 2015).

Some of the world's premier and most popular recreational diving sites are located in the Study Area. Recreational dive sites are not equally distributed by country or even region of the world. Dive site locations vary with the recreational and leisure purposes for diving. For instance, recreational diving for the purpose of observing marine wildlife such as manta rays, sharks, turtles, or coral reef communities are dependent upon the discrete habitats in accessible coastal regions where these marine organisms aggregate or seasonally migrate. Recreational diving to explore shipwrecks or other sunken artifacts depends upon the arbitrary locations where ships or aircraft have sunk. Thus, dive sites for these types of recreational diving purposes are often concentrated in sub-tropical and tropical waters where coral reefs created navigation hazards or in areas where air and sea battles (e.g., World War II) took place.

3.7.1.2.1 Dive Site Compilation

To protect human divers from possible exposure to SURTASS LFA sonar transmissions, the Navy must have an understanding of the locations where recreational and commercial diving occurs (Appendix E, Recreational Dives Sites in the Study Area). As noted, fixed locations where commercial diving may occur are well marked on nautical charts and at-sea navigation systems, which are common tools employed by marine vessels, including the SURTASS LFA sonar vessels. Additionally, notices to mariners are received by the SURTASS LFA sonar vessels to advise them of updates to nautical charts, navigational hazard or safety issues, including underwater operations, such as construction or repair projects that use divers. A number of countries produce nautical charts and may produce notice to mariners in the Study Area, including the U.S., Japan, China, Australia, and India. Mariner notices are updated once a week, bi-monthly, or once a month, depending upon the country (AHO 2008; CCG 2023; USCG 2023). Since these mechanisms provide more accurate information on the dynamic locations where commercial diving may be occurring than any static information, no additional locational information on commercial dive sites is included herein.

Information on recreational dive sites is publicly available for most of the 24 countries bordering the Study area. The compiled recreational dive sites are listed by country in Appendix E (Recreational Dives Sites in the Study Area).

3.7.1.3 Whale Watching

Whale watching is a tourist activity where people generally go out by boat to observe cetaceans (i.e., whales, dolphins, and porpoises) in their natural environment. Cetaceans that are found within the Study Area include NPRW, gray whale, blue whale, fin whale, humpback whale, and more (Section 3.5.1.1.1). Whale watching is a common tourist attraction in the U.S., Australia, India, the Maldives, and Sri Lanka (IWC 2023a). Whale watching is generally a seasonal activity. For example, humpback whale watching around the Hawaiian Islands starts as early as November, but peaks from late February through early April (Carretta et al. 2014; Mobley et al. 2001), whereas humpback whale watching is most common during the months of October to May in Gujarat, India (IWC 2023a). In Sri Lanka, whale watching boats have been recorded to go up to 12 mi (20 km) offshore (IWC 2023a). Whale watching has also been recorded in waters 100 to 400 ft (30 to 120 m) deep (Trull 2023).

There are guidelines and regulations (country dependent) that help promote sustainable whale watching. In the U.S., there are general viewing guidelines that require vessels to stay 300 to 1,500 ft (90 to 500 m) away from some species of large whales (NOAA 2023c). The International Whaling Commission (IWC) has developed a handbook that provides guidelines and support to whale watching managers, regulators, operators, and more to promote sustainable whale watching worldwide (IWC 2023b).

3.7.2 Environmental Consequences

This section evaluates how and to what degree the activities described in Chapter 2 potentially affect economic resources known to occur within the Study Area. The information below builds on the analyses previously conducted in the Navy's past NEPA work for SURTASS LFA Sonar, which is incorporated herein by reference. The only stressor analyzed is the acoustic stressor: underwater SURTASS LFA sonar. Potential underwater acoustic effects include interference with the human environment that involves economics (e.g., employment, income, or revenue) and social conditions (i.e., enjoyment and quality of life) associated with the marine environment.

All physical (vessel movement, passive sonar array movement, and entanglement) or other acoustic (underwater vessel anthropogenic sound, and underwater HF/M3 narrow frequency sound) stressors are not analyzed based on previous SURTASS LFA environmental analyses, best available science, and because negligible effects to economic resources would be expected from these stressors (Refer to Chapter 4 in U.S. Department of Navy 2019).

3.7.2.1 Acoustic Stressor: SURTASS LFA Sonar

Previous SURTASS LFA environmental analyses analyzed potential effects of SURTASS LFA sonar on economic resources. For the convenience of the reader, a summary of the analyses that examined the potential effects of SURTASS LFA sonar on commercial fisheries, scuba diving, and whale watching are included below. Beyond summarizing the 2019 analysis, this section will also update the analysis based on the current action alternatives being considered.

3.7.2.1.1 Commercial Fisheries

SURTASS LFA sonar training and testing activities will not occur within the territorial seas of foreign nations and are geographically restricted such that received levels are less than 180 dB re 1 µPa (rms) SPL within 12 NM from coastlines. These restrictions would cause minimal to no potential effects to commercial fisheries within territorial seas. However, most countries fish beyond their territorial seas within their own EEZ (Tickler et al. 2018). To a lesser extent, countries such as China and Republic of Korea mainly partake in distant-water fishing beyond their own EEZ (Tickler et al. 2018). The Proposed Action has the potential to expose fish to LFA sonar within a country's EEZ and the high seas, which could affect the fisheries targeting those fish.

Potential effects to fish from SURTASS LFA sonar are discussed in Section 3.3.2.1 and apply here as well because effects to fish can affect the ability of fishermen to catch affected fish. For example, skipjack tuna, a popular commercial target species in the Pacific Ocean, does not have a swim bladder. According to the ANSI Sound Exposure Guideline technical report (Popper et al. 2014), fish without swim bladders would have a low chance of potential mortal injury, recoverable injury, masking, and behavioral changes from LF sonar noise (Table 3-5). Potential effects to cephalopod fisheries are not discussed as invertebrates have been categorically eliminated for further consideration due to their hearing capabilities (Section 3.1.2). Alternative 1 or 2 would have less than significant effects on fishes. Therefore, the potential effects to commercial fisheries from SURTASS LFA sonar exposure, under either Alternative 1 or 2, would be less than significant.

3.7.2.1.2 Recreational and Commercial Diving

The Navy concluded that LF sound levels at or below 145 dB re 1 µPa (rms) would not have adverse effects on recreational or commercial divers based on a study conducted by the Office of Naval Research and the Navy Submarine Medical Research Laboratory (U.S. Department of Navy 2001). Therefore, SURTASS LFA sonar received levels associated with training and testing activities are not to exceed 145 dB re 1 µPa (rms) within known recreational and commercial dive sites under normal operating conditions. As previously stated, commercial dive sites are well marked on nautical charts, or notices to mariners are released if locations are uncharted. Recreational dive and snorkeling sites are also well known (Appendix E, Recreational Dives Sites in the Study Area). Common knowledge of recreational and commercial dive sites protects humans from effects so that if vessels are transmitting SURTASS LFA sonar near a dive site, they can alter exposure limits to 145 dB re 1 µPa (rms). Therefore, SURTASS LFA sonar would have less than significant effects on recreational or commercial diving.

3.7.2.1.3 Whale Watching

Whale watching typically takes place during the times of the year and in geographic locations where the probability of observing cetaceans will be greatest. The majority of whale watching occurs within 12 NM (22 km) of land since it is generally a day trip activity. The probability of cetacean occurrence increases in certain regions (e.g., OBIAs) because cetaceans often aggregate in specific areas to participate in some biologically important activity, such as feeding. The SURTASS LFA sonar sound field is restricted to less than 180 dB re 1 µPa (rms) within 12 NM of coastlines and in OBIAs during biologically important seasons. Therefore, SURTASS LFA sonar would have less than significant effects on whale watching.

3.7.2.2 Summary of Potential Effects on Economic Resources

3.7.2.2.1 Economic Resource Significance Determination

As stated in Section 3.1.1, a significance determination is only required for activities that may have reasonably foreseeable adverse effects on the human environment based on the significance factors in Table 3-1. Acoustic stressors from the Proposed Action could have a reasonably foreseeable adverse effect; thus requiring a significance determination.

A stressor is considered to have a significant effect on the human environment based on an examination of the context of the action and the intensity of the effect. The effects of the stressor analyzed herein would be considered significant if the effects would be long term (i.e., lasting for more than a year after the activity) and extend beyond the local geographical area).

3.7.2.2.2 Effects under the No Action Alternative

Under the No Action Alternative, the Navy would not conduct the proposed training and testing activities in the Study Area. SURTASS LFA sonar transmissions would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.7.2.2.3 Effects Under Alternative 1 (Preferred Alternative)

Alternative 1, Preferred Alternative, is described in detail in Section 2.2.2.2. Under Alternative 1, SURTASS LFA sonar transmissions would increase baseline noise conditions within the Study Area. SURTASS LFA sonar would be operated for a maximum of 1,100 hours annually.

The analysis of effects of SURTASS LFA sonar anthropogenic sound to economic resources under Alternative 1, Preferred Alternative, are consistent with a “less than significant” determination since near negligible economic resource effects are anticipated. As discussed above in this section, most economic resources occur within 12 NM of land, and the SURTASS LFA sonar sound field is restricted to less than 180 dB re 1 µPa (rms) within this area, making potential effects not reasonably foreseeable. Even beyond these territorial seas, anticipated effects to fish (Section 3.3.2) and whales (Section 3.5.2) that offshore economic activities are dependent upon would be minimal.

Pursuant to NEPA, acoustic transmissions associated with Alternative 1 would have less than significant effects on the economic resources within the Study Area.

3.7.2.2.4 Effects under Alternative 2

Alternative 2 is described in detail in Section 2.2.2.3. SURTASS LFA sonar transmissions associated with Alternative 2 would increase baseline noise conditions within the Study Area. Under Alterative 2, there would be a total of 2,490 hours of SURTASS LFA sonar transmissions annually.

Although activities under Alternative 2 occur at a slightly higher rate relative to Alternative 1, effects on economic resources under Alternative 2 are not expected to be meaningfully different from those described under Alternative 1. Therefore, effects associated with economic resources are the same as Alternative 1 with a “less than significant” determination. Pursuant to NEPA, acoustic transmissions associated with Alternative 2 would have less than significant effects on the economic resources within the Study Area.

3.8 Cumulative Effects

This section (1) defines cumulative effects, (2) describes past, present, and reasonably foreseeable future actions relevant to cumulative effects, (3) analyzes the incremental interaction the Proposed Action may have with other actions, and (4) evaluates cumulative effects potentially resulting from these interactions.

3.8.1 Definition of Cumulative Effects

The Navy has chosen to voluntarily follow the Council on Environmental Quality (CEQ) regulations (40 CFR sections 1500-1508), which provided the implementing procedures for NEPA, in addition to Navy's procedures/regulations implementing NEPA at 32 CFR Part 775, to meet the agency's obligations under NEPA, 42 U.S.C. §§ 4321 et seq. The 2024 regulations defined "cumulative effects" as:

> "Effects on the environment that result from the incremental effects of the action when added to the effects of other past, present, and reasonably foreseeable actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative effects can result from actions with individually minor but collectively significant effects taking place over a period of time." (40 CFR 1508.1(i(3))) (2024)

To determine the scope of environmental effect analyses, agencies shall consider cumulative actions, which when viewed with other Proposed Actions have cumulatively significant effects and should therefore be discussed in the same effect analysis document.

In addition, CEQ and the United States Environmental Protection Agency (USEPA) have published guidance addressing implementation of cumulative effects analyses—Guidance on the Consideration of Past Actions in Cumulative Effects Analysis (CEQ 2005) and Consideration of Cumulative Impacts in Environmental Protection Agency Review of NEPA Documents (USEPA 1999). CEQ guidance entitled Considering Cumulative Impacts Under NEPA (1997) states that cumulative impact analyses should,

> "…determine the magnitude and significance of the environmental consequences of the Proposed Action in the context of the cumulative impacts of other past, present, and future actions...identify significant cumulative impacts…[and]…focus on truly meaningful impacts."

