DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 218

[Docket No. 180809740–9103–01]

RIN 0648–BI42

Takes of Marine Mammals Incidental to Specified Activities: Taking Marine Mammals Incidental to U.S. Navy Surveillance Towed Array Sensor System Low Frequency Active Sonar Training and Testing in the Central and Western North Pacific Ocean and Eastern Indian Ocean

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Proposed rule; request for comments.

SUMMARY: NMFS has received a request from the U.S. Navy (Navy) for authorization to take marine mammals incidental to the use of Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) 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 Ocean and eastern Indian Ocean (SURTASS LFA sonar activities) beginning August 2019. Pursuant to section 101(a)(5)(A) of the MMPA, NMFS is requesting comments on its proposal to issue regulations to govern the incidental take of marine mammals by Level B harassment during SURTASS LFA sonar activities. The Fiscal Year 2019 (FY19) National Defense Authorization Act (NDAA), signed on August 13, 2018, amended the Marine Mammal Protection Act to extend the maximum authorization period of permitted incidental takings of marine mammals under section 101(a)(5)(A) in the course of specified military readiness activities by the Department of Defense from five to seven years. Therefore, the authorization, if issued, would be in effect from August 2019 to August 2026. NMFS will consider public comments prior to making any final decision on the issuance of the requested MMPA authorization and agency responses will be summarized in the final notice of our decision. The Navy's activities are considered military readiness activities pursuant to the Marine Mammal Protection Act (MMPA), as amended by the National Defense Authorization Act for Fiscal Year 2004 (FY 2004 NDAA).

DATES: Comments and information must be received no later than April 1, 2019.

ADDRESSES: You may submit comments on this document, identified by NOAA–NMFS–2019–0014, by any of the following methods:

- *Electronic submission:* Submit all electronic public comments via the Federal e-Rulemaking Portal. Go to *www.regulations.gov/#!docketDetail;D=NOAA-NMFS-2019-0014,* click the ''Comment Now!'' icon, complete the required fields, and enter or attach your comments.
- *Mail:* Submit written comments to Jolie Harrison, Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service, 1315 East-West Highway, Silver Spring, MD 20910.

Instructions: Comments sent by any other method, to any other address or individual, or received after the end of the comment period, may not be considered by NMFS. All comments received are a part of the public record and will generally be posted for public viewing on *www.regulations.gov* without change. All personal identifying information (*e.g.,* name, address), confidential business information, or otherwise sensitive information submitted voluntarily by the sender will be publicly accessible. NMFS will accept anonymous comments (enter ''N/A'' in the required fields if you wish to remain anonymous). Attachments to electronic comments will be accepted in Microsoft Word, Excel, or Adobe PDF file formats only.

FOR FURTHER INFORMATION CONTACT: Wendy Piniak, Office of Protected Resources, NMFS, (301) 427–8401.

SUPPLEMENTARY INFORMATION:

Availability

A copy of the Navy's application and any supporting documents, as well as a list of the references cited in this document, may be obtained online at: *https://www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-military-readiness-activities.* In case of problems accessing these documents, please call the contact listed above (see **FOR FURTHER INFORMATION CONTACT**).

Purpose and Need for Regulatory Action

NMFS received an application from the Navy requesting regulations and a related letter or letters of authorization (LOA) to take multiple species of marine mammals by Level B harassment incidental to SURTASS LFA sonar activities. Please see ''Background'' below for definitions of harassment. This proposed rule would establish a framework under the authority of the MMPA (16 U.S.C. 1361 *et seq.*) to allow for the authorization of take of marine mammals incidental to the Navy's specified activities.

Legal Authority for the Proposed Action

Section 101(a)(5)(A) of the MMPA (16 U.S.C. 1371(a)(5)(A)) generally directs the Secretary of Commerce to allow, upon request, the incidental, but not intentional taking of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographical region for up to five years if, after notice and public comment, the agency makes certain findings and issues regulations that set forth permissible methods of taking and other means of effecting the least practicable adverse impact on the affected species or stocks and their habitat (see the discussion below in the Proposed Mitigation section), as well as monitoring and reporting requirements. Section 101(a)(5)(A) of the MMPA and the implementing regulations at 50 CFR part 216, subpart I provide the legal basis for issuing this proposed rule and any associated LOAs. As described in the next section, the MMPA has been amended in a number of ways when the specified activity is a military readiness activity, including most recently in 2018 to extend the maximum authorization period under section 101(a)(5)(A) to seven years for Department of Defense military readiness activities. As directed by this legal authority, this proposed rule contains mitigation, monitoring, and reporting requirements.

Background

The MMPA prohibits the ''take'' of marine mammals, with certain exceptions. Sections 101(a)(5)(A) and (D) of the MMPA (16 U.S.C. 1361 *et seq.*) direct the Secretary of Commerce (as delegated to NMFS) to allow, upon request, the incidental, but not intentional, taking of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographical region if certain findings are made and either regulations are issued or, if the taking is limited to harassment, an incidental harassment authorization may be issued following notice and opportunity for public comment.

Authorization for incidental takings shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s) and will not have an unmitigable adverse impact on the availability of the species or stock(s) for taking for subsistence uses (where relevant). Further, NMFS must prescribe the permissible methods of taking and other means of effecting the least practicable adverse impact on the affected species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of such species or stocks for taking for certain subsistence uses (referred to in shorthand as ''mitigation''), and requirements pertaining to the monitoring and reporting of such takings.

The 2004 NDAA (Pub. L. 108–136) removed the ''small numbers'' and ''specified geographical region'' limitations indicated above and amended the definition of ''harassment'' as it applies to a ''military readiness activity'' to read as follows (Section 3(18)(B) of the MMPA): (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). In addition, the FY 2004 NDAA amended the MMPA as it relates to military readiness activities and the incidental take authorization (ITA) process such that ''least practicable adverse impact'' shall include consideration of personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity. As mentioned above, the NDAA for FY 2019 amended the MMPA to extend the authorized period of permitted incidental takings of marine mammals covered by section 101(a)(5)(A) in the course of specified military readiness activities from five to seven years.

The allowance of incidental taking under section 101(a)(5)(A) requires promulgation of activity-specific regulations. Under NMFS' implementing regulations for section 101(a)(5)(A), a Letter of Authorization (LOA) may be issued consistent with the activity-specific regulations, provided that the level of taking will be consistent with the findings made for the total taking allowable under the specific regulations. The promulgation of activity-specific regulations (with their associated prescribed mitigation, monitoring, and reporting) requires notice and opportunity for public comment.

National Marine Sanctuaries Act

NMFS will work with NOAA's Office of National Marine Sanctuaries to fulfill our responsibilities under the NMSA as warranted and will complete any NMSA requirements prior to a determination on the issuance of the final rule and LOAs.

National Environmental Policy Act

To comply with the National Environmental Policy Act of 1969 (NEPA; 42 U.S.C. 4321 *et seq.*) and NOAA Administrative Order (NAO) 216–6A, NMFS must evaluate our proposed action (*i.e.,* the promulgation of regulations and issuance of the LOA) and alternatives with respect to potential impacts on the human environment. NMFS is a cooperating agency on the Navy's supplemental environmental impact statement/supplemental overseas environmental impact statement (SEIS/SOEIS). NMFS plans to adopt the Navy's SEIS/SOEIS for SURTASS LFA sonar training and testing activities, provided our independent evaluation of the document finds that it includes adequate information analyzing the effects on the human environment of issuing the incidental take regulations and LOA.

The Navy published a Notice of Availability of a DSEIS/SOEIS for employment of SURTASS LFA sonar in the **Federal Register** on September 7, 2018 (83 FR 45442), which was available for public review and comment until October 22, 2018. The public may view the DSEIS/SOEIS at: *http://www.surtass-lfa-eis.com.*

NMFS will evaluate the comments received on the DSEIS/SOEIS and comments received as a result of this proposed rulemaking prior to concluding our NEPA process or making a final decision on the request for incidental take authorization.

Summary of Request

On June 4, 2018, NMFS received a request from the Navy for authorization to take, by harassment, 46 species of marine mammals incidental to the use of SURTASS LFA sonar 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 Ocean and eastern Indian Ocean beginning in August 2019. In light of the FY 2019 NDAA amending section 101(a)(5)(A), the period for which the regulations would be effective for issuing the LOA under this rulemaking would extend to August 2026. On July 13, 2018, NMFS published a notice of receipt (NOR) of the Navy's application in the **Federal Register** (83 FR 32615), and requested comments and information related to the Navy's request. The review and comment period for the NOR ended on August 13, 2018. We received one comment in response to the NOR from a private citizen requesting that NMFS deny Navy's incidental take authorization request to avoid harming or killing marine mammals. This comment is available online at: *https://www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-military-readiness-activities.* We note that the Navy has not requested, nor is NMFS anticipating or proposing to authorize any mortality or any form of Level A harassment and, as discussed in more detail below, impacts to marine mammals are anticipated to be limited to Level B harassment only.

The Navy submitted a revised application on November 13, 2018. This revision included a minor change to the mitigation measures provided in the June 2018 application that was available for public review during the review and comment period for the NOR. This revision does not represent a significant change to the proposed mitigation measures for this proposed rule; however, the revised application is available here: *https://www.fisheries.noaa.gov/action/incidental-take-authorization-us-navy-operations-surveillance-towed-array-sensor-system-0* (also see Proposed Mitigation section of this notice for more detail).

The Navy states, and NMFS concurs, that these SURTASS LFA sonar activities, classified as military readiness activities, may incidentally take marine mammals by exposing them to SURTASS LFA sonar at levels that constitute Level B harassment as defined above. The Navy requests authorization to take, by Level B Harassment, individuals from 139 stocks of 46 species of marine mammals (10 species of mysticete (baleen) whales, 31 species of odontocete (toothed) whales, and 5 species of pinnipeds (seals and sea lions)). This rule may also cover the authorization of take of animals from additional associated stocks of marine mammals not listed here, should one or more of the stocks identified in this rule be formally separated into multiple stocks, provided NMFS is able to confirm the necessary findings for the newly identified stocks. As discussed later in this document, incidental takes due to SURTASS LFA sonar will be limited to Level B behavioral harassment. No takes by

Level A harassment are proposed to be authorized as Level A harassment is considered unlikely and will be avoided through the implementation of the Navy's proposed mitigation measures, as discussed below.

In previous SURTASS LFA sonar rulemakings, NMFS authorized some Level A harassment takes in an abundance of caution even though Level A harassment takes were not anticipated. However, to the knowledge of the Navy and NMFS, no Level A harassment takes have resulted over the 17-year history of SURTASS LFA sonar activities. Additionally, the exposure criteria and thresholds for assessing Level A harassment have been modified since prior rules based on the best available science. Under these new metrics, the zone for potential injury is substantially reduced. Therefore, due to the small injury zones and the fact that mitigation measures would ensure that marine mammals would not be exposed to received levels associated with injury, the Navy has not requested authorization for Level A harassment takes, and NMFS is not proposing to authorize any takes by Level A harassment.

NMFS published the first incidental take rule for SURTASS LFA sonar, effective from August 2002 through August 2007, on July 16, 2002 (67 FR 46712); the second rule, effective from August 2007 through August 2012, on August 21, 2007 (72 FR 46846); and the third rule, effective from August 2012 through August 2017, on August 20, 2012 (77 FR 50290).

In 2016, the Navy submitted an application for a fourth incidental take regulation under the MMPA (DoN, 2016) for the taking of marine mammals by harassment incidental to the deployment of up to four SURTASS LFA sonar systems from August 15, 2017, through August 14, 2022. NMFS published a proposed rule on April 27, 2017 (82 FR 19460). On August 10, 2017, the Deputy Secretary of Defense, after conferring with the Secretary of Commerce, determined that it was necessary for the national defense to exempt all military readiness activities that use SURTASS LFA sonar from compliance with the requirements of the MMPA for a period of up to two years beginning August 13, 2017, through August 12, 2019, or until such time when NMFS issues regulations and an LOA under MMPA section 101(a)(5)(A) for military readiness activities associated with the use of SURTASS LFA sonar, whichever is earlier. During the exemption period, all military readiness activities that involve the use of SURTASS LFA sonar are required to comply with all mitigation, monitoring, and reporting measures set forth in the 2017 National Defense Exemption (NDE) for SURTASS LFA sonar, which were based on the measures included in NMFS' prior (2012) Final Rule (77 FR 50290; August 20, 2012) and 2017 Proposed Rule (82 FR 19460; April 27, 2017). As a result of the NDE (available at *http://www.surtass-lfa-eis.com/wp-content/uploads/2018/01/SURTASS_LFA_NDE_10Aug17.pdf*), NMFS did not finalize its April 2017 proposed rule.

The NDE expires August 12, 2019. For this rulemaking, the Navy is proposing to continue using SURTASS LFA sonar systems onboard United States Naval Ship (USNS) surveillance ships for training and testing activities conducted under the authority of the Secretary of the Navy within the western and central North Pacific Ocean and eastern Indian Ocean. The operating features of the LFA sonar have remained the same since the 2001 FOEIS/EIS, except to note that the typical duty cycle of LFA sonar, based on historical SURTASS LFA sonar use, is 7.5 to 10 percent (DoN, 2007). The maximum duty cycle remained the same at 20 percent.

For this rulemaking, the Navy scoped the geographic extent of the area where the specified activity will occur (study area) to better reflect the areas where the Navy anticipates conducting SURTASS LFA sonar training and testing activities. Whereas the previous authorizations included certain routine military operations among the scope of actions analyzed, the Navy also has narrowed the scope of activities in the current request for authorization to training and testing activities only due to various statutory and practical considerations, as described in the SURTASS 2018 DSEIS/OEIS (DoN, 2018), Chapter 1, and discussed further below.

Under the proposed rule, the Navy would transmit a total of up to 496 LFA sonar transmission hours per year for its specified activity, as described below (see Description of the Specified Activities section), pooled across all SURTASS LFA sonar-equipped vessels in the first four years of the authorization, with an increase in usage to a total of up to 592 LFA transmission hours in years five through seven.

Description of the Specified Activities

Overview

The Navy's primary mission is to organize, train, and equip combat-ready naval forces capable of accomplishing American strategic objectives, deterring maritime aggression, and assuring freedom of navigation in ocean areas. This mission is mandated by Federal law in Section 5062 of Title 10 of the United States Code, which directs the Secretary of the Navy to ensure the readiness of the U.S. naval forces.

The Secretary of the Navy and the Chief of Navy Operations (CNO) have established that anti-submarine warfare (ASW) is a critical capability for achieving the Navy's mission, and it requires unfettered access to both the high seas and littoral environments to be prepared for all potential threats by maintaining ASW core competency. The Navy is challenged by the increased difficulty in locating undersea threats solely by using passive acoustic technologies due to the advancement and use of quieting technologies in diesel-electric and nuclear submarines. At the same time as the distance at which submarine threats can be detected decreases due to quieting technologies, improvements in torpedo and missile design have extended the effective range of these weapons.

One of the ways the Navy has addressed the changing requirements for ASW readiness was by developing SURTASS LFA sonar, which is able to reliably detect quieter and harder-to-find submarines at long range before these vessels can get within their effective weapons range to launch against their targets. SURTASS LFA sonar systems have a passive component (SURTASS), which is a towed line array of hydrophones used to detect sound emitted or reflected from submerged targets, and an active component (LFA), which is comprised of a set of acoustic transmitting elements. The active component detects objects by creating a sound pulse, or "ping" that is transmitted through the water and reflects off the target, returning in the form of an echo similar to echolocation used by some marine mammals to locate prey and navigate. SURTASS LFA sonar systems are long-range sensors that operate in the low-frequency (LF) band (*i.e.,* 100–500 Hertz (Hz)). Because LF sound travels in seawater for greater distances than higher frequency sound, the SURTASS LFA sonar system would meet the need for improved detection and tracking of new-generation submarines at a longer range and would maximize the opportunity for U.S. armed forces to safely react to, and defend against, potential submarine threats while remaining a safe distance beyond a submarine's effective weapons range. Thus, the active acoustic component in the SURTASS LFA sonar is an important augmentation to its passive and tactical systems, as its long-range detection capabilities can effectively counter the threat to the Navy and national security interests posed by quiet, diesel submarines.

The Navy's proposed specified activity for MMPA incidental take coverage is the continued employment of SURTASS LFA sonar systems onboard USNS surveillance ships for training and testing activities conducted under the authority of the Secretary of the Navy in the western and central Pacific Ocean and eastern Indian Ocean, which is classified as a military readiness activity, beginning August 13, 2019. The use of the SURTASS LFA sonar system would result in acoustic stimuli from the generation of sound or pressure waves in the water at or above levels that NMFS has determined would result in take of marine mammals under the MMPA. This is the principal means of marine mammal taking associated with these military readiness activities. In addition to the use of active acoustic sources, the Navy's activities include the movement of vessels. This document also analyzes the effects of this aspect of the activities. NMFS does not anticipate takes of marine mammals to result from ship strikes from any SURTASS LFA vessels because each vessel moves at a relatively slow speed (10 to 12 knots (kt) while transiting), especially when towing the SURTASS and LFA sonar systems (moving at 3 to 4 kt), and for a relatively short period of time. Combined with the use of mitigation measures as noted below, it is likely that surveillance vessels would be able to avoid any marine mammals.

The Navy will restrict SURTASS LFA sonar training and testing activities to the central and western North Pacific Ocean and eastern Indian Ocean. The Navy will not conduct training or testing utilizing SURTASS LFA sonar within the foreign territorial seas of other nations and will maintain SURTASS LFA sonar received levels below 180 decibels (dB) re 1 μPa (root-mean-square (rms)) within 12 nautical miles (nmi) (22 kilometers (km)) of any emerged land features or within the boundaries of designated Offshore Biologically Important Areas (OBIAs) during their effective periods (see Proposed Mitigation section below for OBIA details). In addition to these geographic mitigation measures, the Navy will implement procedural mitigation measures including monitoring for the presence of marine mammals (including visual as well as active and passive acoustic monitoring) and implementing shutdown procedures for marine mammals within a mitigation/buffer zone around the LFA sonar source (see Proposed Mitigation section below for further details).

Dates and Duration

This proposed rule (if made final) and associated LOA would be valid beginning August 13, 2019, through August 12, 2026. The Navy currently conducts SURTASS LFA sonar activities from four vessels. The Navy is planning to add new vessels to its ocean surveillance fleet. As new vessels are developed, the onboard LFA and High Frequency Marine Mammal Monitoring sonar (HF/M3 sonar) systems (discussed below) may need to be updated, modified, or even re-designed. Current indications are that future LFA sonar systems will have the same operational characteristics and that updates and modifications are focused toward miniaturizing the system components to reduce the weight and handling of the systems. If system parameters are modified as a result of these updates the Navy will determine if supplementary analysis would be required to cover the deployment of these new systems. As the new vessels and sonar system components are developed and constructed, at-sea testing would eventually be necessary. The Navy anticipates that new vessels, or new/updated sonar system components, would be ready for at-sea testing beginning in the fifth year of the time period covered by this proposed rule. Thus, the Navy's activity analysis included consideration of the sonar hours associated with future testing of new or updated LFA sonar system components and new ocean surveillance vessels. This consideration resulted in two scenarios of annual sonar transmit hours: Years 1 to 4 would entail 496 hours total per year across all SURTASS LFA sonar vessels, while years 5 to 7 would include an increase in LFA sonar transmit hours to 592 hours across all vessels.

The SURTASS LFA sonar transmission hours represent a distribution across six activities that include (with an approximate allocation of hours indicated):

- Contractor crew proficiency training (80 hours per year);
- Military crew (MILCREW) proficiency training (96 hours per year);
- Participation in or support of naval exercises (96 hours per year);
- Vessel and equipment maintenance (64 hours per year);
- Acoustic research testing (160 hours per year); and
- New SURTASS LFA sonar system testing (96 hours per year; would occur in years 5 to 7).