Cumulative effects are most likely to arise when a relationship or synergism exists between a Proposed Action and other actions expected to occur in a similar location or during a similar time period. Actions overlapping with or in close proximity to the Proposed Action would be expected to have more potential for a relationship than those more geographically separated. Similarly, relatively concurrent actions would tend to offer a higher potential for cumulative effects. To identify cumulative effects, the analysis needs to address the following three fundamental questions.

- Does a relationship exist such that affected resource areas of the Proposed Action might interact with the affected resource areas of past, present, or reasonably foreseeable actions?
- If one or more of the affected resource areas of the Proposed Action and another action could be expected to interact, would the proposed action affect or be affected by effects of the other action?
- If such a relationship exists, then does an assessment reveal any potentially significant effects not identified when the Proposed Action is considered alone?

3.8.2 Scope of Cumulative Effects Analysis

The region of influence or geographic boundaries for analyses of cumulative effects can vary for different resources and environmental media. CEQ guidance indicates that geographic boundaries for cumulative effects almost always should be expanded beyond those for the project-specific analyses (CEQ 1997). One method of evaluating geographic boundaries that is proposed by the CEQ guidance is to consider the distance an effect can travel and to identify potential cumulative assessment boundaries accordingly.

The basic region of influence or geographic boundary for the majority of resources analyzed for cumulative effects in this SEIS/OEIS is the entire Study Area (Figure 1-1). The Study Area includes the study areas for other Navy at-sea documents (portions of Hawaii-California Training and Testing [HCTT] and all of the Mariana Islands Training and Testing [MITT]), and cumulative effects within those study areas have been evaluated in prior analyses (the (2018b) Hawaii-Southern California Training and Testing [HSTT] Final EIS/OEIS and the (2020) MITT Final EIS/OEIS), which were consulted for this analysis and are incorporated by reference. The geographic boundaries for cumulative effects analysis for some resources are expanded to include activities outside the Study Area that might affect migratory or wide-ranging animals. Other activities potentially originating from outside the Study Area that are considered in this analysis include effects associated with maritime traffic (e.g., underwater noise) and commercial fishing (e.g., bycatch).

3.8.3 Past, Present, and Reasonably Foreseeable Actions

This section will focus on past, present, and reasonably foreseeable future projects in the western and central North Pacific and eastern Indian Oceans. In determining which projects to include in the cumulative effects analysis, a preliminary determination was made regarding if a relationship exists such that the affected resource areas of the Proposed Action might interact with the affected resource areas of a past, present, or reasonably foreseeable action. If no such potential relationship exists, the project was not carried forward into the cumulative effects analysis. In accordance with CEQ guidance (CEQ 2005), those actions considered but excluded from further cumulative effects analysis are not catalogued here as the intent is to focus the analysis on the meaningful actions relevant to inform decision-making. Past cumulative effects analyses from previous SURTASS LFA environmental analyses as well as from HCTT and MITT at-sea documents were considered in this evaluation.

The cumulative effects analysis makes use of the best available data, quantifying effects where possible and relying on qualitative description and best professional judgement where detailed measurement is unavailable. All likely future development or use of the region is considered to the greatest extent possible, even when a foreseeable future action is not planned in sufficient detail to permit complete analysis (CEQ 1997). The cumulative effects analysis is not bounded by a specific future timeframe (e.g., five years). The Proposed Action includes general types of activities addressed by this SEIS/OEIS that are expected to continue indefinitely, and the associated effects could occur indefinitely. While the training and testing requirements change over time, it should be recognized that available information, uncertainties, and other practical constraints limit the ability to analyze cumulative effects for the indefinite future. New or supplemental environmental planning documents, including cumulative effect analyses, are prepared as needed, covering changes in military readiness activities in the Study Area.

Table 3-12Table 3-12 and Table 3-13Table 3-13 describe other actions that have had, continue to have, or would be expected to have some effect upon resources also effected by the Proposed Action within the Study Area and surrounding areas. Table 3-12Table 3-12 focuses on identifying past, present, and reasonably foreseeable future actions (e.g., military mission, testing, and training; offshore energy development; ocean-dependent commercial industries; research). For perspective of general project locations, refer to the most recent respective HCTT and MITT Final EIS/OEIS, which depicts the Study Area and boundaries of individual training and testing locations, including the Hawaii Range Complex (HRC)—part of the HCTT Study Area—and the MITT Study Area.

Table 3-12. Past, Present, and Reasonably Foreseeable Future Actions

Action	***Geographic Overlap***	***Project Timeline***			***Description***
		Past	***Present***	***Future***	
Military Mission, Testing, and Training Activities					
CNMI Joint Region Marianas Integrated Natural Resources Management Plan (INRMP)	Commonwealth of the Northern Mariana Islands (CNMI)	X	X	X	In June 2019, the Navy completed the Joint Region Marianas Integrated Natural Resources Management Plan (INRMP). An INRMP is a long-term planning document designed to guide the management of natural resources on military-administered areas, support military missions, and ensure compliance with environmental laws and regulations. The purpose of the 2019 Joint Region Marianas INRMP is to maintain long-term ecosystem health and operational requirements of the DoD's mission while minimizing effects on natural resources. It is also the intent of the INRMP to provide a conservation benefit to federally protected species (ESA-listed corals, fishes, sea turtles, and marine mammals).
Foreign Navies Training and Testing Activities	SURTASS Study Area	X	X	X	As the navies of the world increase their "blue water" capabilities, the presence of foreign military within the Study Area will likely increase. Foreign military vessels currently transit through the Global Commons and international waters within the Study Area while en route to and from Guam, Hawaii, and other locations in and bordering the Pacific and Indian Oceans.
Hawaii-California Training and Testing (HCTT) and Hawaii-Southern California Training and Testing (HSTT)	Hawaii Range Complex (HRC)	X	X	X	Would evaluate effects from past activities as well as present training and testing activities based on changing operational requirements, new platforms, and new systems. The full breadth of activities, and their potential effects, of the upcoming 2025 Final HCTT EIS/OEIS, are expected to be similar in nature to those analyzed in the 2018 HSTT EIS/OEIS.
Mariana Islands Training and Testing (MITT)	MITT Study Area	X	X	X	Would evaluate effects from past activities as well as present training and testing activities based on changing operational requirements, new platforms, and new systems. The full breadth of activities, and their potential effects, of the 2027 Final MITT EIS/OEIS, is expected to be similar in nature to those analyzed in the 2020 Final Supplemental EIS/OEIS.
Naval Special Warfare Operations Training	HRC		X		Historical and proposed water-based training activities for Special Operations forces.

Action	***Geographic Overlap***	***Project Timeline***			***Description***
		Past	***Present***	***Future***	
Naval Undersea Warfare Center Division Keyport Fixed Surface Ship Radiated Noise Measurement System	HRC		X		Includes the installation and operation of a hydrophone array, undersea data transmission cable, and a shore station cable landing to measure underwater vessel sound (U.S. Department of Navy 2015a).
U.S. Coast Guard (USCG)	U.S. Territorial Waters, EEZ, and the Global Commons	X	X	X	The USCG performs maritime humanitarian, law enforcement, and safety services in coastal and offshore waters.
Wave Energy Test Site (WETS)	HRC		X	X	The U.S. Navy's WETS, the United States' first grid-connected wave energy test site, was expanded to three test berths in 2015. WETS hosts companies seeking to test their pre-commercial wave energy convertor devices in an operational setting, enabling them to advance their device transition readiness level. Hawaii Natural Energy Institute provides performance analysis, numerical modeling of devices and moorings, wave measurement and forecasting, environmental monitoring (primarily acoustics), and logistics support to the Navy and the companies deploying at WETS.
Other Commercial Industries					
Commercial Fishing	SURTASS Study Area	X	X	X	Commercial fisheries throughout the Study Area have the potential to affect the coastal economies and marine habitats.
Geological and Geophysical Oil and Gas Survey Activities	SURTASS Study Areas	X	X	X	Offshore geological and geophysical research may include seismic air gun surveys and high resolution geophysical surveys supporting oil and gas, renewable energy, and marine minerals exploration (BOEM 2014).
Maritime Traffic	SURTASS Study Area	X	X	X	Key ports facilitate the heavy commercial, recreational, and government marine traffic throughout the Study Area.
Recreational Fishing	SURTASS Study Area	X	X	X	Recreational fishing contributes significantly to the tourism economies throughout the Study Area and has the potential to affect coastal economies and marine habitats.
Wind Energy	SURTASS Study Area		X	X	Development of offshore wind energy includes site characterization, assessment activities, and installation activities.

Action	***Geographic Overlap***	***Project Timeline***			***Description***
		Past	***Present***	***Future***	
Research and Conservation					
Academic Research	SURTASS Study Area		X	X	Wide-scale academic research is conducted in the Study Area by federal entities, such as the Navy and the NOAA/NMFS, as well as state and private entities and other partnerships.
Field Operations at National Marine Sanctuaries and Marine National Monuments	Hawaiian Humpback Whales NMS; Papahānaumokuākea NMS; Papahānaumokuākea MNM		X	X	NOAA conducts field operations within Marine Sanctuaries and Monuments that primarily support resource protection, research, and education objectives of the NMSA.

CNMI = Commonwealth of the Northern Mariana Islands; EEZ = Exclusive Economic Zone; HCTT = Hawaii-California Training and Testing; HSTT = Hawaii-Southern California Training and Testing; INRMP = Joint Region Marianas Integrated Natural Resources Management Plan; HRC = Hawaii Range Complex; MITT = Mariana Islands Training and Testing; NMSA = National Marine Sanctuary Act; MNM = Marine National Monument; NMFS = National Marine Fisheries Service; NMS = National Marine Sanctuary; NOAA = National Oceanic and Atmospheric Administration; USCG = United States Coast Guard; WETS = Wave Energy Test Site

Table 3-13. Ecosystem Alteration Trends

Stressor	***Location***	***Description***
Noise	Global	Ambient noise is the collection of ever-present sounds of both natural and human origin. Ambient noise in the ocean is generated by sources that are natural physical (e.g., earthquakes, rainfall, waves breaking, and lightning hitting the ocean); natural biological (e.g., snapping shrimp and the vocalizations of marine mammals), and anthropogenic (human-generated) sources. Anthropogenic sources have substantially increased ocean noise since the 1960s, and these sources include commercial shipping, oil and gas exploration and production activities (including air gun, drilling, and explosive decommissioning), commercial and recreational fishing (including vessel sound, fish-finding sonar, fathometers, and acoustic deterrent and harassment devices), military (testing, training, and mission activities), shoreline construction projects (including pile driving), recreational boating and whale watching activities, offshore power generation (including offshore windfarms), and research (including sound from air guns, sonar, and telemetry).

°C = degrees Celsius; °F = degrees Fahrenheit; GHG = greenhouse gas

3.8.4 Cumulative Effect Analysis

Since the information available on past, present, and reasonably foreseeable actions varies in quality and level of detail, effects of these actions were quantified where available data made it possible; otherwise, professional judgement and experience were used to make a qualitative assessment of effects. Due to the large scale of the Study Area and multiple activities and stressors interacting in the ocean environment, the analysis for the incremental contribution to cumulative stress that the Proposed Action may have on a given resource is largely qualitative and speculative. Each past, present, or reasonably foreseeable future project was evaluated against the Proposed Action to determine if the two effects may result in cumulative effects on resources.

The differences in cumulative effects from Alternative 1 and Alternative 2 within the Study Area is discussed where applicable below. Alternative 2 would include the introduction of up to two additional T-AGOS vessels into the fleet for training in the Study Area (Chapter 2). The analysis was not fully separated by Alternative because the cumulative effects analysis data from the Proposed Action was mostly qualitative in nature and, from a landscape-level perspective, these qualitative effects are expected to be generally similar. Under Alternative 1 or Alternative 2, the Action Proponent would implement the mitigation measures detailed in Chapter 4 to avoid or reduce potential effects on biological, economic, and cultural resources in the Study Area.

Where feasible, the cumulative effects were assessed using quantifiable data; however, for many of the activities included for analysis, quantifiable data are not available, and a review of the best available information was undertaken. In general, long-term rather than short-term effects and widespread rather than localized effects were considered more likely to contribute to cumulative effects. For example, for biological resources, population-level effects were considered more likely to contribute to cumulative effects than were individual-level effects. Negligible effects were not considered further in the cumulative effect analysis.