Each of these activities utilizes the SURTASS LFA sonar system within the operating profile described above; therefore, the number of hours designated for each activity is merely an estimate for planning purposes.

As noted above, this rulemaking would result in the fourth such regulation for the Navy's SURTASS LFA sonar activities. The Navy is currently conducting the specified activities under an NDE that will expire after August 12, 2019. Therefore, the Navy has requested MMPA rulemaking and a LOA for its SURTASS LFA sonar activities effective beginning August 13, 2019, to take marine mammals incidental to the SURTASS LFA sonar activities for a seven year period.

Potential SURTASS LFA Sonar Training and Testing Areas

The potential geographic scope of the SURTASS LFA sonar activities covered by this proposed rule are the western and central North Pacific Ocean and eastern Indian Ocean outside of the territorial seas of foreign nations (generally 12 nautical miles (nmi) (22 kilometers (km) from most foreign nations). Figure 1 depicts the potential areas of SURTASS LFA sonar activities. In areas within 12 nmi from any emergent land (coastal exclusion areas) and in areas identified as OBIAs, SURTASS LFA sonar training and testing would be conducted such that received levels of LFA sonar are below 180 dB re 1 μPa rms sound pressure level (SPL). This restriction would be observed year-round for coastal standoff zones and during known periods of biological importance for OBIAs.

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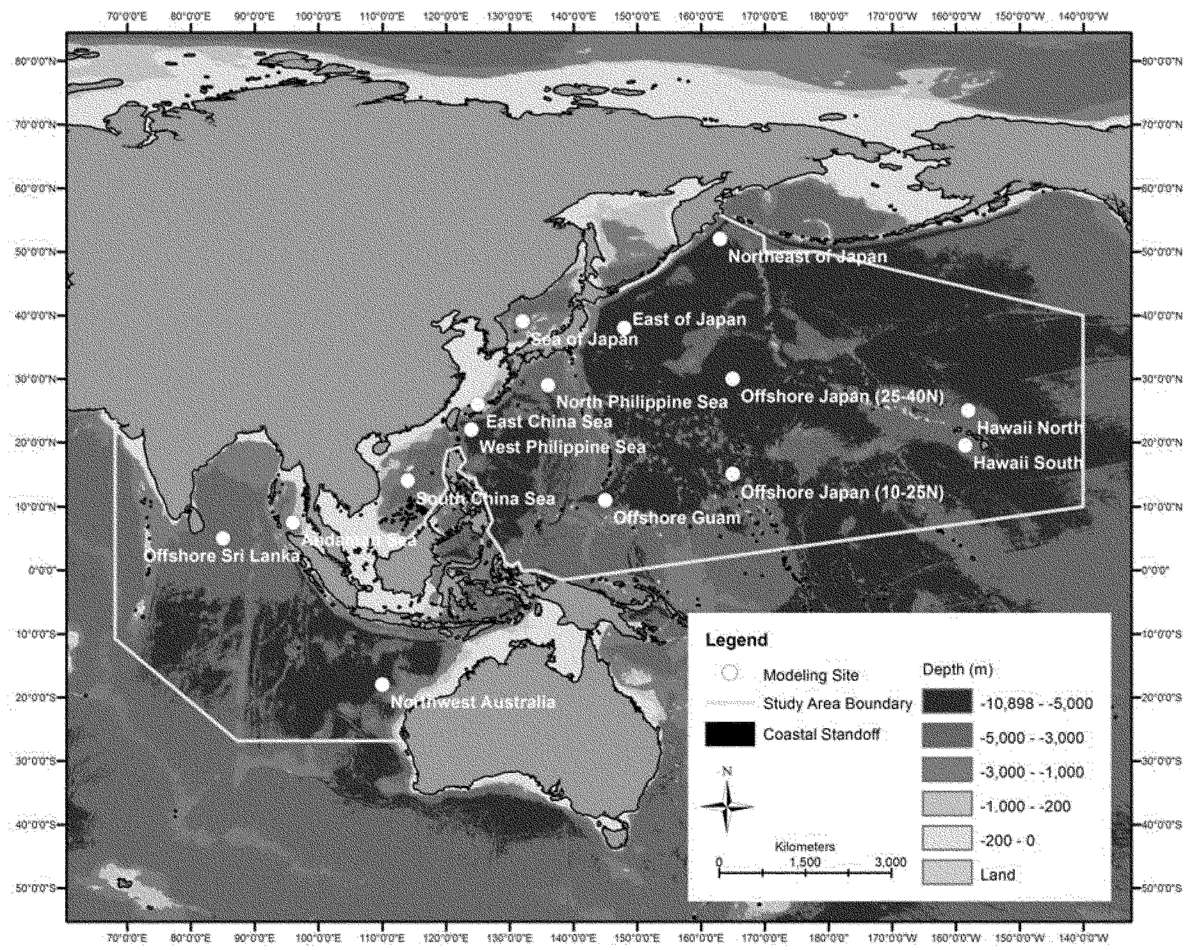

Figure 1. Potential Areas for SURTASS LFA sonar activities including modeling areas (DoN, 2018).

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For this rulemaking, the Navy has scoped the geographic extent of its specified activities to better reflect the areas where the Navy anticipates conducting SURTASS LFA sonar training and testing activities now and into the reasonably foreseeable future. Fifteen representative model areas (shown in Figure 1 and listed in Table 1), with nominal modeling sites in each region, provide geographic context for the proposed SURTASS LFA sonar activities.

TABLE 1—REPRESENTATIVE SURTASS LFA SONAR MODELING AREAS THAT THE NAVY MODELED FOR THE DSEIS/OEIS (DON, 2018) AND THE MMPA RULEMAKING/LOA APPLICATION

Modeled site	Location (latitude/ longitude of center of modeling area)	Notes
East of Japan	38° N, 148° E	
North Philippine Sea	29° N, 136° E	
West Philippine Sea	22° N, 124° E	
Offshore Guam	11° N, 145° E	Navy Mariana Islands Testing and Training Area.
Sea of Japan	39° N, 132° E	
East China Sea	26° N, 125° E	
South China Sea	14° N, 114° E	
Offshore Japan 25° to 40° N	30° N, 165° E	
Offshore Japan 10° to 25° N	15° N, 165° E	
Hawaii North	25° N, 158° W	Navy Hawaii-Southern California Training and Testing Area.
Hawaii South	19.5° N, 158.5° W	Navy Hawaii-Southern California Training and Testing Area.
Offshore Sri Lanka	5° N, 85° E	

TABLE 1—REPRESENTATIVE SURTASS LFA SONAR MODELING AREAS THAT THE NAVY MODELED FOR THE DSEIS/OEIS (DON, 2018) AND THE MMPA RULEMAKING/LOA APPLICATION—Continued

Modeled site	Location (latitude/ longitude of center of modeling area)	Notes
Andaman Sea	7.5° N, 96° E	
Northwest of Australia	18° S, 110° E	
Northeast of Japan	52° N, 163° E	

Detailed Description of the Specified Activities

SURTASS LFA Sonar—SONAR is an acronym for Sound Navigation and Ranging, and its definition includes any system (biological or mechanical) that uses underwater sound, or acoustics, for detection, monitoring, and/or communications. Active sonar is the transmission of sound energy for the purpose of sensing the environment by interpreting features of received signals. Active sonar detects objects by creating a sound pulse, or ''ping'' that is transmitted through the water and reflects off the target, returning in the form of an echo. Passive sonar detects the transmission of sound waves created by an object.

As mentioned previously, the SURTASS LFA sonar system is a long-range, all-weather LF sonar (operating between 100 and 500 Hertz (Hz)) system that has both active and passive components. LFA, the active system component (which allows for the detection of an object that is not generating noise), is comprised of source elements (called projectors) suspended vertically on a cable beneath the surveillance vessel. The projectors produce an active sound pulse by converting electrical energy to mechanical energy by setting up vibrations or pressure disturbances within the water to produce a ping. The Navy uses LFA as an augmentation to the passive SURTASS operations when passive system performance is inadequate. SURTASS, the passive part of the system, uses hydrophones (*i.e.,* underwater microphones) to detect sound emitted or reflected from submerged targets, such as submarines. The SURTASS hydrophones are mounted on a horizontal line array that is towed behind the surveillance vessel. The Navy processes and evaluates the returning signals or echoes, which are usually below background or ambient sound level, to identify and classify potential underwater targets.

LFA Active Component—The active component of the SURTASS LFA sonar system consists of up to 18 projectors suspended beneath the surveillance vessel in a vertical line array. The SURTASS LFA sonar projectors transmit in the low-frequency band (between 100 and 500 Hz). The source level of an individual projector in the SURTASS LFA sonar array is approximately 215 dB re: 1 µPa at 1 m or less. Sound pressure is the sound force per unit area and is usually measured in micropascals (µPa), where one Pascal (Pa) is the pressure resulting from a force of one newton exerted over an area of one square meter. The commonly used reference pressure level in underwater acoustics is 1 µPa at 1 m, and the units for source level are decibels (dB) re: 1 µPa at 1 m). Because of the physics involved in acoustic beamforming (*i.e.,* a method of mapping noise sources by differentiating sound levels based upon the direction from which they originate) and sound transmission loss processes, the SURTASS LFA sonar array cannot have a SPL higher than the SPL of an individual projector.

The SURTASS LFA sonar acoustic transmission is an omnidirectional beam (a full 360 degrees (°)) in the horizontal plane. The LFA sonar system also has a narrow vertical beam that the vessel's crew can steer above or below the horizontal plane. The typical SURTASS LFA sonar signal is not a constant tone, but rather is a transmission of various signal types that vary in frequency and duration (including continuous wave (CW) and frequency-modulated (FM) signals). A complete sequence of sound transmissions, also referred to by the Navy as a ''ping'' or a wavetrain, can be as short as six seconds (sec) or last as long as 100 sec, with an average length of 60 sec. Within each ping, the duration of any continuous frequency sound transmission is no longer than 10 sec and the time between pings is typically from six to 15 minutes (min). Based on the Navy's historical operating parameters, the average duty cycle (*i.e.,* the ratio of sound ''on'' time to total time) for LFA sonar is normally 7.5 to 10 percent and will not exceed a maximum duty cycle of 20 percent.

Compact LFA Active Component—In addition to the LFA sonar system currently deployed on the USNS IMPECCABLE, the Navy developed a compact LFA (CLFA) sonar system, which is now deployed on its three smaller surveillance vessels (*i.e.,* the USNS ABLE, EFFECTIVE, and VICTORIOUS). The operational characteristics of the active component for CLFA sonar are comparable to the LFA system and the potential impacts from CLFA will be similar to the effects from the LFA sonar system. The CLFA sonar system consists of smaller projectors that weigh 142,000 lbs (64,410 kilograms (kg)), which is 182,000 lbs (82,554 kg) less than the weight of the LFA projectors on the USNS IMPECCABLE. The CLFA sonar system also consists of up to 18 projectors suspended beneath the surveillance vessel in a vertical line array and the CLFA sonar projectors transmit in the low-frequency band (also between 100 and 500 Hz) with the same duty cycle as described for LFA sonar. Similar to the active component of the LFA sonar system, the source level of an individual projector in the CLFA sonar array is approximately 215 dB re: 1 µPa or less.

For the analysis in this rulemaking, NMFS will use the term LFA to refer to both the LFA sonar system and/or the CLFA sonar system, unless otherwise specified.

SURTASS Passive Component—The passive component of the SURTASS LFA sonar system consists of a SURTASS Twin-line (TL–29A) horizontal line array mounted with hydrophones. The Y-shaped array is 1,000 ft (305 m) in length and has an operational depth of 500 to 1,500 ft (152.4 to 457.2 m).

High-Frequency Marine Mammal Monitoring Active Sonar (HF/M3)—Although technically not part of the SURTASS LFA sonar system, the Navy also proposes to use a high-frequency sonar system, called the HF/M3 sonar, to detect and locate marine mammals within the SURTASS LFA sonar mitigation and buffer zones, as described later in this proposed rule. This enhanced commercial fish-finding sonar, mounted at the top of the SURTASS LFA sonar vertical line array, has a source level of 220 dB re: 1 µPa at 1 m with a frequency range from 30 to 40 kilohertz (kHz). The duty cycle is variable, but is normally below three to four percent and the maximum pulse duration is 40 milliseconds. The HF/M3 sonar has four transducers with 8° horizontal and 10° vertical beamwidths, which sweep a full 360° in the horizontal plane every 45 to 60 sec with a maximum range of approximately 1.2 mi (2 km).

Vessel Specifications—The Navy currently deploys SURTASS LFA sonar on four twin-hulled ocean surveillance vessels that are 235 to 282 ft (72 to 86 m) in length, with twin-shafted diesel electric engines capable of providing 3,200 to 5,000 horsepower. Each vessel has an observation area on the bridge that is more than 30 ft above sea level from where lookouts will monitor for marine mammals whenever SURTASS LFA sonar is transmitting. As stated previously, the Navy may develop and field additional SURTASS LFA equipped vessels, either to replace or complement the Navy's current SURTASS LFA capable fleet, and these vessels may be in use beginning in the fifth year of the time period covered by this proposed rulemaking.

The operational speed of each vessel during sonar activities will be approximately 3.4 miles per hour (mph) (5.6 km per hour (km/hr); 3 knots (kt)) and each vessel's cruising speed outside of sonar activities would be a maximum of approximately 11.5 to 14.9 mph (18.5 to 24.1 km/hr; 10 to 13 kts). During sonar activities, the SURTASS LFA sonar vessels will generally travel in straight lines or in oval-shaped (*i.e.,* racetrack) patterns depending on the training or testing scenario.

Notice of Receipt Comments and Responses

On July 13, 2018, NMFS published a notice of receipt (NOR) of an application for rulemaking in the **Federal Register** (83 FR 32615) and invited comments and information from the interested public. During the 30-day comment period, which ended on August 13, 2018, NMFS received one comment from a private individual. This comment requested NMFS deny the request to authorize the incidental take of marine mammals and stop the Navy from performing SURTASS LFA sonar training and testing activities, citing concern for assault and mortality of marine mammals. As described below, no mortality of marine mammals is anticipated to occur due to SURTASS LFA sonar activities. Therefore, the Navy has not requested and NMFS is not proposing to authorize any mortality of marine mammals. In addition, no injury (Level A harassment) is anticipated as a result of the SURTASS LFA sonar training and testing activities, so Navy has not requested nor has NMFS proposed authorizing takes due to Level A harassment. Therefore, the incidental take of marine mammals associated with the proposed SURTASS LFA sonar activities would be limited to behavioral effects (Level B harassment).

Description of Marine Mammals in the Area of the Specified Activities

Forty-six species of marine mammals, including 10 baleen whale (mysticete); 31 toothed whale (odontocete); and 5 seal/sea lion (pinniped) species that represent 139 stocks (as currently classified) have confirmed or possible occurrence within potential SURTASS LFA sonar activity areas in the central and western North Pacific Ocean and eastern Indian Ocean. Multiple stocks of some species are affected, and independent assessments are conducted to make the necessary findings and determinations for each of these.

There are 11 marine mammal species under NMFS' jurisdiction listed as endangered or threatened under the Endangered Species Act (ESA; 16 U.S.C. 1531 *et seq.*) with confirmed or possible occurrence in the study area for SURTASS LFA sonar training and testing activities. Marine mammal species under NMFS' jurisdiction in the study area listed as endangered are: North Pacific right whale (*Eubalaena japonica*); gray whale (*Eschrichtius robustus*); blue whale (*Balaenoptera musculus*); fin whale (*Balaenoptera physalus*); Western North Pacific distinct population segment (DPS) of humpback whale (*Megaptera novaeangliae*); sei whale (*Balaenoptera borealis*); sperm whale (*Physeter macrocephalus*); Main Hawaiian Islands Insular DPS of false killer whale (*Pseudorca crassidens*); Western DPS of the Steller sea lion (*Eumetopias jubatus*); and Hawaiian monk seal (*Neomonachus schauinslandi*). The southern DPS of the spotted seal (*Phoca largha*) is listed as threatened under the ESA and is within the study area for SURTASS LFA sonar activities. The aforementioned threatened and endangered marine mammal species also are depleted under the MMPA.

Chinese river dolphins (*Lipotes vexillifer*) do not have stocks designated within the SURTASS LFA sonar study area (see Potential SURTASS LFA Study Area section). The distribution of the Chinese river dolphin is limited to the main channel of a river section between the cities of Jingzhou and Jiangyin. Based on the extremely rare occurrence of these species in the Navy's Study Area and due to the coastal standoff range (*i.e.,* distance of 22 km (13 mi; 12 nmi) from land), take of Chinese river dolphins is not considered a reasonable likelihood; therefore, this species is not addressed further in this document. Similarly, the Taiwanese humpback dolphin, a subspecies of the Indo-Pacific humpback dolphin, is found only in a small, narrow stretch of estuarine waters off the western coast of Taiwan. Take of this species is also not considered a reasonable likelihood and this species is not addressed further in this document.

None of the marine mammal species which the U.S. Fish and Wildlife Service (USFWS) is responsible for managing occur in geographic areas that would overlap with the SURTASS LFA sonar Study Area. Therefore, the Navy has determined that SURTASS LFA sonar activities would have no effect on the endangered or threatened species or the critical habitat of the ESA-listed species under the jurisdiction of the USFWS. These species are not considered further in this notice.

To accurately assess the potential effects of SURTASS LFA sonar activities, the Navy modeled 15 representative sites in the SURTASS LFA sonar activity area. Tables 2 through 16 (below) summarize the abundance, status under the ESA, and density estimates of the marine mammal species and stocks that have confirmed or possible occurrence within the 15 SURTASS LFA sonar modeling areas in the central and western North Pacific Ocean and eastern Indian Ocean.

TABLE 2—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MODEL AREA 1, THE EAST OF JAPAN

Species	Stock name [1]	Stock abundance [2]	Density (animals/km²) [3]				ESA status [4]
			Winter	Spring	Summer	Fall	
Blue whale	WNP	9,250	0.00001	0.00001		0.00001	EN
Bryde's whale	WNP	20,501	0.0006	0.0006	0.0006	0.0006	NL
Common minke whale	WNP "OE"	25,049	0.0022	0.0022	0.0022	0.0022	NL
Fin whale	WNP	9,250			0.0002	0.0002	EN
Humpback whale	WNP stock and DPS	1,328			0.00036	0.00036	EN
North Pacific right whale	WNP	922	0.00001	0.00001			EN
Sei whale	NP	7,000	0.0006	0.0006	0.0006	0.0006	EN
Baird's beaked whale	WNP	5,688			0.0029	0.0029	NL
Common dolphin	WNP	3,286,163	0.0761	0.0761	0.0761	0.0761	NL
Common bottlenose dolphin	WNP Northern Offshore	100,281	0.0171	0.0171	0.0171	0.0171	NL
Cuvier's beaked whale	WNP	90,725	0.0031	0.0031	0.0031	0.0031	NL
Dall's porpoise (*truei*)	WNP *truei*	178,157	0.0390	0.0520		0.0520	NL
False killer whale	WNP	16,668	0.0036	0.0036	0.0036	0.0036	NL
Ginkgo-toothed beaked whale	NP	22,799	0.0005	0.0005	0.0005	0.0005	NL
Harbor porpoise	WNP	31,046	0.0190	0.0190	0.0190	0.0190	NL
Hubbs beaked whale	NP	22,799	0.0005	0.0005	0.0005	0.0005	NL
Killer whale	WNP	12,256	0.0001	0.0001	0.0001	0.0001	NL
Kogia spp. [5]	WNP	350,553	0.0031	0.0031	0.0031	0.0031	NL
Pacific white-sided dolphin	NP	931,000	0.0082	0.0082	0.0082	0.0082	NL
Pantropical spotted dolphin	WNP	130,002			0.0259	0.0259	NL
Pygmy killer whale	WNP	30,214	0.0021	0.0021	0.0021	0.0021	NL
Risso's dolphin	WNP	143,374	0.0097	0.0097	0.0097	0.0097	NL
Rough-toothed dolphin	WNP	5,002	0.00224	0.00224	0.00224	0.00224	NL
Short-finned pilot whale	WNP Northern	20,884	0.0128	0.0128	0.0128	0.0128	NL
Sperm whale	NP	102,112	0.00123	0.00123	0.00123	0.00123	EN
Spinner dolphin	WNP	1,015,059			0.00083	0.00083	NL
Stejneger's beaked whale	WNP	8,000	0.0005	0.0005	0.0005	0.0005	NL
Striped dolphin	WNP Northern Offshore	497,725	0.0111	0.0111	0.0111	0.0111	NL
Northern fur seal	WP	503,609	0.368	0.158			

[1] NP=north Pacific; OE=Offshore Japan; WP=western Pacific; WNP=western north Pacific.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table. No value for density indicates that species is not expected to occur in the model area during that season.
[4] ESA Status: EN=Endangered; T=Threatened; NL=Not Listed.
[5] Pygmy and dwarf sperm whales are difficult to distinguish at sea, and abundance estimates are pooled for *Kogia* spp. as reported in Ferguson and Barlow, 2001 and 2003.