Section 3.8.5 includes a discussion of cumulative effects in a meaningful sense. The analysis is cumulative in that it considers the current condition of each resource, which would include effects by past and present human activity. Environmental consequences for each resources include discussion of the “general threats,” an analysis of aggregate project effects, and a broader level analysis specific to areas where effects are concentrated. Therefore, those analyses are referenced and briefly summarized in each section below to provide context and perspective to the rationale for the conclusions that the Proposed Action would have an insignificant contribution to the cumulative stress experienced by these resources when specific past, present, and reasonably foreseeable future actions are added to the analysis.

3.8.5 Resource-Specific Cumulative Effects

In accordance with CEQ guidance (CEQ 1997), the following cumulative effects analysis focuses on effects that are “truly meaningful.” The level of analysis for each resource is commensurate with the intensity of the effects identified in Chapter 3 or the level to which effects from the Proposed Action are expected to mingle with similar effects from existing activities. As discussed in Section 3.1.3, certain physical (vessel movement, passive sonar array movement, and entanglement) or other acoustic (underwater vessel sound) stressors from the Proposed Action would have negligible effects on environmental resources and are not discussed herein. The cumulative effects from the addition LFA and HF/M3 sonar noise transmissions to the ambient noise in the underwater environment are discussed below.

3.8.5.1 Marine Environment

Noise introduced to the Study Area by the Proposed Action would include vessel anthropogenic sound and sonar acoustic transmissions. Some of the actions listed in Section 3.8.3 (Past, Present, Reasonably Foreseeable) are likely to have at least short-term effects on the ambient acoustic environment. The ambient underwater noise levels throughout the Study Area vary as a result of natural conditions and anthropogenic activities.

Cumulative effects on ambient noise levels from past, present, and future actions would be less than significant because of the operational profile of SURTASS LFA sonar. As described in Chapter 2, SURTASS LFA sonar would transmit 60-sec signals at up to a 20 percent duty cycle, but more often at a 7.5-10 percent duty cycle. The HF/M3 sonar would add additional noise into the environment during use, but the ensonified area would be relatively small due to the high frequency nature of the source.

The potential effect of elevated ambient noise would be transitory and temporary, only for the duration of training or testing activities. Additionally, the total energy output and addition of ambient noise in the Study Area from other operations, including seismic airguns, merchant vessels, and supertankers, are expected to be higher than that of SURTASS LFA sonar transmission. Use of these acoustic sources is likely to continue to increase over time. Therefore, implementation of the Proposed Action and the incremental additive effects from SURTASS LFA sonar transmissions combined with the past, present, and reasonably foreseeable future projects, would result in less than significant effects on the marine environment.

3.8.5.2 Fishes

It is anticipated that the Proposed Action would affect fish species within the Study Area. Potential effects would be short-term behavioral responses, such as startle or avoidance responses, or masking. Overall, long-term consequences for most individual fish populations are unlikely because exposures to the SURTASS LFA sonar system would be intermittent, transient, and unlikely to repeat over short periods.

The aggregate effects of past, present, and reasonably foreseeable future actions contributing multiple water quality, noise, and physical risks to fishes will likely continue to have effects on individual fishes and fish populations. However, SURTASS LFA training and testing activities are generally isolated from other activities in space and time; they could also occur anywhere over the very large Study Area. Although it is possible that the Proposed Action could contribute incremental stressors to a small number of individuals, which would further compound effects on a given individual already experiencing stress from other projects, it is not anticipated that the Proposed Action has the potential to put additional stress on entire populations. Therefore, it is anticipated that the incremental contribution of the Proposed Action, when added to the effects of all other past, present, and reasonably foreseeable future actions, would not result in measurable additional significant effects on fishes in the Study Area or beyond.

3.8.5.3 Sea Turtles

Due to SOPs and mitigation measures, most effects associated with the Proposed Action are not anticipated to interact with or increase similar stressors experienced throughout the Study Area from other projects. Although sea turtles could be exposed to SURTASS LFA sonar transmissions throughout the Study Area, the estimated effects on individual sea turtles are unlikely to affect populations. Most individuals are not likely to experience long-term consequences from behavioral reactions because exposures would be intermittent and spatially distributed, allowing exposed individuals to recover before encountering another stressor. Since long-term consequences for most individuals are unlikely, long-term consequences for populations are not expected.

The potential exists for the effects of ocean pollution (disease, malnourishment), injury, nesting habitat loss, starvation, and the potential that an increased underwater noise environment can contribute multiple stressors to an individual animal. Further, it is possible that the response of a previously stressed animal to effects associated with the Proposed Action could be more severe than the response of an unstressed animal, or that effects from the Proposed Action could make an individual more susceptible to other stressors.

Navy training and testing activities and other past, present, and reasonably foreseeable future projects tend to be isolated from other activities in space and time, especially in the offshore environment of the Study Area. Due to the wide dispersion of stressors and dynamic movement of SURTASS LFA sonar vessels and other activities, it is unlikely that a sea turtle would remain in the potential effect range of multiple sources or sequential exercises.

The regulatory process administered by NMFS, which includes status assessments and 5-year reviews for all ESA-listed species, provides a backstop that informs decisions on take authorizations and Biological Opinions. Biological Opinions for federal and non-federal actions are grounded in status reviews and conditioned to avoid jeopardy and to allow continued progress toward recovery. This process helps to ensure that, through compliance with these regulatory requirements, the Navy’s proposed actions and other federal actions have the least effects possible.

The Proposed Action could contribute incremental stressors to individuals, which would further compound effects on a given individual already experiencing stress from other projects. However, with the implementation of SOPs and mitigation measures reducing the likelihood of effects, the incremental presence of LFA sonar anticipated from the Proposed Action is anticipated to be less than significant.

3.8.5.4 Marine Mammals

In general, bycatch, vessel strikes, and entanglement are leading causes of injury and direct mortality to marine mammals. Although mitigated to the greatest extent practicable, the Proposed Action could also result in physiological or behavioral effects to individuals of some marine mammal species from LFA sonar transmissions. Implementation of measures discussed in Chapter 4 would help avoid or reduce, but not absolutely eliminate, the risk for potential effects. While it is more likely that an individual of an abundant, common stock or species would be affected, there is a chance that a less abundant stock could be affected.

Ocean noise is already significantly elevated over historic, natural levels. Acoustic stressors (sonar and increased Action Proponent vessel sound) associated with the Proposed Action could also result in additive acoustic effects on marine mammals. However, LFA is not known to be a major threat to marine mammal populations or a significant portion of the overall ocean noise budget (Bassett et al. 2010; Baumann-Pickering et al. 2010; International Council for the Exploration of the Sea 2005; McDonald et al. 2006). Other current and future non-military actions such as construction and operation of liquefied natural gas terminals; characterization, construction, and operation of offshore wind energy projects; seismic surveys; and construction, operation, and removal of oil and gas facilities could result in underwater sound levels that could cause behavioral harassment, TTS, AINJ, or injury.

The incremental contribution of the Proposed Action to cumulative effects would be minimal. Activities emitting noise that could result in acoustic effects are widely dispersed, the sound sources are intermittent, and mitigation measures would be implemented. Safety, security, and operational considerations would preclude some training and testing activities in the immediate vicinity of other actions, reducing the likelihood of simultaneous or overlapping exposure to acoustic stressors.

For all U.S. Navy training and testing activities, particularly within the HCTT and MITT Study Areas, the vast majority of effects expected from sonar exposure are behavioral in nature, temporary and comparatively short in duration, relatively infrequent, and not of the type or severity that would be expected to be additive for the small portion of the stocks and species likely to be exposed either annually or in the reasonably foreseeable future. The behavioral and physiological responses of any marine mammal to a potential stressor, such as underwater sound, could be influenced by various factors, including disease, dietary stress, body burden of toxic chemicals, energetic stress, percentage body fat, age, reproductive state, and social position. If the health of an individual marine mammal were already compromised, it is possible this condition could alter the animal's expected response to stressors associated with the Proposed Action. Synergistic effects are also possible; for example, animals exposed to some chemicals may be more susceptible to noise-induced loss of hearing sensitivity (Fechter and Pouyatos 2005). While the response of a previously stressed animal might be different from the response of an unstressed animal, no data is available at this time to accurately predict how stress caused by various ocean pollutants would alter a marine mammal's response to stressors associated with the Proposed Action.

In summary, the aggregate effects of past, present, and reasonably foreseeable future actions continue to have significant effects on some marine mammal species in the Study Area. The Proposed Action could contribute incremental stress from noise exposure to individuals, which would further compound effects on a given individual already experiencing stress from other projects. However, with the implementation of SOPs and mitigation measures reducing the likelihood of effects, the incremental stressors anticipated from the Proposed Action are anticipated to be less than significant.

3.8.5.5 Marine Protected Habitats

The main effect to a marine protected habitat would occur in the Hawaiian Islands Humpback Whale NMS. For an in-depth analysis on the cumulative noise effects associated with LFA sonar transmissions on sanctuary resources, see Section 3.6.2.

3.8.5.6 Economic Resources

The incremental contribution of the Proposed Action to cumulative effects are based on the analysis presented in Section 3.7 of this SEIS/OEIS and the reasons summarized below.

- LFA sonar will have transient and localized effects to fish that would be too minor to have more than a less than significant effect on fisheries' catches, as population-level effects are not expected.
- The geographic restrictions associated with SURTASS LFA sonar activities would also limit effects on recreational marine activities, which most commonly occur beyond LFA sonar operation. LFA sonar is restricted to less than 180 dB re 1 µPa (rms) within 12 NM of coastlines and in OBIAs during biologically important seasons; therefore, effects to the whale watching industry would also be expected to be less than significant.
- Navy training and testing activities conducted in the Study Areas are generally isolated from other activities in space and time. The majority of the proposed training and testing activities occur in

well-known, previously established training range areas; are not generally concentrated in any one location for any extended period of time; have few participants; and are of a short duration.

No cumulative effects on commercial transportation and shipping are anticipated because commercial vessels are primarily transiting through the Study Area along well-established navigable routes that are avoided by Navy LFA SURTASS vessels. Temporary limitations on accessibility to marine areas would not result in a direct loss of income, revenue or employment, resource availability, or quality of experience. Additionally, the Proposed Action and other major projects are well distributed, therefore their cumulative effects should be well dispersed and not overlap in time and space. Short-term effects, should they occur, would not contribute incrementally to cumulative effects on the economic resources in the Study Area. Therefore, further analysis of cumulative effects on economic resources is not warranted.

3.8.6 Summary of Cumulative Effects

The Proposed Action would contribute incremental effects on the ocean ecosystem, which is already experiencing and absorbing a multitude of stressors to a variety of receptors. In general, it is not anticipated that the implementation of the Proposed Action would have a meaningful contribution to the ongoing stress or cause significant collapse of any particular marine resource, but it would contribute minute effects on resources that are already experiencing various degrees of interference and degradation. It is intended that the mitigation measures described in Chapter 4 will further reduce the potential effects of the Proposed Action in such a way that they are avoided to the maximum extent practicable and to ensure that effects do not become cumulatively significant to any marine resource. The anticipated stressors contributing to the cumulative effects analysis associated with past, ongoing, or reasonably foreseeable actions are summarized in Section 3.8.3.

Marine mammals are the primary resources of concern for cumulative effects analysis; however, the incremental contributions of the Proposed Action are not anticipated to meaningfully contribute to the decline of these populations or affect the stabilization and recovery thereof. The Action Proponent utilizes SOPs that reduce the likelihood of overlap of Navy stressors in time and space with non-Navy stressors, and mitigation measures as described in Chapter 4 reduce the risk of direct effects of the Proposed Action to individual animals. The aggregate effects of past, present, and other reasonably foreseeable future actions have resulted in significant effects on some marine mammal species in the Study Area. However, the decline of these species is chiefly attributable to other stressors in the environment, including the synergistic effect of bycatch, entanglement, vessel traffic, ocean pollution, recreation and tourism, and coastal zone development, none of which are causes that would compound with the stressors associated with the Proposed Action. The analysis presented in this section and throughout Chapter 3 indicates that the incremental contribution of the Proposed Action to cumulative effects on air quality, the marine environment, fishes, sea turtles, marine mammals, marine protected habitats, and economic resources would not significantly contribute to cumulative stress on those resources.