TABLE 3—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MODEL AREA 2, NORTH PHILIPPINE SEA

Species	Stock name [1]	Abundance [2]	Density (animals/km²) [3]				ESA status [4]
			Winter	Spring	Summer	Fall	
Blue whale	WNP	9,250	0.00001	0.00001		0.00001	EN
Bryde's whale	WNP	20,501	0.0006	0.0006	0.0006	0.0006	NL
Common minke whale	WNP "OE"	25,049	0.0044	0.0044	0.0044	0.0044	NL
Fin whale	WNP	9,250	0.0002	0.0002			EN
Humpback whale	WNP and DPS	1,328	0.00089	0.00089		.00089	EN
North Pacific right whale	WNP	922	0.00001	0.00001			EN
Omura's whale	WNP	1,800	0.00004	0.00004	0.00004	0.00004	NL
Blainville's beaked whale	WNP	8,032	0.0005	0.0005	0.0005	0.0005	NL
Common dolphin	WNP	3,286,163	0.0562	0.0562	0.0562	0.0562	NL
Common bottlenose dolphin	Japanese Coastal	3,516	0.0146	0.0146	0.0146	0.0146	NL
Cuvier's beaked whale	WNP	90,725	0.0054	0.0054	0.0054	0.0054	NL
False killer whale	WNP	16,668	0.0029	0.0029	0.0029	0.0029	NL
Fraser's dolphin	WNP	220,789	0.0069	0.0069	0.0069	0.0069	NL
Ginkgo-toothed beaked whale	NP	22,799	0.0005	0.0005	0.0005	0.0005	NL
Killer whale	WNP	12,256	0.00009	0.00009	0.00009	0.00009	NL
Kogia spp. [5]	WNP	350,553	0.0031	0.0031	0.0031	0.0031	NL
Longman's beaked whale	WNP	7,619	0.00025	0.00025	0.00025	0.00025	NL
Melon-headed whale	WNP	56,213	0.00428	0.00428	0.00428	0.00428	NL
Pacific white-sided dolphin	NP	931,000	0.0119	0.0119			NL
Pantropical spotted dolphin	WNP	130,002	0.0137	0.0137	0.0137	0.0137	NL
Pygmy killer whale	WNP	30,214	0.0021	0.0021	0.0021	0.0021	NL
Risso's dolphin	WNP	143,374	0.0106	0.0106	0.0106	0.0106	NL
Rough-toothed dolphin	WNP	5,002	0.00224	0.00224	0.00224	0.00224	NL
Short-finned pilot whale	WNP Southern	31,396	0.0153	0.0153	0.0153	0.0153	NL
Sperm whale	NP	102,112	0.00123	0.00123	0.00123	0.00123	EN
Spinner dolphin	WNP	1,015,059	0.00083	0.00083	0.00083	0.00083	NL
Striped dolphin	Japanese Coastal	19,631	0.0329	0.0329	0.0329	0.0329	NL

[1] NP=north Pacific; OE=Offshore Japan; WNP=western north Pacific.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table. No value for density indicates that species is not expected to occur in the mission area during that season.
[4] ESA Status: EN=Endangered; T=Threatened; NL=Not Listed.

[5] Pygmy and dwarf sperm whales are difficult to distinguish at sea, and abundance estimates are pooled for *Kogia* spp. as reported in Ferguson and Barlow, 2001 and 2003.

TABLE 4—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MODEL AREA 3, WEST PHILIPPINE SEA

Species	Stock name [1]	Abundance [2]	Density (animals/km^2) [3]				ESA status [4]
			Winter	Spring	Summer	Fall	
Blue whale	WNP	9,250	0.00001	0.00001		0.00001	EN
Bryde's whale	WNP	20,501	0.0006	0.0006	0.0006	0.0006	NL
Common minke whale	WNP "OE"	25,049	0.0033	0.0033	0.0033	0.0033	NL
Fin whale	WNP	9,250	0.0002	0.0002			EN
Humpback whale	WNP and DPS	1,328	0.00089	0.00089		0.00089	EN
Omura's whale	WNP	1,800	0.00004	0.00004	0.00004	0.00004	NL
Blainville's beaked whale	WNP	8,032	0.0005	0.0005	0.0005	0.0005	NL
Common dolphin	WNP	3,286,163	0.1158	0.1158	0.1158	0.1158	NL
Common bottlenose dolphin	WNP Southern Offshore	40,769	0.0146	0.0146	0.0146	0.0146	NL
Cuvier's beaked whale	WNP	90,725	0.0003	0.0003	0.0003	0.0003	NL
Deraniyagala's beaked whale	NP	22,799	0.0005	0.0005	0.0005	0.0005	NL
False killer whale	WNP	16,668	0.0029	0.0029	0.0029	0.0029	NL
Fraser's dolphin	WNP	220,789	0.0069	0.0069	0.0069	0.0069	NL
Ginkgo-toothed beaked whale	NP	22,799	0.0005	0.0005	0.0005	0.0005	NL
Killer whale	WNP	12,256	0.00009	0.00009	0.00009	0.00009	NL
Kogia spp. [5]	WNP	350,553	0.0017	0.0017	0.0017	0.0017	*
Longman's beaked whale	WNP	7,619	0.00025	0.00025	0.00025	0.00025	NL
Melon-headed whale	WNP	56,213	0.00428	0.00428	0.00428	0.00428	NL
Pantropical spotted dolphin	WNP	130,002	0.0137	0.0137	0.0137	0.0137	NL
Pygmy killer whale	WNP	30,214	0.0021	0.0021	0.0021	0.0021	NL
Risso's dolphin	WNP	143,374	0.0106	0.0106	0.0106	0.0106	NL
Rough-toothed dolphin	WNP	5,002	0.00224	0.00224	0.00224	0.00224	NL
Short-finned pilot whale	WNP Southern	31,396	0.0076	0.0076	0.0076	0.0076	NL
Sperm whale	NP	102,112	0.00123	0.00123	0.00123	0.00123	EN
Spinner dolphin	WNP	1,015,059	0.00083	0.00083	0.00083	0.00083	NL
Striped dolphin	WNP Southern Offshore	52,682	0.0164	0.0164	0.0164	0.0164	NL

[1] NP=north Pacific; OE=Offshore Japan; WNP=western north Pacific.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table. No value for density indicates that species is not expected to occur in the model area during that season.
[4] ESA Status: EN=Endangered; T=Threatened; NL=Not Listed.
[5] Pygmy and dwarf sperm whales are difficult to distinguish at sea, and abundance estimates are pooled for *Kogia* spp. as reported in Ferguson and Barlow, 2001 and 2003.

TABLE 5—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MODEL AREA 4, OFFSHORE GUAM

Species	Stock name [1]	Abundance [2]	Density (animals/km^2) [3]				ESA status [4]
			Winter	Spring	Summer	Fall	
Blue whale	WNP	9,250	0.00001	0.00001		0.00001	EN
Bryde's whale	WNP	20,501	0.0004	0.0004	0.0004	0.0004	NL
Common minke whale	WNP "OE"	25,049	0.00015	0.00015	0.00015	0.00015	NL
Fin whale	WNP	9,250	0.00001	0.00001		0.00001	EN
Humpback whale	WNP and DPS	1,328	0.00089	0.00089		0.00089	EN
Omura's whale	WNP	1,800	0.00004	0.00004	0.00004	0.00004	NL
Sei whale	NP	7,000	0.00029	0.00029		0.00029	EN
Blainville's beaked whale	WNP	8,032	0.00086	0.00086	0.00086	0.00086	NL
Common bottlenose dolphin	WNP Southern Offshore	40,769	0.00899	0.00899	0.00899	0.00899	NL
Cuvier's beaked whale	WNP	90,725	0.0003	0.0003	0.0003	0.0003	NL
Deraniyagala's beaked whale	NP	22,799	0.00093	0.00093	0.00093	0.00093	NL
Dwarf sperm whale	WNP	350,553	0.00714	0.00714	0.00714	0.00714	NL
False killer whale	WNP	16,668	0.00111	0.00111	0.00111	0.00111	NL
Fraser's dolphin	CNP	16,992	0.02104	0.02104	0.02104	0.02104	NL
Ginkgo-toothed beaked whale	NP	22,799	0.00093	0.00093	0.00093	0.00093	NL
Killer whale	WNP	12,256	0.00006	0.00006	0.00006	0.00006	NL
Longman's beaked whale	WNP	7,619	0.00311	0.00311	0.00311	0.00311	NL
Melon-headed whale	WNP	56,213	0.00428	0.00428	0.00428	0.00428	NL
Pantropical spotted dolphin	WNP	130,002	0.0226	0.0226	0.0226	0.0226	NL
Pygmy killer whale	WNP	30,214	0.00014	0.00014	0.00014	0.00014	NL
Pygmy sperm whale	WNP	350,553	0.00291	0.00291	0.00291	0.00291	NL
Risso's dolphin	WNP	143,374	0.00474	0.00474	0.00474	0.00474	NL
Rough-toothed dolphin	WNP	5,002	0.00185	0.00185	0.00185	0.00185	NL
Short-finned pilot whale	WNP Southern	31,396	0.00797	0.00797	0.00797	0.00797	NL
Sperm whale	NP	102,112	0.00123	0.00123	0.00123	0.00123	EN
Spinner dolphin	WNP	1,015,059	0.00083	0.00083	0.00083	0.00083	NL
Striped dolphin	WNP Southern Offshore	52,682	0.00616	0.00616	0.00616	0.00616	NL

[1] CNP=central north Pacific; NP=north Pacific; OE=Offshore Japan; WNP=western north Pacific.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table. No value for density indicates that species is not expected to occur in the mission area during that season.
[4] ESA Status: EN=Endangered; T=Threatened; NL=Not Listed.

TABLE 6—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MODEL AREA 5, SEA OF JAPAN

Species	Stock name [1]	Abundance [2]	Density (animals/km²) [3]				ESA Status [4]
			Winter	Spring	Summer	Fall	
Bryde's whale	WNP	20,501	0.0001	0.0001	0.0001	0.0001	NL
Common minke whale	WNP "JW" Stock	2,611	0.00016	0.00016	0.00016	0.00016	NL
Fin whale	WNP	9,250	0.0009	0.0009		0.0009	EN
North Pacific right whale	WNP	922	0.00001	0.00001			EN
Omura's whale	WNP	1,800	0.00004	0.00004	0.00004	0.00004	NL
Western North Pacific gray whale	WNP Western DPS	140	0.00001	0.00001	0.00001	0.00001	EN [5]
Baird's beaked whale	WNP	5,688	0.0003	0.0003		0.0003	NL
Common dolphin	WNP	279,182	0.1158	0.1158	0.1158	0.1158	NL
Common bottlenose dolphin	IA	105,138	0.00077	0.00077	0.00077	0.00077	NL
Cuvier's beaked whale	WNP	90,725	0.0031	0.0031	0.0031	0.0031	NL
Dall's porpoise	SOJ *dalli*	173,638	0.0520	0.0520		0.0520	NL
False killer whale	IA	9,777	0.0027	0.0027	0.0027	0.0027	NL
Harbor porpoise	WNP	31,046	0.0190	0.0190		0.0190	NL
Killer whale	WNP	12,256	0.00009	0.00009	0.00009	0.00009	NL
Kogia spp [6]	WNP	350,553	0.0017	0.0017	0.0017	0.0017	*
Pacific white-sided dolphin	NP	931,000	0.0030	0.0030			NL
Risso's dolphin	IA	143,374	0.0073	0.0073	0.0073	0.0073	NL
Rough-toothed dolphin	WNP	5,002	0.00224	0.00224	0.00224	0.00224	NL
Sperm whale	NP	102,112	0.00123	0.00123	0.00123	0.00123	EN
Spinner dolphin	WNP	1,015,059			0.00083	0.00083	NL
Stejneger's beaked whale	WNP	8,000	0.0005	0.0005	0.0005	0.0005	NL
Northern fur seal	WP	503,609	0.368	0.158			
Spotted seal	Southern and DPS	3,500	0.00001	0.00001	0.00001	0.00001	T

[1] IA=Inshore Archipelago; JW=Sea of Japan (minke); NP=north Pacific; SOJ=Sea of Japan; WNP=western north Pacific.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table. No value for density indicates that species is not expected to occur in the model area during that season.
[4] ESA Status: EN=Endangered; T=Threatened; NL=Not Listed.
[5] Only the western Pacific population of gray whale is endangered under the ESA.
[6] Pygmy and dwarf sperm whales are difficult to distinguish at sea, and abundance estimates are pooled for *Kogia* spp as reported in Ferguson and Barlow, 2001 and 2003.

TABLE 7—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MODEL AREA 6, EAST CHINA SEA

Species	Stock name [1]	Abundance [2]	Density (animals/km²) [3]				ESA status [4]
			Winter	Spring	Summer	Fall	
Bryde's whale	ECS	137	0.0003	0.0003	0.0003	0.0003	NL
Common minke whale	YS	4,492	0.0018	0.0018	0.0018	0.0018	NL
Fin whale	ECS	500	0.0002	0.0002	0.0002	0.0002	EN
North Pacific right whale	WNP	922	0.00001	0.00001			EN
Omura's whale	WNP	1,800	0.00004	0.00004	0.00004	0.00004	NL
Western North Pacific gray whale	WNP and Western DPS	140	0.00001	0.00001		0.00001	EN [5]
Blainville's beaked whale	WNP	8,032	0.0005	0.0005	0.0005	0.0005	NL
Common dolphin	WNP	279,182	0.1158	0.1158	0.1158	0.1158	NL
Common bottlenose dolphin	IA	105,138	0.00077	0.00077	0.00077	0.00077	NL
Cuvier's beaked whale	WNP	90,725	0.0003	0.0003	0.0003	0.0003	NL
False killer whale	IA	9,777	0.00111	0.00111	0.00111	0.00111	NL
Fraser's dolphin	WNP	220,789	0.00694	0.00694	0.00694	0.00694	NL
Ginkgo-toothed beaked whale	NP	22,799	0.0005	0.0005	0.0005	0.0005	NL
Killer whale	WNP	12,256	0.00009	0.00009	0.00009	0.00009	NL
Kogia spp [6]	WNP	350,553	0.0017	0.0017	0.0017	0.0017	*
Longman's beaked whale	WNP	7,619	0.00025	0.00025	0.00025	0.00025	NL
Melon-headed whale	WNP	56,213	0.00428	0.00428	0.00428	0.00428	NL
Pacific white-sided dolphin	NP	931,000	0.0028	0.0028			NL
Pantropical spotted dolphin	WNP	130,002	0.01374	0.01374	0.01374	0.01374	NL
Pygmy killer whale	WNP	30,214	0.00014	0.00014	0.00014	0.00014	NL
Risso's dolphin	IA	143,374	0.0106	0.0106	0.0106	0.0106	NL
Rough-toothed dolphin	WNP	5,002	0.00224	0.00224	0.00224	0.00224	NL
Sperm whale	NP	102,112	0.00123	0.00123	0.00123	0.00123	EN
Spinner dolphin	WNP	1,015,059	0.00083	0.00083	0.00083	0.00083	NL
Spotted seal	Southern and DPS	1,000	0.00001	0.00001	0.00001	0.00001	T

[1] ECS=East China Sea; IA=Inshore Archipelago; NP=north Pacific; WNP=western north Pacific; YS=Yellow Sea.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table. No value for density indicates that species is not expected to occur in the mission area during that season.
[4] ESA Status: EN=Endangered; T=Threatened; NL=Not Listed.
[5] Only the western Pacific population of gray whale is endangered under the ESA.
[6] Pygmy and dwarf sperm whales are difficult to distinguish at sea, and abundance estimates are pooled for *Kogia* spp. as reported in Ferguson and Barlow, 2001 and 2003.

TABLE 8—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MODEL AREA 7, SOUTH CHINA SEA

Species	Stock name [1]	Abundance [2]	Density (animals/km²) [3]				ESA status [4]
			Winter	Springer	Summer	Fall	
Bryde's whale	WNP	20,501	0.0006	0.0006	0.0006	0.0006	NL
Common minke whale	YS	4,492	0.0018	0.0018	0.0018	0.0018	NL
Fin whale	WNP	9,250	0.0002	0.0002		0.0002	EN
Humpback whale	WNP and DPS	1,328	0.00036	0.00036		0.00036	EN
North Pacific right whale	WNP	922	0.00001	0.00001			EN
Omura's whale	WNP	1,800	0. 00004	0. 00004	0. 00004	0. 00004	NL
Western North Pacific gray whale	WNP and Western DPS	140	0.00001	0.00001		0.00001	EN [5]
Blainville's beaked whale	WNP	8,032	0.0005	0.0005	0.0005	0.0005	NL
Common dolphin	WNP	279,182	0.1158	0.1158	0.1158	0.1158	NL
Common bottlenose dolphin	IA	105,138	0.00077	0.00077	0.00077	0.00077	NL
Cuvier's beaked whale	WNP	90,725	0.0003	0.0003	0.0003	0.0003	NL
Deraniyagala's beaked whale	NP	22,799	0.0005	0.0005	0.0005	0.0005	NL
False killer whale	IA	9,777	0.00111	0.00111	0.00111	0.00111	NL
Fraser's dolphin	WNP	220,789	0.00694	0.00694	0.00694	0.00694	NL
Ginkgo-toothed beaked whale	NP	22,799	0.0005	0.0005	0.0005	0.0005	NL
Killer whale	WNP	12,256	0.00009	0.00009	0.00009	0.00009	NL
Kogia spp [6]	WNP	350,553	0.0017	0.0017	0.0017	0.0017	*
Longman's beaked whale	WNP	7,619	0.00025	0.00025	0.00025	0.00025	NL
Melon-headed whale	WNP	56,213	0.00428	0.00428	0.00428	0.00428	NL
Pantropical spotted dolphin	WNP	130,002	0.01374	0.01374	0.01374	0.01374	NL
Pygmy killer whale	WNP	30,214	0.00014	0.00014	0.00014	0.00014	NL
Risso's dolphin	IA	143,374	0.0106	0.0106	0.0106	0.0106	NL
Rough-toothed dolphin	WNP	5,002	0.00224	0.00224	0.00224	0.00224	NL
Short-finned pilot whale	WNP Southern	31,396	0.00159	0.00159	0.00159	0.00159	NL
Sperm whale	NP	102,112	0.0012	0.0012	0.0012	0.0012	EN
Spinner dolphin	WNP	1,015,059	0.00083	0.00083	0.00083	0.00083	NL
Striped dolphin	WNP Southern Offshore	52,682	0.00584	0.00584	0.00584	0.00584	NL

[1] IA=Inshore Archipelago; NP=north Pacific; WNP=western north Pacific; YS=Yellow Sea.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table. No value for density indicates that species is not expected to occur in the model area during that season.
[4] ESA Status: EN=Endangered; T=Threatened; NL=Not Listed.
[5] Only the western Pacific population of gray whale is endangered under the ESA.
[6] Pygmy and dwarf sperm whales are difficult to distinguish at sea, and abundance estimates are pooled for *Kogia* spp. as reported in Ferguson and Barlow, 2001 and 2003.