4 Mitigation, Monitoring, and Reporting

4.1 Introduction

The terms “mitigation” and “mitigation measures” mean actions taken to completely avoid, partially reduce, or minimize the potential for a stressor to impact a resource. Three alternatives for the use of SURTASS LFA sonar are presented in this SEIS/OEIS (No Action Alternative, Alternative 1, and Alternative 2), two of which would meet the Navy's purpose and need and include mitigation measures that would minimize potential impacts to the greatest extent practicable, furthering NMFS’s purpose and need and its statutory obligations under MMPA. These mitigation measures would apply to both action alternatives so that the Navy would achieve the maximum possible mitigation under either action alternative. Navy and NMFS have coordinated to develop these mitigation measures, and Navy will continue to work with NMFS to finalize mitigation measures through the NEPA and MMPA permitting processes.

Consistent with NMFS’ purpose and need to analyze the impacts of Navy’s proposed activities and prescribe mitigation and monitoring requirements that meet the statutory thresholds under the MMPA, the objective of the mitigation measures for SURTASS LFA sonar’s training and testing activities is the reduction or avoidance of potential effects to marine mammals and sea turtles, and marine habitat. This mitigation objective is met by ensuring that the activities under the Proposed Action:

- Transmit SURTASS LFA sonar such that received levels less than or equal to 180 dB re 1 µPa (rms) (SPL) occur in coastal waters within 12 NM of emergent land;
- Transmit SURTASS LFA sonar such that received levels less than or equal to 180 dB re 1 µPa (rms) (SPL) occur within 0.54 NM (1 km) of any OBIA boundary during biologically important seasons;
- Use no more than 25 percent of the authorized amount of SURTASS LFA sonar for training and testing activities within 10 NM of any single OBIA during any year, unless national security presents a requirement that dictates otherwise;
- Minimize exposure of marine mammals and sea turtles to received levels of SURTASS LFA sonar transmissions by monitoring for their presence and delaying/suspending LFA sonar transmissions when one of these animals enters the 2,000 yd LFA mitigation zone; and
- Transmit SURTASS LFA sonar such that received levels less than or equal to 145 dB re 1 µPa (rms) (SPL) occur at known recreational or commercial dive sites unless the following conditions are met: should national security present a requirement to transmit SURTASS LFA sonar during training or testing activities such that exposure at known recreational or commercial dive sites may exceed received levels equal 145 dB re 1 µPa (rms) (SPL), naval units would obtain permission from the appropriate designated Command authority prior to commencement of the activity. Prior to conducting training or testing activities, the designated Command authority shall conduct a risk assessment, taking into account the potential for exposure to SURTASS LFA sonar by divers.

As described in the 2017 SEIS/SOEIS (U.S. Department of Navy 2017), the Navy proposes to retain the 180 dB re 1 µPa (rms) isopleth as the basis for mitigation of SURTASS LFA sonar transmissions. In the past, this mitigation measure was designed to reduce or alleviate the likelihood that marine mammals would be exposed to levels of sound that may result in injury (AINJ). However, due to the Navy’s Phase IV acoustic guidance (U.S. Department of Navy 2025) and Southall et al. (2019b), this mitigation measure could preclude not only AINJ, but also some TTS and some more severe forms of behavioral harassment.

In addition, the Navy implements a three-part monitoring protocol that is highly effective at detecting marine species, with detection resulting in the suspension or delay of LFA sonar transmissions. The combination of visual, passive acoustic, and active acoustic (HF/M3) monitoring results in near 100 percent detection probability for a medium-sized (approximately 33 ft [10 m]) marine mammal swimming towards the system ((Ellison and Stein 2001), updated 2001). The HF/M3 system substantially increases the probability of detecting a medium- to large-sized marine mammal within 1.1 to 1.3 NM where AINJ, TTS, and some forms of behavioral harassment are predicted to occur. The following describes the mitigation measures that would be implemented during SURTASS LFA sonar training and testing activities.

4.2 Determination of Mitigation Basis

There have been no changes to the rationale for use of specific received levels or mitigation zone distances since the 2019 SEIS/SOEIS. For a description of the evaluation of mitigation basis, please see Section 5.2 of Navy (2019).

4.3 Activity-Based Mitigation Measures

4.3.1 Manned Surface Vessel Mitigation

Manned surface vessel mitigation will be implemented to the maximum extent practical based on the prevailing circumstances, including consideration of safety of vessels, towing platforms, and crews, as well as maneuverability restrictions. Mitigation will not be implemented (1) when marine mammals (e.g., dolphins) are determined to be intentionally swimming at the bow, alongside the vessel or vehicle, or directly behind the vessel or vehicle (e.g., to bow-ride or wake-ride), (2) when the vessel’s safety is threatened, and (3) when impractical based on mission requirements (e.g., restricted ability to maneuver during towing activities).

Immediately prior to getting underway and while underway, the Lookouts will observe for marine mammals and sea turtles. While underway the manned surface vessels will maneuver themselves (which may include reducing speed) to maintain a mitigation zone of 500 yd. around observed whales and 200 yd. around all other marine mammals (except bow- or wake-riding dolphins), providing it is safe to do so. No further action is necessary if a non-whale marine mammal continues to close after the vessel has made one course and/or speed change. Vessels shall maneuver to avoid sea turtles, provided it is safe to do so. Pedestal-mounted 'Big Eye' (20x110) binoculars (if installed) shall be used to assist in the detection of marine mammals and sea turtles in the vicinity of the vessel. If the presence of marine mammals is detected acoustically, Lookouts posted on the vessel shall increase the vigilance of their visual observation.

4.3.1.1 Personnel Training

Underway surface ships operated by or for the Navy have personnel assigned to stand watch at all times (day and night) for safety of navigation, collision avoidance, range clearance, and man-overboard precautions. Personnel on underway small boats (e.g., crewmembers responsible for navigation) fulfill similar watch standing responsibilities to those positioned on surface ships. To qualify to stand watch as a Lookout, personnel undertake a training program that includes computer-based training, on-the-job instruction, and a formal qualification program. Lookouts are trained in accordance with the *U.S. Navy Lookout Training Handbook* or equivalent to use correct scanning procedures while monitoring assigned sectors, to estimate the relative bearing, range, position angle, and target angle of sighted objects, and to rapidly communicate accurate sighting reports. The *U.S. Navy Lookout Training Handbook* was updated in 2022 to include a more robust chapter on environmental compliance, mitigation, and marine species observation tools and techniques (NAVEDTRA 12968-E). Environmental awareness and education training is also provided to personnel through the Afloat Environmental Compliance Training program (described below) or equivalent. Training is designed to help personnel gain an understanding of their personal environmental compliance roles and responsibilities (including mitigation implementation). Upon reporting aboard and annually thereafter, appointed personnel must complete training identified in their career path training plan.

- **Introduction to Afloat Environmental Compliance**. Developed in 2014, the introduction module provides information on at-sea environmental laws, regulations, and compliance roles.
- **Marine Species Awareness Training**. This module was developed by civilian marine biologists employed by the Navy and was reviewed and approved by NMFS. It provides information on marine species sighting cues, visual observation tools and techniques, and sighting notification procedures. It is a video-based complement to the U.S. Navy Lookout Training Handbook or equivalent. Since 2007, this module has been required for commanding officers, executive officers, equivalent civilian personnel, and personnel who will stand watch as a Lookout.

4.3.2 SURTASS LFA Mitigation Zone

In previous applications for SURTASS LFA sonar rulemaking, the Navy proposed a mitigation zone covering a volume of water ensonified to the 180 dB re 1 µPa isopleth (i.e., the volume subjected to SPLs of 180 dB rms or greater) and noted that the nominal outer boundary of this volume of water is approximately 0.54 NM. In each of the previous Final Rules, NMFS added a 0.54 NM buffer zone beyond the Navy's proposed LFA sonar mitigation zone, so the total resulting mitigation/buffer zone was nominally 1.08 NM.

Navy requested, and NMFS agreed, to establish a single, fixed mitigation zone of 2,000 yd (0.99 NM; 1.83 km) rather than a combined mitigation/buffer zone of nominally 1.08 NM (2 km). This 2,000 yd (1.83 km) single fixed mitigation zone would cover virtually all of the previous combined mitigation zone of nominally 1.08 NM, since the difference between 2,000 yd and 2 km is only about 187 yd (or 0.09 NM). Likewise, the difference in the sound field of the combined mitigation zones of 2,000 yd (1.83 km) versus 1.08 NM would also be negligible. At 2,000 yd, modeling shows that the sound field would be about 174.75 dB while at 1.08 NM, the sound file would be 173.98 dB, which is a difference of only 0.77 dB. This very slight sound field difference would not be perceptible to a marine mammal.

Establishing a single, fixed mitigation zone for SURTASS LFA sonar training and testing activities standardizes and thus simplifies implementation of this monitoring requirement using standard Navy metrics (yards not meters), while continuing to ensure protection to marine mammals in all acoustic environments, even in the rare event of a strong acoustic duct in which the volume of water ensonified to 180 dB could be somewhat greater than 0.54 NM (1 km) (U.S. Department of Navy 2001). With the mitigation zone of 2,000 yd, there is limited potential for marine mammals to be exposed to received levels greater than 180 dB rms.

4.3.3 Ramp-up of High Frequency Marine Mammal Monitoring (HF/M3) Sonar

The ramp-up procedure for the HF/M3 sonar system would be implemented to ensure that no inadvertent exposures of marine species to received levels greater than 180 dB re 1 µPa (rms) would occur if an animal were to occur in close proximity to the HF/M3 sonar system. Prior to full-power transmissions, the HF/M3 sonar power level will be ramped up over a period of no less than 5 min from a SL of 180 dB re 1 µPa at 1 m (rms) (SPL) in 10 dB increments until full power (if required) is attained. This ramp-up procedure would commence at least 30 min prior to initiation of any SURTASS LFA sonar transmissions, prior to any sonar calibrations or testing that are not part of the regularly planned transmissions, and any time after the HF/M3 sonar has been powered down for more than two minutes. The HF/M3 active sonar system's SPL may not increase once a marine mammal is detected. The ramp-up process may resume once marine species are no longer detected by all of the monitoring methods.

4.3.4 SURTASS LFA Sonar Suspension/Delay

During training and testing activities, delay of initial SURTASS LFA sonar transmissions or suspension of ongoing transmissions will occur if the Navy detects a marine mammal or sea turtle entering or already located within the LFA mitigation zone. The suspension or delay of SURTASS LFA sonar transmissions would occur if the marine animal is detected by any of the monitoring methods: visual, passive acoustic, or active acoustic monitoring. During the delay/suspension, active acoustic, visual, and passive acoustic monitoring for marine mammals and sea turtles would continue. SURTASS LFA sonar transmissions would be allowed to commence/resume no sooner than 15 min after all marine mammals/sea turtles are no longer detected within the SURTASS LFA sonar mitigation zone and no further detections of marine species by visual, passive acoustic, and active acoustic monitoring have occurred within the mitigation zone.

4.4 Geographic Mitigation

The Navy intends to continue applying the following geographic restrictions during training and testing activities using SURTASS LFA sonar such that:

- SURTASS LFA sonar-generated sound field would be below received levels of 180 dB re 1 µPa (rms) (SPL) within 12 NM of any emergent land (including islands);
- SURTASS LFA sonar-generated sound field would be below received levels of 180 dB re 1 µPa (rms) (SPL) 0.54 NM seaward of the outer perimeter of any OBIA during the biologically important period that have been determined by NMFS and the Navy;
- No more than 25 percent of the authorized amount of SURTASS LFA sonar would be used for training and testing activities within 10 NM 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 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 exceedance of 25 percent) in its annual activity reports submitted to NMFS;
- SURTASS LFA sonar-generated sound field would be less than or equal to received levels of 145 dB re 1 µPa (rms) (SPL) at known recreational or commercial dive sites unless both of the following conditions are met: should national security present a requirement to transmit SURTASS LFA sonar during training or testing activities such that exposure at known recreational or commercial dive may exceed received levels equal to 145 dB re 1 µPa (rms) (SPL), naval units would obtain permission from the appropriate designated Command authority prior to commencement of the activity. Prior to conducting the training or testing activity, the designated Command authority shall

conduct a risk assessment, taking into account the potential for exposure of SURTASS LFA sonar to divers; and

- SURTASS LFA sonar would not be used in the waters over Penguin Bank, Hawaii, to a water depth of 600 ft (183 m), and would be operated such that ensonification of Hawaii waters (out to 3 NN) will not exceed 145 dB re 1 µPa (rms) (SPL).
- NMFS and Navy would consider additional geographic restrictions, as appropriate, based on newly available information or data and the operational practicability of implementing additional mitigation.

4.4.1 Coastal Standoff Range

The CSR refers to the distance of 12 NM from any emergent land wherein the sound field generated by SURTASS LFA sonar during training and testing activities would not exceed 180 dB re 1 µPa (rms) (SPL). Since many areas of biological importance to marine species, particularly protected species, occur in coastal waters, the Navy established the policy of the CSR to lower the risk to many marine species such as marine mammals and especially sea turtles, which aggregate in coastal waters. In a review of existing and proposed marine protected areas, approximately 80 percent were found to be located in the CSR. Coastal waters are heavily used seasonally for biologically important behaviors such as nesting, calving, foraging, and migrating. Some species of sea turtles spend entire life stages in coastal waters. In addition to the CSR, SURTASS LFA sonar training and testing activities would not occur within the territorial seas of foreign nations.

The Navy analyzed the differences in potential impacts from increasing the coastal standoff from 12 to 25 NM, a difference of 13 NM, in the 2007 FSEIS for SURTASS LFA sonar. Based on this analysis of the potential impacts to marine mammals, the Navy concluded that although increasing the CSR distance decreases exposure to higher sonar received levels for coastal species, pelagic marine mammal species (including those species that inhabit the outer continental shelf and shelf-break waters) actually would be predicted to be exposed to increased sonar received levels (U.S. Department of Navy 2007a). Though counter-intuitive, this result is due to an increase in exposure area, with less ensonification overlapping land for the 25 NM standoff distance. The Navy's impact analysis showed that overall, a greater risk of potential impacts to marine mammals resulted with an increase of the coastal standoff from 12 to 25 NM, which did not meet the standard for effecting the least practicable adverse impact on marine mammal species or stocks under the MMPA. Details of this analysis are presented in Subchapter 4.8.6 of the 2007 FSEIS. Thus, the Navy will continue to employ the 12 NM coastal standoff distance for the use of SURTASS LFA sonar.

4.4.2 Offshore Biologically Important Areas (OBIAs)

Given the unique transmission characteristics of SURTASS LFA sonar and recognizing that certain areas of biological importance lie outside of the CSR (i.e., 12 NM from any emergent land) for SURTASS LFA sonar, Navy and NMFS developed the concept of marine mammal OBIAs for SURTASS LFA sonar. OBIAs for SURTASS LFA sonar are not intended to apply to any other Navy activities and were established solely as a mitigation measure to reduce incidental harassment of marine mammals associated with the use of SURTASS LFA sonar (NOAA 2012b). OBIAs only pertain to marine mammals since the potential for impacts to other protected marine species (such as sea turtles or marine fishes) from exposure to SURTASS LFA sonar transmissions would be low to moderate, necessitating no additional preventative measures for these taxa beyond those already established for SURTASS LFA sonar. Further details about the development of OBIAs and the OBIA process over the history of SURTASS LFA sonar may be found in

Chapter 3 of the 2017 SEIS/SOEIS for SURTASS LFA sonar (U.S. Department of Navy 2017) and Chapter 5 of the 2019 SEIS/SOEIS for SURTASS LFA sonar (U.S. Department of Navy 2019). Pertinent information is incorporated by reference herein.

OBIAs were designated for specific marine mammals and are only active during the specific time of year when biologically significant activities are potentially being carried out within that area. NMFS required an additional 0.54 NM buffer zone be implemented around the OBIA boundary. Thus, during the effective period for each OBIA, the sound field generated by SURTASS LFA sonar cannot exceed received levels of 180 dB re 1 µPa (rms) (SPL) at a distance of 0.54 NM of an OBIA boundary. A detailed description of the OBIA designation process, including additional information about the marine areas reviewed by the Navy and NMFS as possible OBIAs and the status of the OBIA designation process relative to this SEIS/OEIS, may be found in Appendix F (Marine Mammal OBIA Analysis).

4.4.2.1 Existing Marine Mammal OBIAs for SURTASS LFA Sonar

The 2019 SEIS/SOEIS for SURTASS LFA sonar lists 39 marine mammal OBIAs and their effective periods as one of the geographic mitigation measures with which all military readiness activities using SURTASS LFA sonar must comply (U.S. Department of Navy 2019) (Appendix F, Marine Mammal OBIA Analysis). This is an increase from the 29 OBIAs listed in the 2017 National Defense Exemption (U.S. Department of Navy 2017). Of the 39 OBIAs, 14 occur in the current Study Area for SURTASS LFA sonar and are shown in Table 4-1 and Figure 4-1; the remaining 25 OBIAs listed in the 2019 SEIS/SOEIS for SURTASS LFA sonar are located in the Atlantic Ocean. Figure 4-1 also shows the proposed OBIAs based on analysis within this document, additional details for proposed OBIAs are discussed below. Four OBIAs originally designated in 2017 were incorporated into larger OBIAs designated in 2019:

- OBIA #16 Penguin Bank, Hawaiian Islands Humpback Whale NMS is now part of OBIA #26 Main Hawaiian Islands.
- OBIA #20 Northern Bay of Bengal and Head of Swatch-of-No-Ground (SoNG) is now part of OBIA #38 Swatch-of-No-Ground.
- OBIA #26 Offshore Sri Lanka is now part of OBIA #39 Sri Lanka.
- OBIA #27 Camden Sound/Kimberly Region is now part of OBIA #36 Western Australia—Humpback Whale.

These four expanded OBIAs, together with an additional 10 OBIAs described in the 2019 analysis, comprise the 14 OBIAs for marine mammals designated in the 2019 SEIS/SOEIS that are located within the SURTASS Study Area. The effective period specified for each OBIA is the season or length of time in which important biological activity is conducted annually by a specific marine mammal species or group of marine mammals in that area.

Table 4-1. Existing Offshore Biologically Important Areas (OBIAs) for SURTASS LFA Sonar Located in the Study Area

OBIA Number	*Name of OBIA*	*Location/Water Body*	*Relevant Low-Frequency Marine Mammal Species*	*Effective Period*
26	Main Hawaiian Islands	Central North Pacific Ocean	HBW	November to April
27	Northwestern Hawaiian Islands	Central North Pacific Ocean	HBW	December to April
28	Marianas Islands	Western North Pacific Ocean	HBW	February to April
29	Ryukyu-Philippines	Western North Pacific Ocean	HBW	January to April
30	Ogasawara—Sperm Whale	Western North Pacific Ocean	Sperm whale	June to September
31	Ogasawara-Kazin—Humpback Whale	Western North Pacific Ocean	HBW	December to May
32	Honshu	Western North Pacific Ocean	Gray whale	January to May
33	Southeast Kamchatka	Western North Pacific Ocean	HBW, fin, gray (WNP), and right whales (North Pacific)	June to September
34	Gulf of Thailand	Eastern Indian Ocean	Bryde's whale	April to November
35	Western Australia—Blue Whale	Eastern Indian Ocean	Blue (pygmy) whale	May to November
36	Western Australia—Humpback Whale	Eastern Indian Ocean	HBW	May to December
37	Southern Bali	Eastern Indian Ocean	Bryde's, sei, HBW, Omura's, and sperm whales	October to November
38	Swatch-of-No-Ground (SoNG)	Northern Bay of Bengal	Bryde's whale	Year-round
39	Sri Lanka	Eastern Indian Ocean	Blue (pygmy) and sperm whales	October to April

HBW = humpback whale; WNP = Western North Pacific

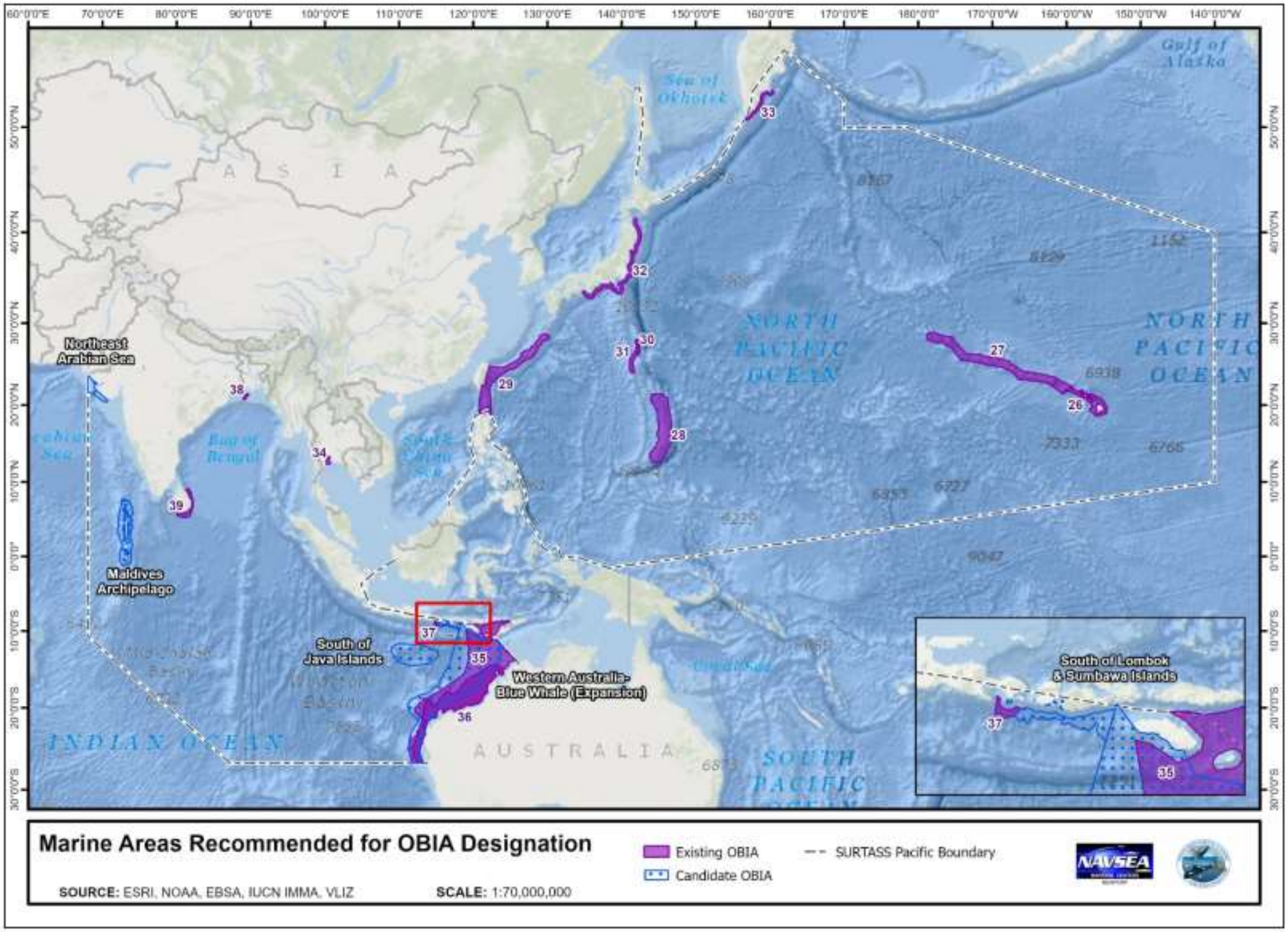

Figure 4-1. Map of Existing and Candidate OBIAs in the Study Area (Numbers Correspond to OBIAs in Table 4-1)

4.4.2.2 Potential Marine Mammal OBIAs for SURTASS LFA Sonar

Since the 2019 SEIS/SOEIS, consideration and assessment of marine areas as potential OBIAs has continued. OBIAs within the current Study Area were reviewed for applicability within this document. The assessment of marine areas included three main steps: criteria definition, described above; data acquisition; and analysis.