TABLE 9—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MODEL AREA 8, OFFSHORE JAPAN 25° TO 40° N

Species	Stock name [1]	Abundance [2]	Density (animals/km²) [3]				ESA status [4]
			Winter	Spring	Summer	Fall	
Blue whale	WNP	9,250	0.00001	0.00001		0.00001	EN
Bryde's whale	WNP	20,501	0.0003	0.0003	0.0003	0.0003	NL
Common minke whale	WNP "OE"	25,049	0.0003	0.0003	0.0003	0.0003	NL
Fin whale	WNP	9,250			0.0001	0.0001	EN
Humpback whale	WNP and DPS	1,328			0.00036	0.00036	EN
Sei whale	NP	7,000		0.00029	0.00029	0.00029	EN
Baird's beaked whale	WNP	5,688	0.0001	0.0001	0.0001	0.0001	NL
Blainville's beaked whale	WNP	8,032	0.0007	0.0007	0.0007	0.0007	NL
Common dolphin	WNP	3,286,163	0.0863	0.0863	0.0863	0.0863	NL
Common bottlenose dolphin	WNP Northern Offshore	100,281	0.00077	0.00077	0.00077	0.00077	NL
Cuvier's beaked whale	WNP	90,725	0.00374	0.00374	0.00374	0.00374	NL
Dall's porpoise	WNP *dalli*	162,000	0.0390	0.0520		0.0520	
Dwarf sperm whale	WNP	350,553	0.0043	0.0043	0.0043	0.0043	NL
False killer whale	WNP	16,668	0.0036	0.0036	0.0036	0.0036	NL
Hubb's beaked whale	NP	22,799	0.0005	0.0005	0.0005	0.0005	NL
Killer whale	WNP	12,256	0.00009	0.00009	0.00009	0.00009	NL
Longman's beaked whale	WNP	7,619	0.00025	0.00025	0.00025	0.00025	NL
Melon-headed whale	WNP	56,213	0.0027	0.0027	0.0027	0.0027	NL
Mesoplodon spp [5]	WNP	22,799	0.0005	0.0005	0.0005	0.0005	NL
Northern right whale dolphin	NP	68,000	0.00001	0.00001		0.00001	NL
Pacific white-sided dolphin	NP	931,000	0.0048	0.0048	0.0048	0.0048	NL
Pantropical spotted dolphin	WNP	130,002	0.0113	0.0113	0.0113	0.0113	NL
Pygmy killer whale	WNP	30,214	0.0001	0.0001	0.0001	0.0001	NL
Pygmy sperm whale	WNP	350,553	0.0018	0.0018	0.0018	0.0018	NL
Risso's dolphin	WNP	143,374	0.0005	0.0005	0.0005	0.0005	NL
Rough-toothed dolphin	WNP	5,002	0.0019	0.0019	0.0019	0.0019	NL
Short-finned pilot whale	WNP Northern	20,884	0.0021	0.0021	0.0021	0.0021	NL
Sperm whale	NP	102,112	0.0022	0.0022	0.0022	0.0022	EN
Spinner dolphin	WNP	1,015,059	0.0019	0.0019	0.0019	0.0019	NL
Stejneger's beaked whale	WNP	8,000	0.0005	0.0005	0.0005	0.0005	NL
Striped dolphin	WNP Northern Offshore	497,725	0.0058	0.0058	0.0058	0.0058	NL
Hawaiian monk seal	Hawaii	1,427	0.00001	0.00001	0.00001	0.00001	EN

TABLE 9—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MODEL AREA 8, OFFSHORE JAPAN 25° TO 40° N—Continued

Species	Stock name [1]	Abundance [2]	Density (animals/km²) [3]				ESA status [4]
			Winter	Spring	Summer	Fall	
Northern fur seal	WP	503,609	0.0123				NL

[1] NP=north Pacific; OE=Offshore Japan; WNP=western north Pacific; WP=Western Pacific.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table. No value for density indicates that species is not expected to occur in the mission area during that season.
[4] ESA Status: EN=Endangered; T=Threatened; NL=Not Listed.
[5] No methods are available to distinguish between the species of *Mesoplodon* beaked whales in the WNP stocks (Blainville's beaked whale (*M. densirostris*), Perrin's beaked whale (*M. perrini*), Lesser beaked whale (*M. peruvianus*), Stejneger's beaked whale (*M. stejnegeri*), Gingko-toothed beaked whale (*M. gingkodens*), and Hubbs' beaked whale (*M. carlhubbsi*)) when observed during at-sea surveys (Carretta *et al.,* 2018). As reported in Ferguson and Barlow, 2001 and 2003, data on these species were pooled. These six species are managed as one unit.

TABLE 10—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MODEL AREA 9, OFFSHORE JAPAN 10° TO 25° N

Species	Stock name [1]	Abundance [2]	Density (animals/km²) [3]				ESA status [4]
			Winter	Spring	Summer	Fall	
Blue whale	WNP	9,250	0.00001	0.00001		0.00001	EN
Bryde's whale	WNP	20,501	0.0003	0.0003	0.0003	0.0003	NL
Fin whale	WNP	9,250	0.00001	0.00001			EN
Humpback whale	WNP and DPS	1,328	0.00036	0.00036		0.00036	EN
Omura's whale	WNP	1,800	0.00004	0.00004	0.00004	0.00004	NL
Sei whale	NP	7,000	0.0029			0.0029	EN
Blainville's beaked whale	WNP	8,032	0.0007	0.0007	0.0007	0.0007	NL
Common bottlenose dolphin	WNP Southern Offshore	40,769	0.00077	0.00077	0.00077	0.00077	NL
Cuvier's beaked whale	WNP	90,725	0.00374	0.00374	0.00374	0.00374	NL
Deraniyagala's beaked whale	NP	22,799	0.00093	0.00093	0.00093	0.00093	NL
Dwarf sperm whale	WNP	350,553	0.0043	0.0043	0.0043	0.0043	NL
False killer whale	WNP	16,668	0.00057	0.00057	0.00057	0.00057	NL
Fraser's dolphin	CNP	16,992	0.00251	0.00251	0.00251	0.00251	NL
Ginkgo-toothed beaked whale	NP	22,799	0.00093	0.00093	0.00093	0.00093	NL
Killer whale	WNP	12,256	0.00009	0.00009	0.00009	0.00009	NL
Longman's beaked whale	WNP	7,619	0.00025	0.00025	0.00025	0.00025	NL
Melon-headed whale	WNP	56,213	0.00267	0.00267	0.00267	0.00267	NL
Pantropical spotted dolphin	WNP	130,002	0.01132	0.01132	0.01132	0.01132	NL
Pygmy killer whale	WNP	30,214	0.00006	0.00006	0.00006	0.00006	NL
Pygmy sperm whale	WNP	350,553	0.00176	0.00176	0.00176	0.00176	NL
Risso's dolphin	WNP	143,374	0.00046	0.00046	0.00046	0.00046	NL
Rough-toothed dolphin	WNP	5,002	0.00185	0.00185	0.00185	0.00185	NL
Short-finned pilot whale	WNP Southern	31,396	0.00211	0.00211	0.00211	0.00211	NL
Sperm whale	NP	102,112	0.00222	0.00222	0.00222	0.00222	EN
Spinner dolphin	WNP	1,015,059	0.00187	0.00187	0.00187	0.00187	NL
Striped dolphin	WNP Southern Offshore	52,682	0.00584	0.00584	0.00584	0.00584	NL

[1] NP=north Pacific; CNP=central north Pacific; WNP=western north Pacific.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table. No value for density indicates that species is not expected to occur in the model area during that season.
[4] ESA Status: EN=Endangered; T=Threatened; NL=Not Listed.

TABLE 11—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MODEL AREA 10, NORTHERN HAWAII

Species	Stock name [1]	Abundance [2]	Density (animals/km²) [3]				ESA status [4]
			Winter	Spring	Summer	Fall	
Blue whale	CNP	133	0.00005	0.00005		0.00005	EN
Bryde's whale	Hawaii	1,751	0.000085	0.000085	0.000085	0.000085	NL
Common minke whale	Hawaii	25,049	0.00423	0.00423		0.00423	NL
Fin whale	Hawaii	154	0.00006	0.00006		0.00006	EN
Humpback whale	CNP and Hawaii DPS	10,103	0.00529	0.00529		0.00529	NL
Sei whale	Hawaii	391	0.00016	0.00016		0.00016	EN
Blainville's beaked whale	Hawaii	2,105	0.00086	0.00086	0.00086	0.00086	NL
Common bottlenose dolphin	Hawaii pelagic	21,815	0.00118	0.00118	0.00118	0.00118	NL
	Kauai/Niihau	184	0.065	0.065	0.065	0.065	NL
	4 Islands	191	0.017	0.017	0.017	0.017	NL
	Oahu	743	0.187	0.187	0.187	0.187	NL
	Hawaii Island	128	0.028	0.028	0.028	0.028	NL
Cuvier's beaked whale	Hawaii	723	0.0003	0.0003	0.0003	0.0003	NL
Dwarf sperm whale	Hawaii	17,519	0.00714	0.00714	0.00714	0.00714	NL
False killer whale	Hawaii-Pelagic	1,540	0.0006	0.0006	0.0006	0.0006	NL
	Main HI Islands Insular and DPS	167	0.0008	0.0008	0.0008	0.0008	EN
	NW HI Islands	617	0.0006	0.0006	0.0006	0.0006	NL
Fraser's dolphin	Hawaii	51,491	0.02104	0.02104	0.02104	0.02104	NL

TABLE 11—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MODEL AREA 10, NORTHERN HAWAII—Continued

Species	Stock name [1]	Abundance [2]	Density (animals/km²) [3]				ESA status [4]
			Winter	Spring	Summer	Fall	
Killer whale	Hawaii	146	0.00006	0.00006	0.00006	0.00006	NL
Longman's beaked whale	Hawaii	7,619	0.00311	0.00311	0.00311	0.00311	NL
Melon-headed whale	Hawaiian Islands	8,666	0.002	0.0020	0.0020	0.0020	NL
	Kohala Resident	447	0.1000	0.1000	0.1000	0.1000	NL
Pantropical spotted dolphin	Hawaiian Pelagic	55,795	0.00369	0.00369	0.00369	0.00369	NL
	Hawaiian Island	220	0.061	0.061	0.061	0.061	NL
	Oahu	220	0.072	0.072	0.072	0.072	NL
	4 Islands	220	0.061	0.061	0.061	0.061	NL
Pygmy killer whale	Hawaii	10,640	0.00435	0.00435	0.00435	0.00435	NL
Pygmy sperm	Hawaii	7,138	0.0029	0.0029	0.0029	0.0029	NL
Risso's dolphin	Hawaii	11,613	0.00474	0.00474	0.00474	0.00474	NL
Rough-toothed dolphin	Hawaii	72,528	0.00224	0.00224	0.00224	0.00224	NL
Short-finned pilot whale	Hawaii	19,503	0.00459	0.00459	0.00459	0.00459	NL
Sperm whale	Hawaii	4,559	0.00158	0.00158	0.00158	0.00158	EN
Spinner dolphin	Hawaii Pelagic	3,351	0.00159	0.00159	0.00159	0.00159	NL
	Kauai/Niihau	601	0.097	0.097	0.097	0.097	NL
	Hawaiian Island	631	0.066	0.066	0.066	0.066	NL
	Oahu/4 Islands	355	0.023	0.023	0.023	0.023	NL
	Kure/Midway Atoll	260	0.0070	0.0070	0.0070	0.0070	NL
	Pearl and Hermes Reef	300	0.0070	0.0070	0.0070	0.0070	NL
Striped dolphin	Hawaii	61,201	0.00385	0.00385	0.00385	0.00385	NL
Hawaiian monk seal	Hawaii	1,427	0.00004	0.00004	0.00004	0.00004	EN

[1] CNP=central north Pacific.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table. No value for density indicates that species is not expected to occur in the mission area during that season.
[4] ESA Status: EN=Endangered; T=Threatened; NL=Not Listed.

TABLE 12—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MODEL AREA 11, SOUTHERN HAWAII

Species	Stock name [1]	Abundance [2]	Density (animals/km²) [3]				ESA status [4]
			Winter	Spring	Summer	Fall	
Blue whale	CNP	133	0.00005	0.00005		0.00005	EN
Bryde's whale	Hawaii	798	0.00012	0.00012	0.00012	0.00012	NL
Common minke whale	Hawaii	25,049	0.00423	0.00423		0.00423	NL
Fin whale	Hawaii	154	0.00006	0.00006		0.00006	EN
Humpback whale	CNP/Hawaii DPS	10,103	0.00631	0.00631		0.00631	NL
Sei whale	Hawaii	391	0.00016	0.00016		0.00016	EN
Blainville's beaked whale	Hawaii	2,105	0.00086	0.00086	0.00086	0.00086	NL
Common bottlenose dolphin	Hawaii Pelagic	21,815	0.00126	0.00126	0.00126	0.00126	NL
	Oahu	743	0.187	0.187	0.187	0.187	NL
	4 Islands	191	0.017	0.017	0.017	0.017	NL
	Hawaii Island	128	0.028	0.028	0.028	0.028	NL
	Kauai/Niihau	184	0.065	0.065	0.065	0.065	NL
Cuvier's beaked whale	Hawaii	723	0.0003	0.0003	0.0003	0.0003	NL
Deraniyagala's beaked whale	NP	22,799	0.00093	0.00093	0.00093	0.00093	NL
Dwarf sperm whale	Hawaii	17,519	0.00714	0.00714	0.00714	0.00714	NL
False killer whale	Hawaii-Pelagic	1,540	0.00086	0.00086	0.00086	0.00086	NL
	Main Hawaiian Island Insular	167	0.0008	0.0008	0.0008	0.0008	EN
Fraser's dolphin	Hawaii	51,491	0.02104	0.02104	0.02104	0.02104	NL
Killer whale	Hawaii	146	0.00006	0.00006	0.00006	0.00006	NL
Longman's beaked whale	Hawaii	7,619	0.00311	0.00311	0.00311	0.00311	NL
Melon-headed whale	Hawaiian Islands	8,666	0.0020	0.0020	0.0020	0.0020	NL
	Kohala Resident	447	0.1000	0.1000	0.1000	0.1000	NL
Pantropical spotted dolphin	Hawaiian Pelagic	55,795	0.00541	0.00541	0.00541	0.00541	NL
	Hawaii Island	220	0.061	0.061	0.061	0.061	NL
	Oahu	220	0.072	0.072	0.072	0.072	NL
	4 Islands	220	0.061	0.061	0.061	0.061	NL
Pygmy killer whale	Hawaii	10,640	0.00435	0.00435	0.00435	0.00435	NL
Pygmy sperm whale	Hawaii	7,138	0.0029	0.0029	0.0029	0.0029	NL
Risso's dolphin	Hawaii	11,613	0.00474	0.00474	0.00474	0.00474	NL
Rough toothed dolphin	Hawaii	75,528	0.00257	0.00257	0.00257	0.00257	NL
Short-finned pilot whale	Hawaii	19,503	0.00549	0.00549	0.00549	0.00549	NL
Sperm whale	Hawaii	4,559	0.00131	0.00131	0.00131	0.00131	EN
Spinner dolphin	Hawaii Pelagic	3,351	0.00348	0.00348	0.00348	0.00348	NL
	Oahu/4-Islands	601	0.023	0.023	0.023	0.023	NL
	Hawaii Island	631	0.066	0.066	0.066	0.066	NL
	Kauai/Niihau	355	0.097	0.097	0.097	0.097	
Striped dolphin	Hawaii	61,201	0.00475	0.00475	0.00475	0.00475	NL
Hawaiian monk seal	Hawaii	1,427	0.00004	0.00004	0.00004	0.00004	EN

[1] CNP=central north Pacific; NP=north Pacific.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.

[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table. No value for density indicates that species is not expected to occur in the model area during that season.
[4] ESA Status: EN=Endangered; T=Threatened; NL=Not Listed.

TABLE 13—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MODEL AREA 12, OFFSHORE SRI LANKA

Species	Stock name [1]	Abundance [2]	Density (animals/km²) [3]				ESA status [4]
			Winter	Spring	Summer	Fall	
Blue whale	NIND	3,691	0.00004	0.00004	0.00004	0.00004	EN
Bryde's whale	NIND	9,176	0.00041	0.00041	0.00041	0.00041	NL
Common minke whale	IND	257,000	0.00001	0.00001	0.00001	0.00001	NL
Fin whale	IND	1,846	0.00001	0.00001	0.00001	0.00001	EN
Omura's whale	NIND	9,176	0.00041	0.00041	0.00041	0.00041	NL
Sei whale	NIND	9,176	0.00041	0.00041	0.00041	0.00041	EN
Blainville's beaked whale	IND	16,867	0.00105	0.00105	0.00105	0.00105	NL
Common dolphin	IND	1,819,982	0.00513	0.00516	0.00541	0.00538	NL
Common bottlenose dolphin	NIND	785,585	0.04839	0.04829	0.04725	0.04740	NL
Cuvier's beaked whale	NIND	27,272	0.00506	0.00508	0.00505	0.00505	NL
Deraniyagala's beaked whale	IND	16,867	0.00513	0.00516	0.00541	0.00538	NL
Dwarf sperm whale	IND	10,541	0.00005	0.00005	0.00005	0.00005	NL
False killer whale	IND	144,188	0.00024	0.00024	0.00024	0.00024	NL
Fraser's dolphin	IND	151,554	0.00207	0.00207	0.00207	0.00207	NL
Indo-Pacific bottlenose dolphin	IND	7,850	0.00048	0.00048	0.00047	0.00047	NL
Killer whale	IND	12,593	0.00697	0.00155	0.00693	0.00694	NL
Longman's beaked whale	IND	16,867	0.00513	0.00516	0.00541	0.00538	NL
Melon-headed whale	IND	64,600	0.00921	0.00920	0.00937	0.00936	NL
Pantropical spotted dolphin	IND	736,575	0.00904	0.00904	0.00904	0.00904	NL
Pygmy killer whale	IND	22,029	0.00138	0.00137	0.00152	0.00153	NL
Pygmy sperm whale	IND	10,541	0.00001	0.00001	0.00001	0.00001	NL
Risso's dolphin	IND	452,125	0.08641	0.08651	0.08435	0.08466	NL
Rough-toothed dolphin	IND	156,690	0.00071	0.00071	0.00071	0.00071	NL
Short-finned pilot whale	IND	268,751	0.03219	0.03228	0.03273	0.03279	NL
Sperm whale	NIND	24,446	0.00129	0.00118	0.00126	0.00121	EN
Spinner dolphin	IND	634,108	0.00678	0.00678	0.00678	0.00678	NL
Striped dolphin	IND	674,578	0.14601	0.14629	0.14780	0.14788	NL

[1] IND=Indian Ocean; NIND=northern Indian Ocean.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table. No value for density indicates that species is not expected to occur in the mission area during that season.
[4] ESA Status: EN=Endangered; T=Threatened; NL=Not Listed.

TABLE 14—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MODEL AREA 13, ANDAMAN SEA

Species	Stock name [1]	Abundance [2]	Density (animals/km²) [3]				ESA status [4]
			Winter	Spring	Summer	Fall	
Blue whale	NIND	3,691	0.00003	0.00003	0.00003	0.00003	EN
Bryde's whale	NIND	9,176	0.00038	0.000036	0.00037	0.00037	NL
Common minke whale	IND	257,000		0.00001	0.00968	0.00001	NL
Fin whale	IND	1,846	0.00001	0.00001		0.00001	EN
Omura's whale	NIND	9,176	0.00038	0.00036	0.00037	0.00037	NL
Blainville's beaked whale	IND	16,867	0.00094	0.00089	0.00094	0.00099	NL
Common bottlenose dolphin	NIND	785,585	0.07578	0.07781	0.07261	0.07212	NL
Cuvier's beaked whale	NIND	27,272	0.00466	0.00482	0.00480	0.00473	NL
Deraniyagala's beaked whale	IND	16,867	0.00094	0.00092	0.00097	0.00099	NL
Dwarf sperm whale	IND	10,541	0.00005	0.00006	0.00006	0.00005	NL
False killer whale	IND	144,188	0.00023	0.00023	0.00024	0.00023	NL
Fraser's dolphin	IND	151,554	0.00176	0.00179	0.00180	0.00180	NL
Ginkgo-toothed beaked whale	IND	16,867	0.00094	0.00092	0.00097	0.00099	NL
Indo-Pacific bottlenose dolphin	IND	7,850	0.00076	0.00078	0.00073	0.00072	NL
Killer whale	IND	12,593	0.00744	0.00178	0.00730	0.00734	NL
Longman's beaked whale	IND	16,867	0.00444	0.00429	0.00459	0.00440	NL
Melon-headed whale	IND	64,600	0.00884	0.00884	0.00878	0.00846	NL
Pantropical spotted dolphin	IND	736,575	0.00868	0.00841	0.00829	0.00873	NL
Pygmy killer whale	IND	22,029	0.00121	0.00113	0.00125	0.00131	NL
Pygmy sperm whale	IND	10,541	0.00001	0.00001	0.00001	0.00001	NL
Risso's dolphin	IND	452,125	0.09197	0.09215	0.09173	0.09366	NL
Rough-toothed dolphin	IND	156,690	0.00077	0.00078	0.00077	0.00074	NL
Short-finned pilot whale	IND	268,751	0.03354	0.03364	0.03543	0.03504	NL
Sperm whale	NIND	24,446	0.00109	0.00099	0.00107	0.00105	EN
Spinner dolphin	IND	634,108	0.00736	0.00711	0.00701	0.00726	NL
Striped dolphin	IND	674,578	0.14413	0.14174	0.14123	0.14402	NL

[1] IND=Indian Ocean; NIND=northern Indian Ocean.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table. No value for density indicates that species is not expected to occur in the model area during that season.
[4] ESA Status: EN=Endangered; T=Threatened; NL=Not Listed.

TABLE 15—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MODEL AREA 14, NORTHWESTERN AUSTRALIA

Species	Stock name [1]	Abundance [2]	Density (animals/km²) [3]				ESA status [4]
			Winter	Spring	Summer	Fall	
Antarctic minke whale	ANT	90,000		0.00001	0.00001	0.00001	NL
Blue whale/Pygmy blue whale	SIND	1,657		0.00003	0.00003	0.00003	EN
Bryde's whale	SIND	13,854	0.00032	0.00032	0.00032	0.00032	NL
Common minke whale	IND	257,500		0.01227	0.01929	0.01947	NL
Fin whale	SIND	38,185	0.00001	0.00099	0.00128	0.00121	EN
Humpback whale	Western Australia stock and DPS	13,640		0.00007	0.00007	0.00007	NL
Omura's whale	SIND	13,854	0.00032	0.00032	0.00032	0.00032	NL
Sei whale	SIND	13,854	0.00001	0.00001	0.00001	0.00001	EN
Blainville's beaked whale	IND	16,867	0.00083	0.00083	0.00082	0.00083	NL
Common bottlenose dolphin	WAU	3,000	0.03630	0.03652	0.03459	0.03725	NL
Cuvier's beaked whale	SH	76,500	0.00399	0.00406	0.00402	0.00405	NL
Dwarf sperm whale	IND	10,541	0.00004	0.00004	0.00004	0.00004	NL
False killer whale	IND	144,188	0.00020	0.00020	0.00019	0.00020	NL
Fraser's dolphin	IND	151,554	0.00145	0.00148	0.00149	0.00147	NL
Killer whale	IND	12,593	0.00585	0.00435	0.00588	0.00580	NL
Longman's beaked whale	IND	16,867	0.00393	0.00393	0.00403	0.00412	NL
Melon-headed whale	IND	64,600	0.00717	0.00717	0.00635	0.00637	NL
Pantropical spotted dolphin	IND	736,575	0.00727	0.00727	0.00715	0.00746	NL
Pygmy killer whale	IND	22,029	0.00100	0.00104	0.00101	0.00097	NL
Risso's dolphin	IND	452,125	0.07152	0.07214	0.06944	0.07173	NL
Rough-toothed dolphin	IND	156,690	0.00059	0.00060	0.00059	0.00059	NL
Short-finned pilot whale	IND	268,751	0.02698	0.02759	0.02689	0.02716	NL
Southern bottlenose whale	IND	599,300	0.00083	0.00083	0.00082	0.00083	NL
Spade-toothed beaked whale	IND	16,867	0.00083	0.00083	0.00082	0.00083	NL
Sperm whale	SIND	24,446	0.00096	0.00087	0.00097	0.00092	EN
Spinner dolphin	IND	634,108	0.00561	0.00549	0.00568	0.00563	NL
Striped dolphin	IND	674,578	0.12018	0.12041	0.11680	0.11727	NL

[1] ANT=Antarctic; SIND=southern Indian Ocean; IND=Indian Ocean; SH=Southern Hemisphere; WAU=Western Australia.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table. No value for density indicates that species is not expected to occur in the mission area during that season.
[4] ESA Status: EN=Endangered; T=Threatened; NL=Not Listed.

TABLE 16—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MODEL AREA 15, NORTHEAST OF JAPAN

Species	Stock name [1]	Abundance [2]	Density (animals/km²) [3]				ESA status [4]
			Winter	Spring	Summer	Fall	
Blue whale	WNP	9,250	0.00001	0.00001		0.00001	EN
Common minke whale	WNP "OE"	25,049	0.0022	0.0022	0.0022	0.0022	NL
Fin whale	WNP	9,250		0.0002	0.0002	0.0002	EN
Humpback whale	WNP and DPS	1,328		0.000498	0.000498	0.000498	EN
North Pacific right whale	WNP	922			0.00001	0.00001	EN
Sei whale	NP	7,000		0.00029	0.00029		EN
Western North Pacific gray whale	Western and DPS	140			0.00001	0.00001	EN
Baird's beaked whale	WNP	5,688		0.0015	0.0029	0.0029	NL
Common dolphin	WNP	3,286,163	0.0863	0.0863	0.0863	0.0863	NL
Cuvier's beaked whale	WNP	90,725	0.0054	0.0054	0.0054	0.0054	NL
Dall's porpoise	WNP *dalli*	162,000	0.0390	0.0520	0.0650	0.0520	NL
Killer whale	WNP	12,256	0.0036	0.0036	0.0036	0.0036	NL
Pacific white-sided dolphin	NP	931,000	0.0048	0.0048	0.0048	0.0048	NL
Sperm whale	NP	102,112	0.0017	0.0022	0.0022	0.0022	EN
Stejneger's beaked whale	WNP	8,000	0.0005	0.0005	0.0005	0.0005	NL
Northern fur seal	Western Pacific	503,609	0.00689	0.01378	0.01378	0.01378	NL
Ribbon seal	NP	365,000	0.0904	0.0904	0.0452	0.0452	NL
Spotted seal	Alaska/Bering Sea DPS	461,625		0.2770	0.1385		NL
Steller sea lion	West-Asian and Western DPS	71,221	0.00001	0.00001	0.00001	0.00001	EN

[1] IND=Indian Ocean; NP=northern Pacific; WNP=western north Pacific; OE=Offshore Japan.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table. No value for density indicates that species is not expected to occur in the model area during that season.
[4] ESA Status: EN=Endangered; T=Threatened; NL=Not Listed.

Information on how the density and abundance stock estimates were derived for the selected mission sites is in the Navy's application (refer to section 3.2). These data are derived from the best available published source documentation and provide general area information for each model area with species-specific information on the animals that could occur in that area, including estimates for their stock, abundance, and density. The Navy developed the abundance and density estimates by first using estimates from line-transect surveys that occurred in or near each of the 15 model sites (*e.g.,* Bradford *et al.,* 2017). When density estimates were not available from a survey in the model area, the Navy extrapolated density estimates from a region with similar oceanographic characteristics to that model area. For example, the eastern tropical Pacific has been extensively surveyed and provides a comprehensive understanding of marine mammals in temperate oceanic waters (Ferguson and Barlow, 2001, 2003). Density estimates for some model areas were also derived from the Navy's Marine Species Density Database (DoN, 2018). In addition, density estimates are usually not available for rare marine mammal species or for those that have been newly defined (*e.g.,* the Deraniyagala's beaked whale). For these species, the lowest density estimate of 0.0001 animals/square kilometer (0.0001 animals/km^2) was used in the take analysis to reflect the low probability of occurrence in a specific SURTASS LFA sonar model area. Further, the Navy pooled density estimates for species of the same genus if sufficient data were not available to compute a density for individual species or the species are difficult to distinguish at sea, which is often the case for beaked whales (*e.g., Mesoplodon* spp.), as well as the pygmy and dwarf sperm whales (*Kogia* spp.). Density estimates are available for species groups rather than the individual species for *Kogia* spp. in model areas 1, 2, 3, 5, 6, and 7 and for *Mesoplodon* spp. in model area 8, as the best available data (Ferguson and Barlow, 2001 and 2003) were reported as pooled data.

The Navy provides detailed descriptions of the distribution, abundance, diving behavior, life history, and hearing vocalization information for each affected marine mammal species with confirmed or possible occurrence within SURTASS LFA sonar study areas in section 4 (pages 4–1 through 4–44) of the application, which is available online at *https://www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-military-readiness-activities.*

Although not repeated in this document, NMFS has reviewed these data, determined them to be the best available scientific information for the proposed rulemaking, and considers this information part of the administrative record for this action. Additional information is available in NMFS' Marine Mammal Stock Assessment Reports, which may be viewed at *https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessments.* NMFS refers the public to Table 3–2 (pages 3–6 through 3–25) of the Navy's application for literature references associated with abundance and density estimates presented in these tables.

Brief Background on Sound, Marine Mammal Hearing, and Vocalization

Underwater Sound

An understanding of the basic properties of underwater sound is necessary to comprehend many of the concepts and analyses presented in this document. Sound travels in waves, the basic components of which are frequency, wavelength, velocity, and amplitude. Sound frequency is measured in cycles per second, referred to as Hertz (Hz), and is analogous to musical pitch; high-pitched sounds contain high frequencies and low-pitched sounds contain low frequencies. Frequency, or the ''pitch'' of a sound, is the number of pressure waves that pass by a reference point per unit of time and is measured in Hz or cycles per second. Wavelength is the distance between two peaks or corresponding points of a sound wave (length of one cycle). Higher frequency sounds have shorter wavelengths than lower frequency sounds, and typically attenuate (decrease) more rapidly, except in certain cases in shallower water. Amplitude is the height of the sound pressure wave or the ''loudness'' of a sound and is typically described using the relative unit of the dB. A sound pressure level (SPL) in dB is described as the ratio between a measured pressure and a reference pressure (for underwater sound, this is 1 microPascal (μPa)) and is a logarithmic unit that accounts for large variations in amplitude; therefore, a relatively small change in dB corresponds to large changes in sound pressure. The source level (SL) represents the SPL referenced at a distance of 1 m from the source (referenced to 1 μPa), while the received level is the SPL at the listener's position (referenced to 1 μPa).

Natural sounds in the ocean span a large range of frequencies: From earthquake noise at five Hz to harbor porpoise clicks at 150,000 Hz (150 kilohertz (kHz)). These sounds are so low or so high in pitch that humans cannot even hear them; acousticians call these infrasonic (typically below 20 Hz, which is considered the low frequency bound of human hearing) and ultrasonic (typically above 20,000 Hz, which is considered the upper bound of human hearing) sounds, respectively. A single sound may be made up of multiple frequencies. Sounds made up of only a small range of frequencies are called narrowband, and sounds with a broad range of frequencies are called broadband. Explosives are an example of a broadband sound source and tactical military sonars are an example of a narrowband sound source.

When underwater objects vibrate or activity occurs, sound-pressure waves are created. These waves alternately compress and decompress the water as the sound wave travels. Underwater sound waves radiate in a manner similar to ripples on the surface of a pond and may be either directed in a beam or beams or may radiate in all directions (omnidirectional sources), as is the case for sound produced by LFA sonar. The compressions and decompressions associated with sound waves are detected as changes in pressure by aquatic life and man-made sound receptors such as hydrophones.

Sounds are often considered to fall into one of two general types: Impulsive and non-impulsive (described below). The distinction between these two sound types is important because they have differing potential to cause physical effects, particularly with regard to hearing (*e.g.,* Ward, 1997 in Southall *et al.,* 2007). Please see Southall *et al.* (2007) for an in-depth discussion of these concepts. The distinction between these two sound types is not always obvious, as certain signals share properties of both pulsed and non-pulsed sounds. A signal near a source could be categorized as a pulse, but due to propagation effects as it moves farther from the source, the signal duration becomes longer (*e.g.,* Greene and Richardson, 1988).

Impulsive sound sources (*e.g.,* airguns, explosions, gunshots, sonic booms, impact pile driving) produce signals that are brief (typically considered to be less than one second), broadband, atonal transients (ANSI, 1986, 2005; Harris, 1998; NIOSH, 1998; ISO, 2003) and occur either as isolated events or repeated in some succession. Impulsive sounds are all characterized by a relatively rapid rise from ambient pressure to a maximal pressure value followed by a rapid decay period that may include a period of diminishing, oscillating maximal and minimal pressures, and generally have an increased capacity to induce physical injury as compared with sounds that lack these features.

Non-impulsive sounds can be tonal, narrowband, or broadband, brief or prolonged, and may be either continuous or intermittent (ANSI, 1995; NIOSH, 1998). Some of these non-impulsive sounds can be transient signals of short duration but without the essential properties of pulses (*e.g.,* rapid rise time). Examples of non-impulsive sounds include those produced by vessels, aircraft, machinery operations such as drilling or dredging, and vibratory pile driving. The duration of such sounds, as received at a distance, can be greatly extended in a highly reverberant environment. Given the non-pulsed nature of the LFA sonar source, it is appropriate to consider it a non-impulsive source for estimation of permanent and temporary threshold shifts (PTS and TTS, respectively). The Navy derived the potential for Level B harassment directly from data obtained during experiments exposing marine mammals (mysticetes) to low frequency sonar. Refer to the ''Estimated Take'' section for more information regarding the estimation of take by harassment.

Metrics Used in This Document

This section includes a brief explanation of the sound measurement metrics frequently used in the discussions of acoustic effects in this document.

Sound Pressure Level

Sound pressure level (SPL) is expressed as the ratio of a measured sound pressure and a reference level. The commonly used reference pressure level in underwater acoustics is 1 μPa, and the units for SPLs are decibels (dB) re: 1 μPa. SPL (in dB) = 20 log (pressure/reference pressure). SPL is an instantaneous measurement and can be expressed as the peak (pk), the peak-peak (p-p), or the root mean square (RMS). SPL does not directly take the duration of exposure to a sound into account, though the duration over which the root mean square pressure is averaged should be noted since it influences the result. Root mean square pressure, which is the square root of the arithmetic average of the squared instantaneous pressure values (Urick, 1983), is typically used in discussions of behavioral effects of sounds on vertebrates in part because behavioral effects, which often result from auditory cues, may be better expressed through averaged units than by peak pressures. SPL_{pk} is applicable to impulsive, or pulsed, noise (such as airguns, explosions, gunshots, sonic booms, and impact pile driving); as such it is not applicable to SURTASS LFA sonar and therefore is not used for estimation of PTS (Level A harassment) in this rulemaking. All references to SPL in this document refer to the RMS unless otherwise noted. In addition, the Navy uses a Single Ping Equivalent (SPE) metric for the estimation of Level B harassment, as described below.

Cumulative Sound Exposure Level

Sound exposure level (SEL; represented as dB re 1 μPa^2-s) represents the total energy contained within a pulse, and considers both exposure level and duration of exposure.

To assess potential for auditory injury of marine mammals from sound exposure, NMFS' 2018 Revision to Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Acoustic Technical Guidance) identifies specific injury thresholds for impulsive and non-impulsive sources, and divides marine mammals into hearing groups based on measured or estimated generalized hearing ranges. The Acoustic Technical Guidance uses a dual metric approach for impulsive sounds (*i.e.,* peak SPL (SPL_{pk}) and cumulative SEL (SEL_{cum})), but since SURTASS LFA sonar is a non-impulsive source, only the cumulative SEL_{cum} metric is used to account for the total energy received over the specified duration of sound exposure (*i.e.,* the metric accounts for both received level and duration of exposure) (Southall *et al.,* 2007; NMFS, 2018). NMFS' Acoustic Technical Guidance builds upon the foundation provided by Southall *et al.* (2007), while incorporating updated information that since became available on marine mammal hearing and impacts of noise on hearing (*e.g.,* DoN, 2017). NMFS (2018) recommends 24 hours as the default maximum accumulation period relative to SEL_{cum} thresholds.

Note that NMFS' SEL_{cum} acoustic thresholds also incorporate marine mammal auditory weighting functions, which take into account what is known about marine mammal hearing sensitivity and susceptibility to noise-induced hearing loss, and can be applied to a sound-level measurement to account for frequency-dependent hearing (NMFS, 2018). See Houser (2017) for a review of the development of auditory weighting functions for marine mammals. For further discussion of auditory weighting functions and their application or metrics associated with evaluating noise-induced hearing loss, see also NMFS (2018).

Table 17 displays auditory impact thresholds for onset of temporary and permanent threshold shifts (TTS and PTS, respectively) in hearing (from NMFS (2018)).

TABLE 17—TTS AND PTS ONSET THRESHOLDS FOR NON-IMPULSIVE SOUNDS [1]

Hearing group	Cumulative sound exposure level for TTS [1] (dB)	Cumulative sound exposure level for PTS [1] (dB)
Low-frequency cetaceans	179	199
Mid-frequency cetaceans	178	198
High-frequency cetaceans	153	173
Phoicid pinnipeds (PW) (Underwater)	181	201
Otariid pinnipeds (OW) (Underwater)	199	219

[1] Referenced to 1 $\mu Pa^2 s$; weighted according to appropriate auditory weighting function.

Single Ping Equivalent (SPE)

To model potential behavioral impacts to marine animals from exposure to SURTASS LFA sonar sound, the Navy has developed a methodology to estimate the total exposure of modeled animals exposed to multiple pings over an extended period of time. The Navy's acoustic model analyzes the following components: (1) The LFA sonar source modeled as a point source, with an effective source level (SL) of approximately 240 dB re: 1 μPa at 1 m (SPL); (2) a 60-sec duration signal; and (3) a beam pattern that is correct for the number and spacing of the individual projectors (source elements). This source model, when combined with the three-dimensional transmission loss (TL) field generated by the Parabolic Equation (PE) acoustic propagation model, defines the received level (RL) (in SPL) sound field surrounding the source for a 60-sec LFA sonar signal (*i.e.,* the SPE metric accounts for received level and exposure from multiple pings). To estimate the total exposure of animals exposed to multiple pings, the Navy models the RLs for each modeled location and any computer-simulated marine mammals (animats) within the location, records the exposure history of each animat, and generates a SPE value. Thus, the Navy can model the SURTASS LFA sound field, providing a four-dimensional (position and time) representation of a sound pressure field within the marine environment and estimates of an animal's exposure to sound over a period of 24 hours.

Figure 2 shows the Navy calculation that converts SPL values to SPE values in order to estimate impacts to marine mammals from SURTASS LFA sonar transmissions. For a more detailed explanation of the SPE calculations, NMFS refers the public to Appendix B of the SURTASS 2018 DSEIS/SOEIS.

Figure 2. Equation for SPE as a Function of SPL.

$$SPE = 5 \times \text{Log}_{10} \left(\sum \left(10^{(P_N/10)}\right)^2 \right)$$

SPE is the single ping equivalent of the N received transmissions at the animal.