4.4.2.2.1 Marine Areas Further Considered as Candidate OBIAs for SURTASS LFA Sonar

The Navy and NMFS made determinations on which of all the marine areas considered met all OBIA selection criteria and factors except the Navy operational practicability criterion (see Appendix F for details on the OBIA methodology). During the assessment, consideration was given to whether different types of marine areas should be combined if they were designated for the same geographic area or if different species of marine mammals were designated in the same marine area. This combination of areas resulted in 38 marine areas being considered as potential OBIAs. These 38 areas were fully assessed for all OBIA Criteria, including Criterion 3: Biological Importance.

Of the 38 marine areas assessed, the Navy and NMFS's analysis resulted in the recommendation of five new marine areas for OBIA designation, pending Navy fleet review for practicability (Table 4-2). One OBIA is an expansion of an existing OBIA (OBIA #35, Western Australia—Blue Whale), to include the entirety of the Indian Ocean Blue Whale Migratory Route IMMA. A second OBIA (OBIA #43, South of Lombok and Sumbawa Islands) represents an area that connects an existing OBIA (OBIA #37, Southern Bali) to the newly expanded OBIA #35, Western Australia—Blue Whale. The remaining three OBIAs are standalone areas, disconnected from any existing OBIAs in the Study Area.

4.4.2.2.2 Navy Practicability Assessment

The five candidate OBIAs underwent Navy fleet practicability review. The Navy fleet determined that the designation of the five OBIAs in the Study Area and the relevant seasonal effectiveness periods would not impede the effectiveness of SURTASS LFA sonar training and testing activities, would be practicable to implement as a geographic mitigation measure, and would not impact personnel safety. As a result, five new marine mammal OBIAs for SURTASS LFA sonar have been designated herein (Table 4-2).

Table 4-2. New OBIAs Designated in the Study Area

Candidate OBIA Number	*OBIA Name*	*Ocean Area*	*Relevant Low-Frequency Marine Mammal Species*	*Effective Seasonal Period*	*Notes*
35	Western Australia—Blue Whale	East Indian Ocean	Blue (pygmy) whale	May to November	Expansion of existing OBIA #35, Western Australia—Blue Whale, to include entirety of Eastern Indian Ocean Blue Whale Migratory Route
40	Maldives Archipelago	Central Indian Ocean	Blue (pygmy), HBW, Bryde's, and sperm whales	October to May	
41	Northeast Arabian Sea	Arabian Sea	HBW (Arabian Sea), blue, and Bryde's whales	Year-round	
42	South of Java Island	East Indian Ocean	Blue (pygmy) whale	October to November	
43	South of Lombok and Sumbawa Islands	East Indian Ocean	Blue (pygmy) whale	October to November	

4.4.2.3 Dive Sites

SURTASS LFA sonar transmissions would be constrained in the vicinity of known recreational and commercial dive sites to ensure that the sound field at such sites does not exceed received levels of 145 dB re 1 µPa (rms) unless the following conditions are met: should national security present a requirement to transmit SURTASS LFA sonar during training or testing activities such that exposure at known recreational or commercial dive may exceed received levels equal to 145 dB re 1 µPa (rms) (SPL), naval units would obtain permission from the appropriate designated Command authority prior to commencement of the activity. Prior to conducting the training or testing activity, the designated Command authority shall conduct a risk assessment, taking into account the potential for exposure of SURTASS LFA sonar to divers.

Recreational dive sites are generally located in coastal/island waters less than 130 ft (40 m) in depth, although dive sites may be located in other waters. Details on the recreational and commercial dive sites in the SURTASS LFA sonar Study Area may be found in Chapter 3 (Section 3.7.1.2) and Appendix F (Marine Mammal OBIA Analysis).

4.5 Monitoring for SURTASS LFA Sonar

The Navy would cooperate with NMFS and other federal agencies to monitor impacts on marine mammals and to designate qualified on-site personnel to conduct mitigation, monitoring, and reporting activities in support of SURTASS LFA sonar. The Navy would continue to conduct the following monitoring measures whenever SURTASS LFA sonar is transmitting during training and testing activities:

- Visual monitoring for marine mammals and sea turtles from the SURTASS LFA sonar vessels during daylight hours by personnel trained to detect and identify sea turtles and marine mammals at sea;
- Passive acoustic monitoring using the passive SURTASS towed array to listen for sounds generated by marine mammals as an indicator of their presence;
- Active acoustic monitoring using the HF/M3 sonar, which is a Navy-developed, enhanced HF commercial sonar, to detect, locate, and track marine mammals and, to some extent, sea turtles, that may pass close enough to the SURTASS LFA sonar's transmit array to enter the LFA mitigation zone; and,
- Continue annual passive acoustic training of SURTASS analysis for improved marine mammal detection.

4.5.1 Visual Monitoring

Visual monitoring would include daytime observations of the sea surface for the presence of marine mammals and sea turtles from the bridge of SURTASS LFA sonar vessels. Daytime is defined as 30 min before sunrise until 30 min after sunset. Visual monitoring would begin 30 min before sunrise or 30 min before SURTASS LFA sonar begins to transmit and would continue until 30 min after sunset or until the SURTASS LFA sonar transmissions cease. Observations would be made by ship personnel trained in detecting and identifying marine mammals and sea turtles from the ship's bridge using standard binoculars (7x) and the naked eye. The objective of visual monitoring would be to ensure that no marine mammal approaches the ship or transmitting sonar array close enough to enter the LFA mitigation zone.

Visual observers would maintain a watch for marine mammals and sea turtles at the sea surface and log all detections during SURTASS LFA sonar transmissions. The number, identification, bearing, and range of observed marine mammals or sea turtles would be recorded; marine mammals and sea turtles would be identified to the lowest taxonomic level possible, which sometimes is only dolphin or large whale. A designated ship's officer would monitor the conduct of the visual watches and would periodically review the observation log. If a potentially affected marine mammal or sea turtle would be sighted within the LFA mitigation zone, the visual observer would notify the senior military member-in-charge, who would order the immediate delay or suspension of SURTASS LFA sonar transmissions. Similarly, if a marine mammal were sighted outside the LFA mitigation zone, the bridge officer would notify the senior military member-in-charge of the estimated range and bearing of the observed marine mammal. The senior military member- in-charge would notify the HF/M3 sonar operator to verify or determine the range and projected track of the detected marine mammal/sea turtle. If the sonar operator determined that the marine mammal or sea turtle would pass into the LFA mitigation zone, the senior military member-in-charge would order the immediate delay or suspension of SURTASS LFA sonar transmissions when the marine animal entered the LFA mitigation zone.

The visual observer would continue visual observations until the marine mammal or sea turtle was no longer observed. SURTASS LFA sonar transmissions would commence/resume 15 min after there would be no further detection of marine mammals or sea turtles by visual, active acoustic (HF/M3 sonar), or passive acoustic monitoring within the LFA mitigation zone.

4.5.2 Passive Acoustic Monitoring

Passive acoustic monitoring would be conducted using the SURTASS towed HLA to detect vocalizing marine mammals as an indicator of their presence. If a detected sound were estimated to be from a vocalizing marine mammal, the sonar technician would notify the senior military member-in-charge, who would alert the HF/M3 sonar operator and visual observers (during daylight). Delay or suspension of SURTASS LFA sonar transmissions would be ordered when the HF/M3 sonar and/or visual observers verify the presence of a marine mammal to be within the LFA mitigation zone. Passive acoustic sonar technicians are trained to identify the detected vocalizations to marine mammal species whenever possible. Passive acoustic monitoring would begin 30 min prior to the first SURTASS LFA sonar transmission, continue throughout all SURTASS LFA sonar transmissions, and cease 15 min after SURTASS LFA sonar transmissions have concluded.

4.5.3 Active Acoustic (HF/M3) Monitoring

Active acoustic monitoring uses the HF/M3 sonar to detect, locate, and track marine mammals that could pass close enough to the SURTASS LFA sonar array to enter the LFA mitigation zone.

Detection of sea turtles by the HF/M3 sonar system is possible due to the position of the HF/M3 sonar system above the SURTASS LFA sonar array, since a sea turtle would have to swim from the surface through the HF/M3 sonar detection zone to enter into the LFA mitigation zone.

HF/M3 sonar monitoring would begin 30 min before the first SURTASS LFA sonar transmission is scheduled to commence and continue until 15 min after SURTASS LFA sonar transmissions are terminated. Prior to full-power operations of the HF/M3 sonar, the power level would be ramped up over a period of 5 min from the SL of 180 dB re 1 µPa at 1 m (rms) (SPL) in 10 dB increments until full power (if required) would be attained.

If a marine mammal or sea turtle were detected during HF/M3 monitoring within the LFA mitigation zone, the sonar operator would notify the senior military member-in-charge, who would order the immediate delay or suspension of SURTASS LFA sonar transmissions. Likewise, if HF/M3 monitoring were to detect a possible marine mammal outside the LFA mitigation zone, the HF/M3 sonar operator would determine the range and projected track of the marine mammal and notify the senior military member-in-charge that a detected animal would pass within the LFA mitigation zone. The senior military member-in-charge would notify the bridge and passive sonar operator of the potential presence of a marine animal projected to enter the mitigation zone. The senior military member-in-charge would order the delay or suspension of SURTASS LFA sonar transmissions only when the marine mammal/sea turtle would enter the LFA mitigation zone, as detected by any of the three monitoring methods. SURTASS LFA sonar transmissions would commence/resume 15 min after there are no further detections of the animal within the LFA mitigation zone were made by the HF/M3 sonar, visual, or passive acoustic monitoring.

The effectiveness of the HF/M3 sonar system to monitor and detect marine mammals has been described in the Navy's 2001 FOEIS/EIS (Chapters 2 and 4) for SURTASS LFA sonar (U.S. Department of Navy 2001) in addition to the technical report by Ellison and Stein (2001). To summarize the effectiveness of the HF/M3 sonar system, the Navy's testing and analysis of the HF/M3 sonar system's capabilities indicated that the system:

- Substantially increased the probability of detecting a marine mammal within the LFA mitigation zone;
- Provides a superior monitoring capability, especially for medium- to large-sized marine mammals to a distance of 1.1 to 1.3 NM (2 to 2.5 km) from the system (U.S. Department of Navy 2001);
- Would result in several detections of a marine mammal before it even entered the LFA mitigation zone (U.S. Department of Navy 2001)—based on the scan rate of the HF/M3 sonar system, most

animals would receive at least eight pings from the sonar (i.e., eight sonar returns or detections) before even entering the LFA mitigation zone;

  - based on this scan rate, the probability of any marine mammal being detected prior to even entering the LFA mitigation zone approaches 100 percent (Ellison and Stein 2001);
  - the probability of the HF/M3 sonar system detecting a medium- to large-sized (~33 to 98 ft [10 to 30 m]) marine mammal (humpback to blue whale) swimming towards the system in the LFA mitigation zone with only one HF/M3 ping would be near 100 percent (Ellison and Stein 2001);
  - for a small (approximately 8 ft (2.5 m]) marine mammal such as a dolphin, the detection probability is 55 percent from one HF/M3 ping when the sonar is located at a distance of 2,625 to 3,051 ft (800 to 930 m) from the animal, while the detection probability increases to 90 percent for four HF/M3 pings; and
- May result in higher detection probabilities in a typical at-sea operating environment—during HF/M3 testing, analysts noted that in the expected at-sea conditions of reduced clutter interference in the open ocean and small marine mammals traveling in their typical group configurations (i.e., in pods), the detection rate would be higher (Ellison and Stein 2001). Also, we note that the underwater conditions during which the HF/M3 data on detection distances were collected were extremely challenging (i.e., sea state and weather conditions).