N is the number of received transmissions at the animal, and

P_N is the received level or pressure in in dB re: 1 μPa (in SPL) at the modeled animal for each received transmission

Marine Mammal Hearing

Hearing is the most important sensory modality for marine mammals underwater, and exposure to anthropogenic sound can have deleterious effects. To appropriately assess the potential effects of exposure to sound, it is necessary to understand the frequency ranges marine mammals are able to hear. Current data indicate that not all marine mammal species have equal hearing capabilities (*e.g.,* Richardson *et al.,* 1995; Wartzok and Ketten, 1999; Au and Hastings, 2008). To reflect this, Southall *et al.* (2007) recommended that marine mammals be divided into functional hearing groups based on directly measured or estimated hearing ranges on the basis of available behavioral response data, audiograms derived using auditory evoked potential techniques, anatomical modeling, and other data. Note that no direct measurements of hearing ability have been successfully completed for mysticetes (*i.e.,* low-frequency cetaceans).

Subsequently, NMFS (2018) described generalized hearing ranges for these marine mammal hearing groups. Generalized hearing ranges were chosen based on the approximately 65 dB threshold from the normalized composite audiograms, with an exception for lower limits for low-frequency cetaceans where the result was deemed to be biologically implausible, and the lower bound from Southall *et al.* (2007) was retained while the lower frequency range for phocid pinnipeds was approximated. The generalized hearing groups and the associated frequencies are indicated below (note that these frequency ranges correspond to the range for the composite group, with the entire range not necessarily reflecting the capabilities of every species within that group):

- Low-frequency (LF) cetaceans (mysticetes): Generalized hearing is estimated to occur between approximately 7 Hz and 35 kHz;
- Mid-frequency (MF) cetaceans (larger toothed whales, beaked whales, and most delphinids): Generalized hearing is estimated to occur between approximately 150 Hz and 160 kHz;
- High-frequency (HF) cetaceans (porpoises, river dolphins, and members of the genera *Kogia* and *Cephalorhynchus*; including two members of the genus *Lagenorhynchus,* on the basis of recent echolocation data and genetic data): Generalized hearing is estimated to occur between approximately 275 Hz and 160 kHz;
- Pinnipeds in water; Phocidae (true seals): Generalized hearing is estimated to occur between approximately 50 Hz to 86 kHz;
- Pinnipeds in water; Otariidae (eared seals): Generalized hearing is estimated to occur between 60 Hz and 39 kHz for Otariidae.

Marine Mammal Hearing Groups and LFA Sonar

Baleen (mysticete) whales (members of the LF hearing group) have inner ears that appear to be specialized for low-frequency hearing. Conversely, most odontocetes (*i.e.,* dolphins and porpoises) have inner ears that are specialized to hear mid and high frequencies. Pinnipeds, which lack the highly specialized active biosonar systems of odontocetes, have inner ears that are specialized to hear a broad range of frequencies in water (Southall *et al.,* 2007 and NMFS, 2018). Based on measured hearing thresholds, the LFA sound source is below the range of known highest hearing sensitivity for MF and HF odontocetes and pinnipeds in water (Au, 1993; Au and Hastings, 2008; Gentry, 2009; Hall and Johnson, 1972; Houser *et al.,* 2008; Kastelein *et al.,* 2009, 2005, 2003, and 2002; Montie *et al.,* 2011; Mooney *et al.,* 2015; Mulsow and Reichmuth, 2010; Nedwell *et al.,* 2004; Richardson *et al.,* 1995; Ridgeway and Carder, 2001; Pacini *et al.,* 2011; Schlundt *et al.,* 2011; Sills *et al.,* 2014; Southall *et al.,* 2007; Szymanski *et al.,* 1999; Thomas *et al.,* 1990; Yuen *et al.,* 2005).

Marine Mammal Vocalization

Marine mammal vocalizations often extend both above and below the range of human hearing (higher than 20 kHz and lower than 20 Hz; Research Council, 2003). Measured data on the hearing abilities of cetaceans are sparse or non-existent, particularly for the larger cetaceans such as the baleen whales (mysticetes). The auditory thresholds of some of the smaller odontocetes have been determined in captivity. It is generally believed that cetaceans should at least be sensitive to the frequencies of their own vocalizations and those of conspecifics (*i.e.,* an organism of the same or similar species). Comparisons of the anatomy of cetacean inner ears and models of the structural properties and the response to vibrations of the ear's components in different species provide an indication of likely sensitivity to various sound frequencies. Thus, the ears of small toothed whales are optimized for receiving high-frequency sound, while baleen whale inner ears are best suited for low frequencies, including to infrasonic frequencies (Ketten, 1992; 1994; 1997; 1998).

Baleen whale (*i.e.,* mysticete) vocalizations are composed primarily of frequencies below one kHz, and some contain fundamental frequencies as low as 16 Hz (Watkins *et al.,* 1987; Richardson *et al.,* 1995; Rivers, 1997;

Moore *et al.,* 1998; Stafford *et al.,* 1999; Wartzok and Ketten, 1999) but can be as high as 24 kHz (humpback whale; Au *et al.,* 2006). Clark and Ellison (2004) suggested that baleen whales use low frequency sounds not only for long-range communication, but also as a simple form of echo ranging, using echoes to navigate and orient relative to physical features of the ocean. Information on auditory function in mysticetes is limited. Sensitivity to low frequency sound by baleen whales has been inferred from observed vocalization frequencies, observed reactions to playback of sounds, and anatomical analyses of the auditory system. Although there is apparently much variation, the source levels of most baleen whale vocalizations lie in the range of 150–190 dB re: 1 μPa at 1 m. Low-frequency vocalizations made by baleen whales and their corresponding auditory anatomy suggest that they have good low-frequency hearing (Ketten, 2000), although specific data on sensitivity, frequency or intensity discrimination, or localization abilities are lacking. Marine mammals, like all mammals, have typical U-shaped audiograms that begin with relatively low sensitivity (high threshold) at some specified low frequency with increased sensitivity (low threshold) to a species-specific optimum followed by a generally steep rise at higher frequencies (high threshold) (Fay, 1988).

Toothed whales (*i.e.,* odontocetes) produce a wide variety of sounds, which include species-specific broadband ‘‘clicks’’ with peak energy between 10 and 200 kHz, individually variable ‘‘burst pulse’’ click trains, and constant frequency or frequency-modulated (FM) whistles ranging from 4 to 16 kHz (Wartzok and Ketten, 1999). The general consensus is that the tonal vocalizations (whistles) produced by toothed whales play an important role in maintaining contact between dispersed individuals, while broadband clicks are used during echolocation (Wartzok and Ketten, 1999). Burst pulses have also been strongly implicated in communication, with some scientists suggesting that they play an important role in agonistic encounters (McCowan and Reiss, 1995), while others have proposed that they represent ‘‘emotive’’ signals in a broader sense, possibly representing graded communication signals (Herzing, 1996). Sperm whales, however, are known to produce only clicks, which are used for both communication and echolocation (Whitehead, 2003). Most of the energy of toothed whales' (*i.e.,* odontocetes) social vocalizations is concentrated near 10 kHz, with source levels for whistles as high as 100–180 dB re 1 μPa at 1 m (Richardson *et al.,* 1995). No odontocete has been shown audiometrically to have acute hearing (less than 80 dB re 1 μPa at 1 m) below 500 Hz (DoN, 2001; Ketten, 1998). Sperm whales produce clicks, which may be used to echolocate (Mullins *et al.,* 1988), with a frequency range from less than 100 Hz to 30 kHz and source levels up to 230 dB re 1 μPa at 1 m or greater (Mohl *et al.,* 2000).

Potential Effects of the Specified Activity on Marine Mammals and Their Habitat

This section includes a summary and discussion of the ways that components of the specified activities (*e.g.,* use of acoustic sources) may impact marine mammals and their habitat. The ‘‘Estimated Take’’ section later in this document includes a quantitative analysis of the number of individuals that are expected to be taken by this activity. The ‘‘Negligible Impact Analysis and Determination’’ section considers the content of this section and the material it references, the ‘‘Estimated Take’’ section, and the ‘‘Proposed Mitigation’’ section to draw conclusions regarding the likely impacts of these activities on the reproductive success or survivorship of individuals and how those impacts on individuals are likely to impact marine mammal species or stocks.

The Navy has requested authorization for the incidental take of marine mammals that may result from upcoming use of SURTASS LFA sonar during training and testing activities on U.S. Naval ships in certain areas of the central and western North Pacific Ocean and eastern Indian Ocean. In addition to the use of LFA and HF/M3 sonar, the Navy has analyzed the potential impact of ship strike to marine mammals from SURTASS LFA sonar activities and, in consultation with NMFS as a cooperating agency for the SURTASS LFA sonar 2018 DSEIS/SOEIS, has determined that take of marine mammals incidental to this non-acoustic component of the Navy's training and testing activities is not reasonably likely to occur. This is due to the low speed at which the SURTASS LFA sonar vessels test and train (10 to 12 knots (kt)) and the suite of mitigation and monitoring efforts employed, including a three-pronged monitoring effort that involves visual and passive acoustic monitoring for marine mammals as well as use of the HF/M3 sonar (please see the Proposed Mitigation section below for more detail), which has been shown to be highly effective at detecting marine mammals. The Navy has not requested authorization for take of marine mammals that might occur incidental to vessel ship strike. In this document, NMFS analyzes the potential effects on marine mammals from exposure to LFA and HF/M3 sonar, but also includes some additional analysis of the potential impacts from vessel operations.

Overview of Potential Effects of Exposure to SURTASS LFA Sonar Activities

The potential effects of sound from the proposed SURTASS LFA sonar training and testing activities might include one or more of the following: Behavioral changes, masking, non-auditory injury (*i.e.,* gas bubble formation/rectified diffusion), and noise-induced loss of hearing sensitivity (more commonly called threshold shift). NMFS discusses these potential effects in more detail below.

The effects of underwater noise on marine mammals are highly variable, and one can categorize the effects as follows (Richardson *et al.,* 1995; Nowacek *et al.,* 2007; Southall *et al.,* 2007):

(1) The noise may be too weak to be heard at the location of the animal (*i.e.,* lower than the prevailing ambient noise level, the hearing threshold of the animal at relevant frequencies, or both);

(2) The noise may be audible but not strong enough to elicit any overt behavioral response;

(3) The noise may elicit behavioral reactions of variable conspicuousness and relevance to the well-being of the animal. These can range from temporary alert responses to active avoidance reactions such as vacating an area at least until the noise event ceases, but potentially for longer periods of time. Depending on the nature and duration of these the disturbances, they could have effects on the well-being or reproduction of the animals involved;

(4) Upon repeated exposure, a marine mammal may exhibit diminishing responsiveness (habituation), disturbance effects may persist, or disturbance effects could increase (sensitization, or becoming more sensitive to exposure). Persistent disturbance and sensitization are more likely with sounds that are highly variable in characteristics, infrequent, and unpredictable in occurrence, and associated with situations that the animal perceives as a threat. Marine mammals are not likely to be exposed enough to SURTASS LFA sonar to exhibit habituation or increased sensitization, due to the fact that SURTASS LFA sonar is a mobile source

operating in open water, and animals are likely to move away and/or would not be receiving pings in the way that small resident populations would receive with a stationary source;

(5) Any anthropogenic (human-made) noise that is strong enough to be heard has the potential to reduce the ability of a marine mammal to hear natural sounds at similar frequencies (masking), including calls from conspecifics, and underwater environmental sounds such as surf noise;

(6) If mammals remain in an area because it is important for feeding, breeding, or some other biologically important purpose even though there is a chronic exposure to noise, it is possible that there could be noise-induced physiological stress. This might in turn have negative effects on the well-being or reproduction of the animals involved; and

(7) Very strong sounds have the potential to cause temporary or permanent reduction in hearing sensitivity, also known as threshold shift. In terrestrial mammals and presumably marine mammals, received sound levels must far exceed the animal's hearing threshold for there to be any temporary threshold shift (TTS) in its hearing ability. For transient sounds, the sound level necessary to cause TTS is inversely related to the duration of the sound. Received sound levels must be even higher for there to be the possibility of permanent hearing impairment. In addition, intense acoustic events may cause trauma to tissues associated with organs vital for hearing, sound production, respiration and other functions. This trauma may include minor to severe hemorrhage.

Direct Physiological Effects

Below we discuss the potential direct physiological effects of exposure to SURTASS LFA sonar, which include threshold shift (permanent and temporary) and acoustically mediated bubble growth.

Threshold Shift (Noise-Induced Loss of Hearing in Certain Frequencies)

When animals exhibit reduced hearing sensitivity within their auditory range (*i.e.,* sounds must be louder for an animal to detect them) following exposure to a sufficiently intense sound, or a less intense sound for a sufficient duration, it is referred to as a noise-induced threshold shift (TS). An animal can experience a TTS and/or permanent threshold shift (PTS). TTS can last from minutes or hours to days (*i.e.,* there is recovery back to baseline/pre-exposure levels), can occur within a specific frequency range (*i.e.,* an animal might only have a temporary loss of hearing sensitivity within a limited frequency band of its auditory range), and can be of varying amounts (for example, an animal's hearing sensitivity might be reduced by only six dB or reduced by 30 dB). PTS is permanent (*i.e.,* there is incomplete recovery back to baseline/pre-exposure levels), but also can occur in a specific frequency range and amount as mentioned above for TTS.

The following physiological mechanisms are thought to play a role in inducing auditory TS: Effects to sensory hair cells in the inner ear that reduce their sensitivity; modification of the chemical environment within the sensory cells; residual muscular activity in the middle ear; displacement of certain inner ear membranes; increased blood flow; and post-stimulatory reduction in both efferent and sensory neural output (Southall *et al.,* 2007). The amplitude, duration, frequency, temporal pattern, and energy distribution of sound exposure all can affect the amount of associated TS and the frequency range in which it occurs. Generally, the amount of TS, and the time needed to recover from the effect, increase as amplitude and duration of sound exposure increases. Human non-impulsive noise exposure guidelines are based on the assumption that exposures of equal energy (the same SEL) produce equal amounts of hearing impairment regardless of how the sound energy is distributed in time (NIOSH, 1998). Previous marine mammal TTS studies have also generally supported this equal energy relationship (Southall *et al.,* 2007). However, some more recent studies concluded that for all noise exposure situations the equal energy relationship may not be the best indicator to predict TTS onset levels (Mooney *et al.,* 2009a and 2009b; Kastak *et al.,* 2007). These studies highlight the inherent complexity of predicting TTS onset in marine mammals, as well as the importance of considering exposure duration when assessing potential impacts. Generally, with sound exposures of equal energy, those that were quieter (lower sound pressure level (SPL)) with longer duration were found to induce TTS onset at lower levels than those of louder (higher SPL) and shorter duration. Less TS will occur from intermittent sounds than from a continuous exposure with the same energy (some recovery can occur between intermittent exposures) (Kryter *et al.,* 1966; Ward, 1997; Mooney *et al.,* 2009a, 2009b; Finneran *et al.,* 2010). For example, one short but loud (higher SPL) sound exposure may induce the same impairment as one longer but softer (lower SPL) sound, which in turn may cause more impairment than a series of several intermittent softer sounds with the same total energy (Ward, 1997). Additionally, though TTS is temporary, very prolonged or repeated exposure to sound strong enough to elicit TTS, or shorter-term exposure to sound levels well above the TTS threshold can cause PTS, at least in terrestrial mammals (Kryter, 1985; Lonsbury-Martin *et al.,* 1987). However, in the case of the proposed SURTASS LFA sonar activities, animals are not expected to be exposed to levels high enough or durations long enough to result in PTS due to the nature of the activities. The potential for PTS becomes even more unlikely when mitigation measures are considered. PTS is considered auditory injury (Southall *et al.,* 2007). Irreparable damage to the inner or outer cochlear hair cells may cause PTS; however, other mechanisms are also involved, such as exceeding the elastic limits of certain tissues and membranes in the middle and inner ears and resultant changes in the chemical composition of the inner ear fluids (Southall *et al.,* 2007).

Although the published body of scientific literature contains numerous theoretical studies and discussion papers on hearing impairments that can occur with exposure to a loud sound, only a few studies provide empirical information on the levels at which noise-induced loss in hearing sensitivity occurs in nonhuman animals. The NMFS 2018 Acoustic Technical Guidance, which was used in the assessment of effects for this action, compiled, interpreted, and synthesized the best available scientific information for noise-induced hearing effects for marine mammals to derive updated thresholds for assessing the impacts of noise on marine mammal hearing, as noted above. For cetaceans, published data on the onset of TTS are limited to the captive bottlenose dolphin, beluga, harbor porpoise, and Yangtze finless porpoise (summarized in DoN, 2017). TTS studies involving exposure to SURTASS LFA or other low-frequency sonar (below 1 kHz) have never been conducted due to logistical difficulties of conducting experiments with low frequency sound sources. However, there are TTS measurements for exposures to other LF sources, such as seismic airguns. Finneran *et al.* (2015) suggest that the potential for airguns to cause hearing loss in dolphins is lower than previously predicted, perhaps as a result of the low-frequency content of airgun impulses compared to the high-frequency hearing ability of dolphins. For pinnipeds in water, measurements of TTS are limited to harbor seals, elephant seals, and California sea lions (summarized in Finneran, 2015).

Marine mammal hearing plays a critical role in communication with conspecifics and in interpretation of environmental cues for purposes such as predator avoidance and prey capture. Depending on the degree (elevation of threshold in dB), duration (*i.e.,* recovery time), and frequency range of TTS, and the context in which it is experienced, TTS can have effects on marine mammals ranging from discountable to serious, similar to those discussed in auditory masking, below. Available data (of mid-frequency hearing specialists exposed to mid- or high-frequency sounds; Southall *et al.,* 2007) suggest that most TTS occurs in the frequency range of the source up to one octave higher than the source (with the maximum TTS at ½ octave above). The Navy's SURTASS LFA source utilizes the 100–500 Hz frequency band, which suggests that if TTS were to be induced it would be in a frequency band somewhere between approximately 200 Hz and 1 kHz (but likely more in the middle of that range), which is in the range of most communication calls for mysticetes, some for pinnipeds, but below the range of most communication calls for odontocetes. While there are some broadband clicks in this range, most echolocation calls used by odontocetes for foraging are also below this frequency. Also, a marine mammal may be able to readily compensate for a brief, relatively small amount of TTS in a non-critical frequency range that takes place during a time when the animal is traveling through the open ocean, where ambient noise is lower and there are not as many competing sounds present. Alternatively, a larger amount and longer duration of TTS sustained during a time when communication is critical for successful mother/calf interactions could have more serious impacts if it were in the same frequency band as the necessary vocalizations and of a severity that impeded communication. The fact that animals exposed to high levels of sound that would be expected to result in this physiological response would also be expected to have behavioral responses of a comparatively more severe or sustained nature is potentially more significant than simple existence of a TTS. However, it is important to note that TTS can result from longer exposures to sound at lower levels where a behavioral response may not be elicited.

Depending on the degree and frequency range, the effects of PTS on an animal could also range in severity, although PTS is considered generally more serious than TTS because it is a permanent condition. Of note, reduced hearing sensitivity as a simple function of aging has been observed in marine mammals, as well as humans and other taxa (Southall *et al.,* 2007), so we can infer that strategies exist for coping with this condition to some degree, though likely not without some cost to the animal. There is no empirical evidence that exposure to SURTASS LFA sonar can cause PTS in any marine mammals, especially given the proximity to and duration that an animal would need to be exposed; instead the possibility of PTS has been inferred from studies of TTS on captive marine mammals.

As stated in the SURTASS DSEIS/SOEIS (section 4.5.2.1.3), modeling results show that all hearing groups except LF cetaceans would need to be within 22 feet (ft) (7 meters (m)) for an entire LFA transmission (60 seconds) to potentially experience PTS. A LF cetacean would need to be within 135 ft (41 m) for an entire LFA transmission to potentially experience PTS. Based on the mitigation procedures used during SURTASS LFA sonar activities, and the fact that animals reasonably can be expected to move away from disturbances, the chances of this occurring are negligible. This conclusion is supported by the fact that a marine mammal would have to match its swim speed with that of the SURTASS LFA sonar vessel while also remaining undetected by the HF/M3 mitigation system as it moved through the 2,000-yard LFA Mitigation Zone, and remain close to the source for a 60-second ping.

Acoustically Mediated Bubble Growth

One theoretical cause of injury to marine mammals is rectified diffusion (Crum and Mao, 1996), the process of increasing the size of a bubble by exposing it to a sound field. This process could be facilitated if the environment in which the ensonified bubbles exist is supersaturated with gas. Repetitive diving by marine mammals can cause the blood and some tissues to accumulate gas to a greater degree than is supported by the surrounding environmental pressure (Ridgway and Howard, 1979). The deeper and longer dives of some marine mammals (*e.g.,* beaked whales) are theoretically predicted to induce greater supersaturation (Houser *et al.,* 2001b). A study of repetitive diving in trained bottlenose dolphins found no increase in blood nitrogen levels or formation of bubbles (Houser *et al.,* 2009). If rectified diffusion were possible in marine mammals exposed to high-level sound, conditions of tissue supersaturation could theoretically speed the rate and increase the size of bubble growth. Subsequent effects due to tissue trauma and emboli would presumably mirror those observed in humans suffering from decompression sickness.

It is unlikely that the short duration of the SURTASS LFA sonar pings would be long enough to drive bubble growth to any substantial size, if such a phenomenon occurs. However, an alternative but related hypothesis has also been suggested; stable bubbles could be destabilized by high-level sound exposures such that bubble growth then occurs through static diffusion of gas out of the tissues. In such a scenario the marine mammal would need to be in a gas-supersaturated state for a long enough period of time for bubbles to become a problematic size. Research with *ex vivo* supersaturated bovine tissues suggests that, for a 37 kHz signal, a sound exposure of approximately 215 dB re 1μPa would be required before microbubbles became destabilized and grew (Crum *et al.,* 2005). Furthermore, tissues in the study were supersaturated by exposing them to pressures of 400–700 kiloPascals for periods of hours and then releasing them to ambient pressures. Assuming the equilibration of gases with the tissues occurred when the tissues were exposed to high pressures, levels of supersaturation in the tissues could have been as high as 400–700 percent. These levels of tissue supersaturation are substantially higher than model predictions for marine mammals (Houser *et al.,* 2001; Saunders *et al.,* 2008). Both the degree of supersaturation and exposure levels observed to cause microbubble destabilization are unlikely to occur, either alone or in concert.

Yet another hypothesis (decompression sickness) speculates that rapid ascent to the surface following exposure to a startling sound might produce tissue gas saturation sufficient for the evolution of nitrogen bubbles (Jepson *et al.,* 2003; Fernandez *et al.,* 2005; Fernandez *et al.,* 2012). In this scenario, the rate of ascent would need to be sufficiently rapid to compromise behavioral or physiological protections against nitrogen bubble formation. Alternatively, Tyack *et al.* (2006) studied the deep diving behavior of beaked whales and concluded that: ''Using current models of breath-hold diving, we infer that their natural diving behavior is inconsistent with known problems of acute nitrogen supersaturation and embolism.'' Collectively, these hypotheses (rectified diffusion and decompression sickness) can be referred to as ''hypotheses of acoustically-mediated bubble growth.''

Although theoretical predictions suggest the possibility for acoustically mediated bubble growth, there is considerable disagreement among scientists as to its likelihood (Piantadosi and Thalmann, 2004; Evans and Miller, 2003; Cox *et al.,* 2006; Rommel *et al.,* 2006). Crum and Mao (1996) hypothesized that received levels would have to exceed 190 dB in order for there to be the possibility of significant bubble growth due to supersaturation of gases in the blood (*i.e.,* rectified diffusion). Work conducted by Crum *et al.* (2005) demonstrated the possibility of rectified diffusion for short duration signals, but at exposure levels and tissue saturation levels that are highly improbable to occur in diving marine mammals. Nowacek *et al.* (2007) and Southall *et al.* (2007) reviewed potential types of non-auditory injury to marine mammals from active sonar transmissions, including acoustically mediated bubble growth within tissues from supersaturated dissolved nitrogen gas. Detailed descriptions and information on these types of non-auditory impacts were provided in previous documentation for SURTASS LFA sonar (DoN, 2007, 2012, 2017), and no new data have emerged to contradict any of the assumptions or conclusions in previous LFA documentation, especially the conclusion that SURTASS LFA sonar transmissions are not expected to cause gas bubble formation or strandings. Although it has been argued that traumas from some beaked whale strandings are consistent with gas emboli and bubble-induced tissue separations (Jepson *et al.,* 2003), there is no conclusive evidence of this (Rommel *et al.,* 2006). However, Jepson *et al.* (2003, 2005) and Fernandez *et al.* (2004, 2005, 2012) concluded that in vivo bubble formation, which may be exacerbated by deep, long-duration, repetitive dives, may explain why beaked whales appear to be particularly vulnerable to MF and HF active sonar exposures. This has not been demonstrated for LF sonar exposures, such as SURTASS LFA sonar.

In 2009, Hooker *et al.* tested two mathematical models to predict blood and tissue tension N2 (P_{N2}) using field data from three beaked whale species: Northern bottlenose whales, Cuvier's beaked whales, and Blainville's beaked whales. The researchers aimed to determine if physiology (body mass, diving lung volume, and dive response) or dive behavior (dive depth and duration, changes in ascent rate, and diel behavior) would lead to differences in P_{N2} levels and thereby decompression sickness risk between species.

In their study, they compared results for previously published time depth recorder data (Hooker and Baird, 1999; Baird *et al.,* 2006, 2008) from Cuvier's beaked whale, Blainville's beaked whale, and northern bottlenose whale. They reported that diving lung volume and extent of the dive response had a large effect on end-dive P_{N2}. Also, results showed that dive profiles had a larger influence on end-dive P_{N2} than body mass differences between species. Despite diel changes (*i.e.,* variation that occurs regularly every day or most days) in dive behavior, P_{N2} levels showed no consistent trend. Model output suggested that all three species live with tissue P_{N2} levels that would cause a significant proportion of decompression sickness cases in terrestrial mammals. The authors concluded that the dive behavior of Cuvier's beaked whale was different from both Blainville's beaked whale and northern bottlenose whale, resulting in higher predicted tissue and blood N2 levels (Hooker *et al.,* 2009) and suggesting that the prevalence of Cuvier's beaked whale strandings after naval sonar exercises could be explained by either a higher abundance of this species in the affected areas, or by possible species differences in behavior and/or physiology related to MF active sonar (Hooker *et al.,* 2009).

Bernaldo de Quiros *et al.* (2012) showed that, among evaluated stranded whales, deep diving species of whales had higher abundances of gas bubbles compared to shallow diving species. Kvadsheim *et al.* (2012) estimated blood and tissue P_{N2} levels in species representing shallow, intermediate, deep diving cetaceans following behavioral responses to sonar and their comparisons found that deep diving species had higher end-dive blood and tissue N_2 levels, indicating a higher risk of developing gas bubble emboli compared with shallow diving species. Fahlmann *et al.* (2014) evaluated dive data recorded from sperm, killer, long-finned pilot, Blainville's beaked and Cuvier's beaked whales before and during exposure to low (1–2 kHz) and mid (2–7 kHz) frequency active sonar in an attempt to determine if either differences in dive behavior or physiological responses to sonar are plausible risk factors for bubble formation. Note that SURTASS LFA sonar is transmitted between 100–500 Hz, which is well below the low frequency sonar in these studies. The authors suggested that CO_2 may initiate bubble formation and growth, while elevated levels of N_2 may be important for continued bubble growth. The authors also suggest that if CO_2 plays an important role in bubble formation, a cetacean escaping a sound source may experience increased metabolic rate, CO_2 production, and alteration in cardiac output, which could increase risk of gas bubble emboli. However, as discussed in Kvadsheim *et al.* (2012), the actual observed behavioral responses to sonar from the species in their study (sperm, killer, long-finned pilot, Blainville's beaked, and Cuvier's beaked whales) did not imply any significantly increased risk of decompression sickness due to high levels of N_2. Therefore, further information is needed to understand the relationship between exposure to stimuli, behavioral response (discussed in more detail below), elevated N_2 levels, and gas bubble emboli in marine mammals. The hypotheses for gas bubble formation related to beaked whale strandings is that beaked whales potentially have strong avoidance responses to MF active sonars because they sound similar to their main predator, the killer whale (Cox *et al.,* 2006; Southall *et al.,* 2007; Zimmer and Tyack, 2007; Baird *et al.,* 2008; Hooker *et al.,* 2009). Further investigation is needed to assess the potential validity of these hypotheses. However, because SURTASS LFA sonar transmissions are lower in frequency (less than 500 Hz) and dissimilar in characteristics from those of marine mammal predators, the SURTASS LFA sonar transmissions are not expected to cause gas bubble formation or beaked whale strandings.

To summarize, there are few data related to the potential for strong, anthropogenic underwater sounds to cause non-auditory physical effects in marine mammals. Such effects, if they occur at all, would presumably be limited to situations where marine mammals were exposed to high powered sounds at close range over a prolonged period of time. The available data do not allow identification of a specific exposure level above which non-auditory effects can be expected (Southall *et al.,* 2007) or any meaningful quantitative predictions of the numbers (if any) of marine mammals that might be affected in those ways. However, as noted above, non-auditory physical effects are not likely to result from the use of SURTASS LFA sonar because of the required mitigation and unlikelihood of marine mammals being exposed to high powered sounds at close range.

Acoustic Masking

Marine mammals use acoustic signals for a variety of purposes, which differ among species, but include communication between individuals, navigation, foraging, reproduction, and learning about their environment (Erbe and Farmer, 2000; Tyack, 2000). Masking, or auditory interference, generally occurs when other sounds in the environment are of a similar frequency and are louder than auditory signals an animal is trying to receive. Masking is a phenomenon that affects animals trying to receive acoustic information about their environment, including sounds from other members of their species, predators, prey, and sounds that allow them to orient in their environment. Masking these acoustic signals can disrupt the behavior of individual animals, groups of animals, or, when over large spatial and temporal scales, entire populations.

The extent of the masking interference depends on the spectral, temporal, and spatial relationships between the signals an animal is trying to receive and the masking noise, in addition to other factors. In humans, significant masking of tonal signals occurs as a result of exposure to noise in a narrow band of similar frequencies. As the sound level increases, the detection of frequencies above those of the masking stimulus decreases. This principle is expected to apply to marine mammals as well because of common biomechanical cochlear properties across taxa.

Richardson *et al.* (1995b) argued that the maximum radius of influence of an industrial noise (including broadband low-frequency sound transmission) on a marine mammal is the distance from the source to the point at which the noise can barely be heard. This range is determined by either the hearing sensitivity of the animal or the background noise level present. Industrial masking has the potential to affect some species' ability to detect communication calls and natural sounds (*i.e.,* surf noise, prey noise, etc.) (Richardson *et al.,* 1995).

Erbe *et al.* (2016) reviewed the current state of understanding of masking in marine mammals, including anti-masking strategies for both receivers and senders. When a signal and noise are received from different directions, a receiver with directional hearing can reduce the masking impact. This is known as spatial release from masking, and this ability has been found in dolphins, killer whales and harbor seals. Given the hearing abilities of marine mammals, it is likely that most, if not all, species have this ability to some extent.

The echolocation calls of toothed whales are subject to masking by high-frequency sound. Human data indicate that low-frequency sounds can mask high-frequency sounds (*i.e.,* upward masking). Studies on captive odontocetes by Au *et al.* (1974, 1985, and 1993) indicate that some species may use various processes to reduce masking effects (*e.g.,* adjustments in echolocation call intensity or frequency as a function of background noise conditions). There is also evidence that the directional hearing abilities of odontocetes are useful in reducing masking at the higher frequencies these cetaceans use to echolocate, but not at the low-to-moderate frequencies they use to communicate (Zaitseva *et al.,* 1980). A study by Nachtigall and Supin (2008) showed that false killer whales adjust their hearing to compensate for ambient sounds and the intensity of returning echolocation signals. Holt *et al.* (2009) measured killer whale call source levels and background noise levels in the one to 40 kHz band and reported that the whales increased their call source levels by one dB SPL for every one dB SPL increase in background noise level. Similarly, another study on St. Lawrence River belugas reported a similar rate of increase in vocalization activity in response to passing vessels (Scheifele *et al.,* 2005).

Parks *et al.* (2007) provided evidence of behavioral changes in the acoustic behaviors of the endangered North Atlantic right whale, and the South Atlantic right whale, and suggested that these were correlated to increased underwater noise levels. The study indicated that right whales might shift the frequency band of their calls to compensate for increased in-band background noise. The significance of their result is the indication of potential species-wide behavioral change in response to gradual, chronic increases in underwater ambient noise. Di Iorio and Clark (2010) showed that blue whale calling rates vary in association with seismic sparker survey activity, with whales calling more on days with survey than on days without surveys. They suggested that the whales called more during seismic survey periods as a way to compensate for the elevated noise conditions.

Risch *et al.* (2012) documented reductions in humpback whale vocalizations in the Stellwagen Bank National Marine Sanctuary concurrent with transmissions of the Ocean Acoustic Waveguide Remote Sensing (OAWRS) low-frequency fish sensor system at distances of 200 km (124 mi) from the source. The recorded OAWRS produced a series of frequency-modulated pulses and the signal received levels ranged from 88 to 110 dB re: 1 μPa (Risch *et al.,* 2012). The authors hypothesized that individuals did not leave the area but instead ceased singing and noted that the duration and frequency range of the OAWRS signals (a novel sound to the whales) were similar to those of natural humpback whale song components used during mating (Risch *et al.,* 2012). Thus, the novelty of the sound to humpback whales in the study area provided a compelling contextual probability for the observed effects (Risch *et al.,* 2012). However, the authors did not state or imply that these changes had long-term effects on individual animals or populations (Risch *et al.,* 2012). Gong *et al.,* (2014) assessed the effects of the OAWRS transmissions on calling rates on Georges Bank and determined constant vocalization rates of humpback whales, with a reduction occurring before the OAWRS system began transmitting. 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, RL above background noise level, novelty of signal, and differences in behavioral state.

Redundancy and context can also facilitate detection of weak signals. These phenomena may help marine mammals detect weak sounds in the presence of natural or manmade noise. Most masking studies in marine mammals present the test signal and the masking noise from the same direction. The sound localization abilities of marine mammals suggest that, if signal and noise come from different directions, masking would not be as severe as some masking studies might suggest (Richardson *et al.,* 1995). The dominant background noise may be highly directional if it comes from a particular anthropogenic source such as a ship or industrial site. Directional hearing may significantly reduce the masking effects of these sounds by improving the effective signal-to-noise ratio.

As mentioned previously, the hearing ranges of mysticetes overlap with the frequencies of the SURTASS LFA sonar sources. The closer the characteristics of the masking signal to the signal of interest, the more likely masking is to occur. The Navy provided an analysis of marine mammal hearing and masking in Subchapter 4.5.2.1.3 of the DSEIS/

SOEIS, and the masking effects of the SURTASS LFA sonar signal are expected to be limited for a number of reasons. First, the frequency range (bandwidth) of the system is limited to approximately 30 Hz, and the instantaneous bandwidth at any given time of the signal is small, on the order of 10 Hz. Second, the average duty cycle is always less than 20 percent and, based on past SURTASS LFA sonar operational parameters (2003 to 2018), is normally 7.5 to 10 percent. Third, given the average maximum pulse length (60 sec), and the fact that the signals vary and do not remain at a single frequency for more than 10 sec, SURTASS LFA sonar is not likely to cause significant masking. In other words, the LFA sonar transmissions are coherent, narrow bandwidth signals of six to 100 sec in length followed by a quiet period of six to 15 minutes. Therefore, the effect of masking will be limited because animals that use this frequency range typically use broader bandwidth signals. As a result, the chances of an LFA sonar sound actually overlapping whale calls at levels that would interfere with their detection and recognition will be extremely low.

Impaired Communication

In addition to making it more difficult for animals to perceive acoustic cues in their environment, anthropogenic sound presents separate challenges for animals that are vocalizing. When they vocalize, animals are aware of environmental conditions that affect the ''active space'' of their vocalizations, which is the maximum area within which their vocalizations can be detected before they drop to the level of ambient noise (Brenowitz, 2004; Brumm *et al.,* 2004; Lohr *et al.,* 2003). Animals are also aware of environmental conditions that affect whether listeners can discriminate and recognize their vocalizations apart from other sounds, which is more important than simply detecting that a vocalization is occurring (Brenowitz, 1982; Brumm *et al.,* 2004; Dooling, 2004, Marten and Marler, 1977; Patricelli *et al.,* 2006). Most species that vocalize are able to adapt by adjusting their vocalizations to increase the signal-to-noise ratio, active space, and recognizability/distinguishability of their vocalizations in the face of temporary changes in background noise (Brumm *et al.,* 2004; Patricelli *et al.,* 2006). Vocalizing animals can make adjustments to vocalization characteristics such as the frequency structure, amplitude, temporal structure and temporal delivery.

Many animals will combine several of these strategies to compensate for high levels of background noise. Anthropogenic sounds that reduce the signal-to-noise ratio of animal vocalizations, increase the masked auditory thresholds of animals listening for such vocalizations, or reduce the active space of an animal's vocalizations, impairing communications between animals. Most animals that vocalize have evolved strategies to compensate for the effects of short-term or temporary increases in background or ambient noise on their songs or calls. Although the fitness consequences of these vocal adjustments are not directly known in all instances, like most other trade-offs animals must make, some of these strategies probably come at a cost (Patricelli *et al.,* 2006). Shifting songs and calls to higher frequencies may also impose energetic costs (Lambrechts, 1996). For example in birds, vocalizing more loudly in noisy environments may have energetic costs that decrease the net benefits of vocal adjustment and alter a bird's energy budget (Brumm, 2004; Wood and Yezerinac, 2006).

Stress Responses

Classic stress responses begin when an animal's central nervous system perceives a potential threat to its homeostasis. That perception triggers stress responses regardless of whether a stimulus actually threatens the animal; the mere perception of a threat is sometimes sufficient to trigger a stress response (Moberg, 2000; Sapolsky *et al.,* 2005; Seyle, 1950). Once an animal's central nervous system perceives a threat, it mounts a biological response or defense that consists of a combination of the four general biological defense responses: Behavioral responses, autonomic nervous system responses, neuroendocrine responses, or immune responses.

According to Moberg (2000), in the case of many stressors, an animal's first and most economical (in terms of biotic costs) response is behavioral avoidance of the potential stressor or avoidance of continued exposure to a stressor. An animal's second line of defense to stressors involves the sympathetic part of the autonomic nervous system and the classical ''fight or flight'' response which includes the cardiovascular system, the gastrointestinal system, the exocrine glands, and the adrenal medulla to produce changes in heart rate, blood pressure, and gastrointestinal activity that humans commonly associate with ''stress.'' These responses have a relatively short duration and may or may not have significant long-term effect on an animal's welfare.

An animal's third line of defense to stressors involves its neuroendocrine or sympathetic nervous systems; the system that has received the most study has been the hypothalmus-pituitary-adrenal system (also known as the HPA axis in mammals or the hypothalamus-pituitary-interrenal axis in fish and some reptiles). Unlike stress responses associated with the autonomic nervous system, virtually all neuro-endocrine functions that are affected by stress—including immune competence, reproduction, metabolism, and behavior—are regulated by pituitary hormones. Stress-induced changes in the secretion of pituitary hormones have been implicated in failed reproduction (Moberg, 1987; Rivier and Rivest, 1991), altered metabolism (Elasser *et al.,* 2000), reduced immune competence (Blecha, 2000), and behavioral disturbance (Moberg, 1987; Blecha, 2000). Increases in the circulation of glucocorticosteroids (cortisol, corticosterone, and aldosterone in marine mammals; see Romano *et al.,* 2004) have been equated with stress for many years.