The information on the HF/M3 sonar system remains valid and is incorporated herein by reference. Qualitative and quantitative assessments of the HF/M3 system's ability to detect marine mammals of various sizes were verified by 170 hours of at-sea testing (Ellison and Stein 2001).

4.5.4 Visual and Passive Acoustic Observer Training

The ship's lookouts would conduct visual monitoring for marine species at the sea surface. A marine mammal biologist qualified in conducting at-sea visual monitoring of marine mammals from surface vessels would train and qualify designated personnel aboard the Navy's ocean surveillance vessels to conduct at-sea visual monitoring for marine mammals and sea turtles. Training of the civilian ship personnel would include effective and swift communication within the observer's command structure to facilitate quick execution of protective measures if marine mammals or other marine species are observed at the sea surface (NOAA 2012b). The visual training may be accomplished either in-person or via video training.

In addition, the Navy routinely conducts training of the MILCREWs stationed aboard SURTASS LFA sonar vessels to augment their sonar detection capabilities. Senior marine acousticians and a senior marine biologist conduct passive acoustic training of the MILCREWs to increase their ability as sonar operators to distinguish biological sounds from those of mission-directed sounds.

4.5.5 Observation to Increase Knowledge of Marine Mammals

The MMPA requires that entities authorized to take marine mammals conduct monitoring that increases knowledge of the species as well as the impacts of the activity on the affected marine mammals. As such, the Navy has undertaken several efforts (e.g., research through the Navy's Living Marine Resources program) designed to increase knowledge of the marine mammal species potentially affected during use of SURTASS LFA sonar.

4.5.6 Ambient Noise Monitoring

The Navy collects ambient noise data on the marine environment when the SURTASS passive towed HLA is deployed. However, because the collected ambient noise data may also contain sensitive acoustic information, the Navy classifies the data, and thus, does not make these data publicly available. The ambient noise data, especially from areas of the ocean for which marine ambient noise data may be lacking, would be a beneficial addition to the comprehensive ocean noise budget (i.e., an accounting of the relative contributions of various underwater sources to the ocean noise field) and would increase knowledge of the ambient noise environment of the world's oceans. Ocean noise budgets are an important component of varied marine environmental analyses, including studies of masking in marine species, marine habitat characterization, and marine species impact analyses.

In acknowledgement of the valuable data the Navy routinely collects, NMFS has recommended that the Navy continue to explore the feasibility of declassifying and archiving the ambient noise data for incorporation into appropriate ocean noise budget efforts. Due to national security concerns, these data currently remain classified. The Navy continues to study the feasibility of declassifying portions of these data after all related security concerns have been resolved. As an initial step in this process, SURTASS LFA sonar's Marine Mammal Monitoring (M3) program has compiled information on the ambient noise data that have been collected by various underwater acoustic systems and is assessing the range of and usable content of the data prior to further discussions on data dissemination, either at a classified or unclassified level.

4.5.7 Marine Mammal Monitoring (M3) Program

SURTASS LFA sonar's M3 program uses the Navy's fixed and mobile passive acoustic monitoring systems to enhance the Navy's collection of long-term data on individual and population levels of acoustically active marine mammals, principally baleen and sperm whales. The data that the M3 program collects are classified, however, M3 analysts are working to develop reports that can be declassified and result in scientific papers that are peer-reviewed publications in scientific journals. Progress has been achieved on addressing security concerns and declassifying data on fin whale singing and swimming behaviors from which a scientific paper has been prepared and submitted to a scientific journal for review (U.S. Department of Navy 2018a). In addition, information on detections of WNP gray whale vocalizations in the East China Sea has been shared with marine mammal researchers participating in discussions with the IUCN and the IWC about the WNP gray whale's status and determination of possible wintering areas for this critically endangered marine mammal (U.S. Department of Navy 2016). The Navy (OPNAV N2/N6F24) continues to assess and analyze M3 data collected from Navy passive acoustic monitoring systems and is working toward making some portion of that data, after appropriate security reviews, available to scientists with appropriate clearances and ultimately made publicly available.

4.5.8 Stranding Incident Monitoring

Over the twenty-one years of SURTASS LFA sonar use, no injured or disabled marine mammals have been observed either during or after SURTASS LFA sonar activities nor have any mass or individual strandings been associated with SURTASS LFA sonar activities. Under either action alternative, the Navy would continue to monitor for injured or disabled marine mammals and monitor the principal marine mammal stranding networks and media for correlative strandings that overlap in time and space with SURTASS LFA sonar operations.

4.6 Mitigation and Monitoring Measures Considered but Eliminated

The following includes discussion of additional mitigation measures considered by the Navy and NMFS. In previous documentation for SURTASS LFA sonar, other mitigation measures, including the use of small boats, underwater gliders, or aircraft for pre-operational surveys were considered, but not carried forward. The Navy concluded that boat, glider, or aircraft pre-operational surveys were not feasible because they were not practicable, not effective, might increase the harassment of marine mammals, and were not safe to the human performers. Other discussions of recommended mitigation measures may be found in Chapter 10 of the 2007 FSEIS (U.S. Department of Navy 2007a), Chapter 7 of the 2012 SEIS/SOEIS (U.S. Department of Navy 2012), Chapter 5 of the 2017 SEIS/SOEIS (U.S. Department of Navy 2017), and Chapter 5 of the 2019 SEIS/SOEIS (U.S. Department of Navy 2018b, 2019).

4.6.1 Longer Suspension/Delay Period

Navy has considered whether a longer clearance time of 30 min before SURTASS LFA sonar transmissions are allowed to commence or resume after an animal is detected in the LFA mitigation zone would be more be protective than the current 15-min clearance time. The 30-min timeframe is more widely used in other mitigation plans where marine mammals are principally detected by visual monitoring and this time period allows for the visual detection of marine mammals that are longer-duration divers. However, given the superior effectiveness of the HF/M3 sonar system in detecting marine mammals underwater, with the probability of any marine mammal being detected prior to even entering the LFA mitigation zone approaching 100 percent (Ellison and Stein 2001), in addition to the use of the SURTASS passive system, the Navy concluded that such a long clearance time to detect deeper diving marine mammals was not necessary or warranted. HF/M3 sonar used in combination with passive acoustic and visual monitoring would effectively detect marine mammals present in the mitigation zone within the 15-min timeframe.

4.6.2 Restrict Transmission to Daylight Hours

The Navy assessed the requirements for the use of SURTASS LFA sonar for the proposed training and testing activities. Training and testing at night in addition to during daylight hours is a necessity for Navy and civilian personnel to participate in realistic at-sea scenarios that best replicate activities as they may be encountered in real-world scenarios. To do so otherwise would lessen the effectiveness of training and testing, reduce crews' abilities, and potentially introduce an increased safety risk to personnel. The civilian and military personnel aboard SURTASS LFA sonar vessels must be capable of operating and deploying all SURTASS LFA sonar systems in all environments that may be experienced year-round, including night conditions. Training and testing during night hours are vital because environmental differences between day and night affect the detection capabilities of sonar. Consequently, personnel must train and test during all hours of the day and night to ensure they identify and respond to changing environmental conditions. Avoiding or reducing active sonar use at night for the purpose of mitigation would result in an unacceptable impact on military readiness.

The Navy implements two other mitigation monitoring methods (passive acoustic and active acoustic monitoring) in addition to visual monitoring, so that if SURTASS LFA sonar were transmitting during the night, marine mammals or sea turtles could still be efficiently detected, and SURTASS LFA sonar transmissions suspended or delayed, accordingly, upon detection of a marine animal in the mitigation zone. Therefore, the mitigation measure to restrict sonar transmissions to daylight hours was eliminated from further consideration.

4.6.3 Reduce Training and Testing Activities

In Chapter 2, the Navy detailed the types of training and testing activities that comprise their proposed use of SURTASS LFA sonar. The Navy carefully considered the total sonar transmission hours that are necessary to meet its purpose and need. The ability to efficiently and effectively deploy and operate the SURTASS LFA sonar systems and vessels are skills that must be repeatedly practiced under realistic conditions. Training and testing during varied weather, light, and sea-state conditions is critical since the associated environmental conditions affect sound propagation and the detection capabilities of SURTASS LFA sonar.

The Navy uses computer simulation to augment at-sea training and testing whenever possible. Computer simulation is intended to augment, not replace, at-sea training and testing since computer simulations cannot provide the fidelity and level of training necessary nor replicate all possible environmental scenarios that routinely occur in the marine environment. While the Navy would continue to use simulation to augment training and testing capabilities, a reduction in at-sea training and testing that would subsequently result from a further reduction in SURTASS LFA sonar transmission hours would not meet the Navy's need for combat-ready naval forces and would negatively impact military readiness. For this reason, this mitigation measure was eliminated from further consideration.

4.6.4 Increased Coastal Standoff Range

The Navy analyzed an increased CSR of 25 NM in Section 4.7.6 of the 2007 FSEIS/SOEIS, which is incorporated by reference. To summarize the analysis results and Navy's conclusion, increasing the CSR from 12 NM to 25 NM decreased the exposures of coastal shelf species to SURTASS LFA sonar transmissions but increased the exposures of marine mammal species that occurred in deeper, pelagic waters. This result is due to the reduced overlap of the SURTASS LFA sonar exposure area with land when the sound source moves farther offshore, resulting in greater overlap of the SURTASS LFA sonar exposure area with pelagic species. Since there was no overall benefit to protected species from changing the CSR, the Navy did not implement this option and it has not been further considered.

4.6.5 Expanded Geographic Sound Field Operational Constraints

The Navy considered reducing the sonar-generated sound field produced by SURTASS LFA sonar transmissions in the CSR and at OBIA boundaries from below received levels of 180 dB re 1 µPa to below received levels of 150 dB re 1 µPa. The selection of the 180 dB re 1 µPa isopleth was reconfirmed with the Navy's Phase IV acoustic guidance (U.S. Department of Navy 2025) to encompass the zone within which onset of potential injury (AINJ) could occur, as well as most of the non-injurious physiological (TTS) and exposure levels that could be associated with potentially more severe behavioral responses. Considering the 60-sec duration of a SURTASS LFA sonar pulse at a frequency of 300 Hz, the AINJ SEL threshold (197 dB SEL) with frequency weighting for an LF or VLF cetacean is equivalent to a SPL received level of the LFA sonar transmission of 182.7 dB re 1 µPa (rms) SPL. Therefore, using a threshold of 180 dB re 1 µPa (rms) SPL at the CSR and OBIA boundary is conservative.

In addition, SURTASS LFA sonar vessels are in constant motion when LFA sonar is transmitting, so any sonar transmission received levels within an OBIA or the CSR that could potentially cause behavioral disruption would likely be experienced briefly as the ship moves by and likely perceived as occurring in the distance, which are important contextual factors to consider. Furthermore, the range to the 150 dB (rms) isopleth would vary from tens of km to over 54 NM based on propagation conditions. Increasing the mitigation zone to such sizes would impact the effectiveness of military readiness activities by reducing the acoustic regions in which training and testing of the SURTASS LFA sonar could occur, due to the standoff distance LFA sonar vessels would have to operate off these areas. Since the current suite of mitigation measures is implemented to lessen or avoid injury, most TTS, and most biologically significant behavioral responses, constraining the geographic sound field to a lower received level would not provide a significant reduction in the anticipated impact to marine mammals to sufficiently offset the associated decrease in military readiness. For these reasons, this potential mitigation measure was eliminated from additional consideration.

4.7 Reporting

Under either action alternative, the Navy would continue to annually report to NMFS on SURTASS LFA sonar activities, including the locations in which LFA sonar transmissions occurred, the duration of LFA sonar transmissions, and the results of the mitigation monitoring using visual, passive acoustics, and active acoustic monitoring and LFA sonar shutdowns. The Navy would continue to track and report the cumulative number of SURTASS LFA sonar transmission hours associated with training and testing activities throughout each annual period to ensure that the maximum approved level of sonar transmission hours is not exceeded.

4.7.1 Incident Reporting

Navy Lookouts and civilian monitoring personnel aboard SURTASS LFA sonar vessels systematically observe the sea surface during and after SURTASS LFA sonar transmissions for the presence of injured or disabled marine mammals or sea turtles. The Navy must notify NMFS immediately, or as soon as clearance procedures allow, if an injured, stranded, or dead marine mammal or sea turtle is found during, shortly after (within 24 hours), or in the vicinity of any SURTASS LFA sonar training or testing activities or anytime an injured, stranded, or dead marine mammal is observed at sea. In the event that an injured, stranded, or dead marine mammal is observed by the SURTASS LFA sonar vessel crew during transit or during normal ship activities not related to training or testing of SURTASS LFA sonar, the Navy would report the incident as soon as operationally feasible and clearance procedures allow. In addition, the Navy would immediately, or as soon as clearance procedures allow, report any ship strikes of marine mammals or sea turtles by one of the SURTASS LFA sonar vessels, including all pertinent information on the strike and associated vessel. In the history of the use of SURTASS LFA sonar, no marine mammal or sea turtles have been struck by SURTASS LFA sonar vessels nor have any injured or disabled marine mammals or sea turtles been observed during or following SURTASS LFA sonar activities.

The Navy also routinely monitors the principal marine mammal stranding networks, the Internet, and social media to compile stranding data for the regions in which SURTASS LFA sonar activities were conducted and evaluate the temporal and spatial correlation of SURTASS LFA sonar transmissions with marine mammal strandings, particularly mass strandings. The Navy would report to NMFS any marine mammal strandings that were correlated in time and space with the training or testing activities of any SURTASS LFA sonar vessels.

4.7.2 Annual and Comprehensive Reports

Annually, the Navy would submit unclassified and classified synthesis reports to the NMFS Office of Protected Resources' Director no later than 90 days after the anniversary of the date on which the Navy's LOAs for SURTASS LFA sonar become effective. These reports would detail the SURTASS LFA sonar training and testing activities conducted during the annual effective period and would include summaries of the dates, times, and locations of LFA sonar activity; marine mammal or sea turtle detections from visual, passive acoustic, and active acoustic monitoring; and delays or suspensions of LFA sonar transmissions due only to mitigation monitoring protocol. Information reported on marine mammal detections would include general type of marine mammals (i.e., whales, dolphins) and/or species identifications, if possible; number of marine mammals detected; range and bearing of the detected animal from the vessel; detection method (visual, passive acoustic, HF/M3 sonar); and remarks/narrative, as needed.

Each annual report would build on the previous annual report to provide a cumulative overview of the level of training and testing transmission hours per year. At the end of the seven-year effective period of the LOAs, the final annual reports would be cumulative, comprehensive reports of SURTASS LFA sonar activities conducted during the MMPA regulation period.

5 Other Considerations Required by NEPA

This chapter summarizes environmental compliance for the Proposed Action, consistency with other federal, state, and local plans, policies; the relationship between short-term impacts and the maintenance and enhancement of long-term productivity in the affected environment; irreversible and irretrievable commitments of resources; and energy conservation.

5.1 Consistency with Other Federal, State, and Local Laws, Plans, Policies, and Regulations

When implemented, the Proposed Action for the SURTASS LFA Sonar Training and Testing SEIS/OEIS would comply with applicable federal laws, regulations, and executive orders. Regulatory agency consultations are underway and will be completed prior to implementing the Proposed Action ensuring all legal requirements are met. Table 5-1 also summarizes additional environmental compliance requirements not specifically assessed in the resource chapters. Brief background and excerpts of the primary federal statutes, executive orders, and guidance that form the regulatory framework for the resource evaluations are also discussed in Table 5-1. Regulatory agency consultation and coordination documents are provided in Appendix A (Public and Agency Participation).

Table 5-1. Principal Federal Laws Applicable to the Proposed Action

Laws and Executive Orders	*Description of Laws, Executive Orders, International Standards, and Guidance; and Status of Compliance*
Laws	
Act to Prevent Pollution from Ships (APPS) (33 U.S.C. section 1901 et seq.)	As applicable to the Proposed Action, these legal requirements have not changed since the 2019 SEIS/SOEIS. Operation of the SURTASS LFA sonar system itself would not result in the discharge of pollutants regulated under the APPS.
Clean Air Act (CAA) (42 U.S.C. section 7401 et seq.)	CAA is the primary federal statute governing the control of air quality (36 FR 22384, Nov. 25, 1971). The CAA designates six pollutants as "criteria pollutants" for which the USEPA has established NAAQS to protect public health and welfare (40 CFR part 50). The General Conformity Rule ensures that federal actions do not prohibit States from achieving NAAQS. SURTASS LFA Sonar vessels do not conduct training and testing in areas subject to the CAA General Conformity Rule.
Clean Water Act (CWA) (33 U.S.C. section 1251 et seq.)	As applicable to the Proposed Action, these legal requirements have not changed since the 2019 SEIS/SOEIS, and the Navy has verified that the updated proposed activities and stressor quantities do not change its compliance with these requirements.
Coastal Zone Management Act (CZMA) (16 U.S.C. section 1451 et seq.)	Pursuant to the CZMA (15 CFR Part 930) regulations, as part of the analyses for the 2001 FOEIS/EIS, the Navy determined that its Proposed Action would be consistent to the maximum extent practicable with the relevant enforceable policies of the one state and two territories that are located in the current study area for SURTASS LFA sonar: Hawaii, Guam, and the CNMI. No amendments to enforceable policies in Hawaii change the Proposed Action compliance with these requirements, and no changes to enforceable policies in Guam or CNMI have occurred since the 2019 SEIS/SOEIS. Additionally, no effects on coastal zone use or resources are anticipated since no SURTASS LFA training or testing would occur inside the 3 NM coastal zone, given mitigations described in Chapter 4.
Endangered Species Act (ESA) (16 U.S.C. section 1531 et seq.)	Potential effects to marine species listed under the ESA as well as designated critical habitats of those species have been assessed in this SEIS/SOEIS. Consultations with NMFS will be initiated. See Sections 3.3.2.2, 3.4.2.2, and 3.5.2.3 of this SEIS/OEIS for the associated effects analyses.
Magnuson-Stevens Fishery Conservation and Management Reauthorization Act (MSFCMA) (16 U.S.C. section 1801 et seq.)	Consultation/coordination under the MSFCMA was conducted as part of the analyses for the Navy's 2001 FOEIS/EIS (U.S. Department of Navy 2001) for SURTASS LFA sonar. The Navy concluded that implementation of its Proposed Action would result in no adverse effects to designated EFH. There have been no changes to designated EFH that would change the Navy's effects determination.
Marine Mammal Protection Act (MMPA) (16 U.S.C. section 1361 et seq.)	This SEIS/OEIS updates the analysis and is the basis for a request for a 7-year Letter of Authorization from NMFS. Analyzed in this SEIS/SOEIS are the potential impacts to marine mammals resulting from execution of the Proposed Action. An application for rulemaking and a Letter of Authorization under the MMPA will be submitted to NMFS. See Section 3.5.2.3 of this SEIS/OEIS for the associated effects analyses.
National Historic Preservation Act (NHPA) (54 U.S.C. section 3001018 et seq.)	SURTASS LFA sonar training and testing activities are considered an "undertaking" under NHPA. However, the nature and level of sonar are such that there would be no potential to cause effects to historic properties and, therefore, there is no requirement for consultation under NHPA Section 106 or Section 402.
National Marine Sanctuaries Act (NMSA) (16 U.S.C. sections 1431 et seq.)	The Navy has determined that its planned use of SURTASS LFA sonar pursuant to this SEIS/OEIS may require consultation under Section 304(d) of the NMSA for the Hawaiian Islands Humpback Whale and Papahānaumokuākea NMSs. See Section 3.6.2.1 of this SEIS/OEIS for the associated effects analyses.

Laws and Executive Orders	*Description of Laws, Executive Orders, International Standards, and Guidance; and Status of Compliance*
EOs	
EO 12962, Recreational Fisheries	Since the Proposed Action would have no significant harm to fishes or fisheries and would in no way impair access to recreational fishing areas, the Navy concluded that it has fulfilled its EO 12962 responsibilities regarding recreational fishing uses and resources.
EO 13158, Marine Protected Areas (MPAs)	The Proposed Action would not harm nor affect the natural or cultural resources of any MPA, as specified under EO 13158. See Section 3.6.2.3 of this SEIS/OEIS for the associated effects analyses.
EO 13175, Consultation and Coordination with Indian Tribal Governments, and Department of Defense (DoD) Instruction 4710.3, Consultation with Native Hawaiian Organizations	The Proposed Action does not entail employment of SURTASS LFA sonar in U.S. waters due to the employment of the 12 NM CSR. No SURTASS LFA training would occur within state waters of Hawaii or the territorial waters of Guam/CNMI; no federally recognized Indian or Native Alaskan tribes or organizations are located within the bounds of the Study Area. Therefore, no consultation or coordination under EO 13175 is required. Similarly, the Proposed Action would not adversely affect resources of traditional religious or cultural importance to Native Hawaiian organizations, and therefore no consultation with those organizations is required.
EO 13840, Ocean Policy to Advance the Economic, Security, and Environmental Interests of the U.S.	EO 13840 is intended to advance the economic, security, and environmental interests of the U.S. through improved public access to marine data and information; efficient federal agency coordination on ocean related matters; and engagement with marine industries, the science and technology community, and other ocean stakeholders, including Regional Ocean Partnerships. The Proposed Action is consistent with EO 13840.

CEQ = Council on Environmental Quality; CFR = Code of Federal Regulations; CO_2e = carbon dioxide equivalent ; EEZ = Exclusive Economic Zone; EIS = Environmental Impact Statement; EFH = Essential Fish Habitat; EO = Executive Order; FOEIS = Final Overseas Environmental Impact Statement; FR = Federal Register GHGs = greenhouse gases; km = kilometers; LFA = Low Frequency Active; MPA = Marine Protected Area; NAAQS = National Ambient Air Quality Standards; Navy = United States Department of the Navy ; NM = Nautical Miles; NMFS = National Marine Fisheries Service; NMS = National Marine Sanctuaries; NMSA = National Marine Sanctuary Act; NEPA = National Environmental Policy Act; NOAA = National Oceanic and Atmospheric Administration; OEIS = Overseas Environmental Impact Statement; ONMS = Office of National Marine Sanctuaries; SEIS = Supplemental Environmental Impact Statement; SOEIS = Supplemental Overseas Environmental Impact Statement; SURTASS = Surveillance Towed Array Sensor System ; U.S. = United States ; U.S.C = United States Code; USEPA = United States Environmental Protection Agency; USFWS = U.S. Fish and Wildlife Service

5.2 Irreversible or Irretrievable Commitments of Resources

Resources that are irreversibly or irretrievably committed to a project are those that are used on a long-term or permanent basis. This includes the use of non-renewable resources such as metal and fuel, and natural or cultural resources. These resources are irretrievable in that they would be used for this project when they could have been used for other purposes. Human labor is also considered an irretrievable resource. Another impact that falls under this category is the unavoidable destruction of natural resources that could limit the range of potential uses of that environment.

For the Proposed Action, most resource commitments would be neither irreversible nor irretrievable. Impacts would be short term and temporary. Because there would be no building or facility construction, the consumption of material typically associated with such construction (e.g., concrete, metal, sand, fuel) would not occur. Energy typically associated with construction activities would not be expended and irretrievably lost.

5.3 Relationship between Short-Term Use of the Environment and Long-Term Productivity

NEPA requires an analysis of the relationship between a project's short-term impacts on the environment and the effects that these impacts may have on the maintenance and enhancement of the long-term productivity of the affected environment. Impacts that narrow the range of beneficial uses of the environment are of particular concern. The Proposed Action could result in primarily short-erm environmental impacts. However, these are not expected to result in any impacts that would reduce environmental productivity, permanently narrow the range of beneficial uses of the environment, or pose long-term risks to health, safety, or general welfare of the public.

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This SEIS/OEIS was prepared collaboratively between the Navy and contractor preparers. It relies on language prepared in previous documents (see Chapter 8: List of Preparers in U.S. Department of Navy 2019a).

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