The primary distinction between stress, which is adaptive and does not normally place an animal at risk, and distress is the biotic cost of the response. During a stress response, an animal uses glycogen stores that can be quickly replenished once the stress is alleviated. In such circumstances, the cost of the stress response would not pose a risk to the animal's welfare. However, when an animal does not have sufficient energy reserves to satisfy the energetic costs of a stress response, energy resources must be diverted from other biotic functions, which impair those functions. For example, when a stress response diverts energy away from growth in young animals, those animals may experience stunted growth. When a stress response diverts energy from a fetus, an animal's reproductive success and fitness will suffer. In these cases, the animals will have entered a pre-pathological or pathological state which is called distress (Seyle, 1950) or allostatic loading (McEwen and Wingfield, 2003). This pathological state will last until the animal replenishes its biotic reserves sufficient to restore normal function. Note that these examples involve a long-term (days or weeks) stress response exposure to stimuli.

Relationships between these physiological mechanisms, animal behavior, and the costs of stress responses have also been documented fairly well through controlled experiments; because this physiology exists in every vertebrate that has been studied, it is not surprising that stress responses and their costs have been documented in both laboratory and free-living animals (for examples see, Holberton *et al.,* 1996; Hood *et al.,* 1998; Jessop *et al.,* 2003; Krausman *et al.,* 2004; Lankford *et al.,* 2005; Thompson and Hamer, 2000).

There is limited information on the physiological responses of marine mammals to anthropogenic sound exposure, as most observations have been limited to short-term behavioral responses, which included cessation of feeding, resting, or social interactions. Information has been collected on the physiological responses of marine mammals to anthropogenic sounds (Fair and Becker, 2000; Romano *et al.,* 2002; Wright *et al.,* 2008), and various efforts have been undertaken to investigate the impact from vessels including whale watching vessels as well as general vessel traffic noise (Bain, 2002; Erbe, 2002; Noren *et al.,* 2009; Williams *et al.,* 2006, 2009, 2014a, 2014b; Read *et al.,* 2014; Rolland *et al.,* 2012; Pirotta *et al.,* 2015). This body of research for the most part has investigated impacts associated with the presence of chronic stressors (*e.g.,* whale watch vessels), which differ significantly from the proposed Navy SURTASS LFA sonar activities. For example, in the analysis of energy costs to killer whales, Williams *et al.* (2009) suggested that whale-watching in Canada's Johnstone Strait resulted in lost feeding opportunities due to vessel disturbance, which could carry higher costs than other measures of behavioral change might suggest. Ayres *et al.* (2012) reported on research in the Salish Sea (state of Washington) involving the measurement of southern resident killer whale fecal hormones to assess two potential threats to the species recovery: Lack of prey (salmon) and impacts to behavior from vessel traffic. The authors suggested that the lack of prey overshadowed any population-level physiological impacts on southern resident killer whales from vessel traffic. Rolland *et al.* (2012) found that noise reduction from reduced ship traffic in the Bay of Fundy was associated with decreased stress in North Atlantic right whales. In a conceptual model developed by the Population Consequences of Acoustic Disturbance (PCAD) working group, serum hormones were identified as possible indicators of behavioral effects that are translated into altered rates of reproduction and mortality (NRC, 2005). The Office of Naval Research hosted a workshop (Effects of Stress on Marine Mammals Exposed to Sound) in 2009 that focused on this very topic (ONR, 2009). Ultimately, the PCAD working group issued a report (Cochrem, 2014) that summarized information compiled from 239 papers or book chapters relating to stress in marine mammals and concluded that stress responses can last from minutes to hours and, while we typically focus on adverse stress responses, stress response is part of a natural process to help animals adjust to changes in their environment and can also be either neutral or beneficial. Of note, work published by the National Academies of Sciences, Engineering and Medicine built upon previous reports to assess current methodologies used for evaluating cumulative effects and identified new approaches that could improve these assessments focusing on ways to quantify exposure-related changes in behavior, health, or body condition of individual marine mammals (National Academies, 2017).

Despite the lack of robust information on stress responses for marine mammals exposed to anthropogenic sounds, studies of other marine and terrestrial animals lead us to expect some marine mammals to experience physiological stress responses and, perhaps, physiological responses that would be classified as distress upon exposure to low-frequency sounds. For example, Jansen (1998) reported on the relationship between acoustic exposures and physiological responses that are indicative of stress responses in humans (*e.g.,* elevated respiration and increased heart rates). Jones (1998) reported on reductions in human performance when faced with acute, repetitive exposures to acoustic disturbance. Trimper *et al.* (1998) reported on the physiological stress responses of osprey to low-level aircraft noise while Krausman *et al.* (2004) reported on the auditory and physiology stress responses of endangered Sonoran pronghorn to military overflights. Smith *et al.* (2004a, 2004b) identified noise-induced physiological transient stress responses in hearing-specialist fish (*i.e.,* goldfish) that accompanied short- and long-term hearing losses. Welch and Welch (1970) reported physiological and behavioral stress responses that accompanied damage to the inner ears of fish and several mammals.

Hearing is one of the primary senses marine mammals use to gather information about their environment and communicate with conspecifics. Although empirical information on the relationship between sensory impairment (TTS, PTS, and acoustic masking) and stress in marine mammals remains limited, it is reasonable to assume that reducing an animal's ability to gather information about its environment and communicate with conspecifics could induce stress in animals that use hearing as their primary sensory mechanism. We also assume that acoustic exposures sufficient to trigger onset of a threshold shift (PTS or TTS) would be accompanied by physiological stress responses, because terrestrial animals exhibit those responses under similar conditions (NRC, 2003). More importantly, due to the effect of noise and the need to effectively gather acoustic information and respond, marine mammals might experience stress responses at received levels lower than those necessary to trigger onset of TTS. Based on empirical studies of the time required to recover from stress responses (Moberg, 2000), NMFS also assumes that stress responses could persist beyond the time interval required for animals to recover from TTS and might result in pathological and pre-pathological states that would be as significant as behavioral responses associated with TTS. Much more research is needed to begin to understand the potential for physiological stress in marine mammals. As discussed in the Behavioral Response/Disturbance section below, the existing data suggest a variable response that depends on the characteristics of the received signal and prior experience with the received signal. However, NMFS anticipates that the nature of SURTASS LFA sonar training and testing activities, where a small number of vessels operate LFA sonar for relatively short durations in open ocean environments, in combination with many of the same factors discussed above related to masking, will limit the potential for stress responses due to SURTASS LFA sonar training and testing activities. These factors include the fact that continuous-frequency waveforms have durations of no longer than 10 seconds; frequency-modulated waveforms have limited bandwidths (30 Hz); and when LFA sonar is transmitting, 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.

Behavioral Response/Disturbance

Southall *et al.* (2007) reviewed the available literature on marine mammal hearing and physiological and behavioral responses to human-made sound with the goal of proposing exposure criteria for certain effects. This peer-reviewed compilation of literature is very valuable, though Southall *et al.* (2007) note that not all data are equal:

Some have poor statistical power, insufficient controls, and/or limited information on received levels, background noise, and other potentially important contextual variables. Such data were reviewed and sometimes used for qualitative illustration, but no quantitative criteria were recommended for behavioral responses. All of the studies considered, however, contain an estimate of the received sound level when the animal exhibited the indicated response.

In the Southall *et al.* (2007) publication, for the purposes of analyzing responses of marine mammals to anthropogenic sound and developing criteria, the authors differentiate between single pulse sounds, multiple pulse sounds, and non-pulse sounds. LFA sonar is considered a non-pulse sound. Southall *et al.* (2007) summarizes the studies associated with low-frequency, mid-frequency, and high-frequency cetacean and pinniped responses to non-pulse sounds, based strictly on received level, in Appendix C of their article (incorporated by reference and summarized in the following paragraphs).

The studies that address responses of low-frequency cetaceans to non-pulse sounds include data gathered in the field and related to several types of sound sources, including: Vessel noise, drilling and machinery playback, low-frequency M-sequences (sine wave with multiple phase reversals) playback, tactical low-frequency active sonar playback, drill ships, Acoustic Thermometry of Ocean Climate (ATOC) source, and non-pulse playbacks. These studies generally indicate no (or very limited) responses to received levels in the 90 to 120 dB re: 1 µPa range and an increasing likelihood of avoidance and other behavioral effects in the 120 to 160 dB re: 1 µPa range. As mentioned earlier, though, contextual variables play a very important role in the reported responses, and the severity of effects are not necessarily linear when compared to a received level. Also, few of the laboratory or field datasets had common conditions, behavioral contexts, or sound sources, so it is not surprising that responses differ.

The studies that address responses of mid-frequency cetaceans to non-pulse sounds include data gathered both in the field and the laboratory and related to several different sound sources including: Pingers, drilling playbacks, ship and ice-breaking noise, vessel noise, Acoustic Harassment Devices (AHDs), Acoustic Deterrent Devices (ADDs), MF active sonar, and non-pulse bands and tones. Southall *et al.* (2007) were unable to come to a clear conclusion regarding the results of these studies. In some cases, animals in the field showed significant responses to received levels between 90 and 120 dB re: 1 µPa, while in other cases these responses were not seen in the 120 to 150 dB re: 1 µPa range. The disparity in results was likely due to contextual variation and the differences between the results in the field and laboratory data (animals typically responded at lower levels in the field).

The studies that address responses of high-frequency cetaceans to non-pulse sounds include data gathered both in the field and the laboratory and related to several different sound sources including: Pingers, AHDs, and various laboratory non-pulse sounds. All of these data were collected from harbor porpoises. Southall *et al.* (2007) concluded that the existing data indicate that harbor porpoises are likely sensitive to a wide range of anthropogenic sounds at low received levels (approximately 90–120 dB re: 1 µPa), at least for initial exposures. All recorded exposures above 140 dB re: 1 µPa induced profound and sustained avoidance behavior in wild harbor porpoises (Southall *et al.,* 2007). Rapid habituation was noted in some but not all studies. There are no data to indicate whether other high-frequency cetaceans are as sensitive to anthropogenic sound as harbor porpoises.

The studies that address the responses of pinnipeds in water to non-pulse sounds include data gathered both in the field and the laboratory and related to several different sound sources including: AHDs, ATOC, various non-pulse sounds used in underwater data communication, underwater drilling, and construction noise. Few studies exist with enough information to include them in this analysis. The limited data suggest that exposure to non-pulse sounds between 90 and 140 dB re: 1 µPa generally do not result in strong behavioral responses of pinnipeds in water, but no data exist at higher received levels.

Behavioral responses to sound are highly variable and context-specific. Many different variables can influence an animal's perception of, as well as the nature and magnitude of response to, an acoustic event. An animal's prior experience with a sound or sound source affects whether it is less likely (habituation) or more likely (sensitization) to respond to certain sounds in the future. Animals can also be innately predisposed to respond to certain sounds in certain ways (Southall *et al.,* 2007). Related to the sound itself, the perceived nearness of the sound, bearing of the sound (approaching vs. retreating), similarity of the sound to biologically relevant sounds in the animal's environment (*i.e.,* calls of predators, prey, or conspecifics), and familiarity of the sound may affect the way an animal responds to the sound (Southall *et al.,* 2007; DeRuiter *et al.,* 2013). Individuals of different age, gender, reproductive status, etc. among most populations will have variable hearing capabilities, and differing behavioral sensitivities to sounds that will be affected by prior conditioning, experience, and current activities of those individuals. Often, specific acoustic features of the sound and contextual variables (*i.e.,* proximity, duration, or recurrence of the sound or the current behavior that the marine mammal is engaged in or its prior experience), as well as entirely separate factors such as the physical presence of a nearby vessel, may be more relevant to the animal's response than the received level alone. For example, Goldbogen *et al.* (2013) demonstrated that individual behavioral state was critically important in determining response of blue whales to sonar, noting that individuals engaged in deep (≤50 m) feeding behavior had greater dive responses than those in shallow feeding or non-feeding conditions. Some blue whales in the Goldbogen *et al.* (2013) study that were engaged in shallow feeding behavior demonstrated no clear changes in diving or movement even when RLs were high (~160 dB re 1µPa) for exposures to 3–4 kHz sonar signals, while others showed a clear response at exposures at lower RLs of sonar and pseudorandom noise.

Studies by DeRuiter *et al.* (2012) indicate that variability of responses to acoustic stimuli depends not only on the species receiving the sound and the sound source, but also on the social, behavioral, or environmental contexts of exposure. Another study by DeRuiter *et al.* (2013) examined behavioral responses of Cuvier's beaked whales to MF sonar and found that whales responded strongly at low received levels (RL of 89–127 dB re 1µPa) by ceasing normal fluking and echolocation, swimming rapidly away, and extending both dive duration and subsequent non-foraging intervals when the sound source was 3.4–9.5 km away. Importantly, this study also showed that whales exposed to a similar range of RLs (78–106 dB re 1µPa) from distant sonar exercises (118 km away) did not elicit such responses, suggesting that context (here, in the form of distance) may moderate reactions. In a review of research conducted, including 370 published papers, Gomez *et al.* (2016)

demonstrated that more severe behavioral responses were not consistently associated with higher RL, but that the type of source transmitting the acoustic energy was a key factor, highlighting the importance of context of exposure in impact analysis.

Ellison *et al.* (2012) outlined an approach to assessing the effects of sound on marine mammals that incorporates contextual-based factors. The authors recommend considering not just the received level of sound, but also the activity the animal is engaged in at the time the sound is received, the nature and novelty of the sound (*i.e.,* is this a new sound from the animal's perspective), and the distance between the sound source and the animal. They submit that this ''exposure context,'' as it is termed, greatly influences the type of behavioral response exhibited by the animal. This sort of contextual information is challenging to predict with accuracy for ongoing activities that occur over large spatial and temporal expanses. While contextual elements of this sort are typically not included in calculations to quantify take estimates of marine mammals, they are often considered qualitatively in the analysis of the likely consequences of sound exposure, where supporting information is available.

Friedlaender *et al.* (2016) provided the first integration of direct measures of prey distribution and density variables incorporated into across-individual analyses of behavior responses of blue whales to sonar, and demonstrated a 5-fold increase in the ability to quantify variability in blue whale diving behavior. These results illustrate that responses evaluated without such measurements for foraging animals may be misleading, which again illustrates the context-dependent nature of the probability of response.

Exposure of marine mammals to sound sources can result in, but is not limited to, no response or any of the following observable responses: Increased alertness; orientation or attraction to a sound source; vocal modifications; cessation of feeding; cessation of social interaction; alteration of movement or diving behavior; avoidance; habitat abandonment (temporary or permanent); and, in severe cases, panic, flight, stampede, or stranding, potentially resulting in death (Southall *et al.,* 2007). A review of marine mammal responses to anthropogenic sound was first conducted by Richardson (1995). More recent reviews (Nowacek *et al.,* 2007; DeRuiter *et al.,* 2012 and 2013; Ellison *et al.,* 2012) addressed studies conducted since 1995 and focused on observations where the received sound level of the exposed marine mammal(s) was known or could be estimated. In a review of experimental field studies to measure behavioral responses of cetaceans to sonar, Southall *et al.* (2016) states that results demonstrate that some individuals of different species display clear yet varied responses, some of which have negative implications, while others appear to tolerate high levels, and that responses may not be fully predictable with simple acoustic exposure metrics (*e.g.,* received sound level). Rather, the authors state that differences among species and individuals along with contextual aspects of exposure (*e.g.,* behavioral state) appear to affect response probability. The following subsections provide examples of behavioral responses that provide an idea of the variability in behavioral responses that would be expected given the different sensitivities of marine mammal species to sound and the wide range of potential acoustic sources to which a marine mammal may be exposed. Predictions about the types of behavioral responses that could occur for a given sound exposure should be determined from the literature that is available for each species or extrapolated from closely related species when no information exists, along with contextual factors.

Alteration of Diving or Movement

Changes in dive behavior can vary widely. They may consist of increased or decreased dive times and surface intervals as well as changes in the rates of ascent and descent during a dive. Variations in dive behavior may reflect interruptions in biologically significant activities (*e.g.,* foraging) or they may be of little biological significance. Variations in dive behavior may also expose an animal to potentially harmful conditions (*e.g.,* increasing the chance of ship-strike) or may serve as an avoidance response that enhances survivorship. The impact of a variation in diving resulting from an acoustic exposure depends on what the animal is doing at the time of the exposure and the type and magnitude of the response.

Nowacek *et al.* (2004) reported disruptions of dive behaviors in foraging North Atlantic right whales when exposed to an alerting stimulus, which they noted could lead to an increased likelihood of ship strike. However, the whales did not respond to playbacks of either right whale social sounds or vessel noise, highlighting the importance of the sound characteristics in producing a behavioral reaction. Conversely, Indo-Pacific humpback dolphins have been observed to dive for longer periods of time in areas where vessels were present and/or approaching (Ng and Leung, 2003). In both of these studies, the influence of the sound exposure cannot be decoupled from the physical presence of a surface vessel, thus complicating interpretations of the relative contribution of each stimulus to the response. Indeed, the presence of surface vessels, their approach, and the speed of approach, all seemed to be significant factors in the response of the Indo-Pacific humpback dolphins (Ng and Leung, 2003). Low-frequency signals of the ATOC sound source were not found to affect dive times of humpback whales in Hawaiian waters (Frankel and Clark, 2000) or to overtly affect elephant seal dives (Costa *et al.,* 2003). However, they did produce subtle effects that varied in direction and degree among the individual seals, illustrating the varied nature of behavioral effects and consequent difficulty in defining and predicting them. Lastly, as noted previously, DeRuiter *et al.* (2013) noted that distance from a sound source may moderate marine mammal reactions in their study of Cuvier's beaked whales showing the whales swimming rapidly and silently away when a sonar signal was 3.4–9.5 km away, while showing no such reaction to the same signal when the signal was 118 km away even though the RLs were similar.

Foraging

Disruption of feeding behavior can be difficult to correlate with anthropogenic sound exposure, so it is usually inferred by observed displacement from known foraging areas, the appearance of secondary indicators (*e.g.,* bubble nets or sediment plumes), or changes in dive behavior. Noise from seismic surveys was not found to impact the feeding behavior of western gray whales off the coast of Russia (Yazvenko *et al.,* 2007) and sperm whales engaged in foraging dives did not abandon dives when exposed to distant signatures of seismic airguns (Madsen *et al.,* 2006). Balaenopterid whales exposed to moderate SURTASS LFA sonar demonstrated no responses or change in foraging behavior that could be attributed to the low-frequency sounds (Croll *et al.,* 2001), whereas five out of six North Atlantic right whales exposed to an acoustic alarm interrupted their foraging dives (Nowacek *et al.,* 2004). Although the received sound pressure level was similar in the latter two studies, the frequency, duration, and temporal pattern of signal presentation were different. These factors, as well as differences in species sensitivity, are likely contributing factors to the differential response.

Blue whales exposed to simulated mid-frequency sonar in the Southern California Bight were less likely to produce low frequency calls usually associated with feeding behavior (Melcón *et al.,* 2012). However, the authors were unable to determine if suppression of low frequency calls reflected a change in their feeding performance, or abandonment of foraging behavior and indicated that implications of the documented responses are unknown. Further, it is not known whether the lower rates of calling actually indicated a reduction in feeding behavior or social contact since the study used data from remotely deployed, passive acoustic monitoring buoys. In contrast, blue whales increased their likelihood of calling when ship noise was present, and decreased their likelihood of calling in the presence of explosive noise, although this result was not statistically significant (Melcón *et al.,* 2012). Additionally, the likelihood of an animal calling decreased with the increased received level of mid-frequency sonar, beginning at a SPL of approximately 110–120 dB re 1 µPa (Melcón *et al.,* 2012). Results from the 2010–2011 field season of an ongoing behavioral response study in Southern California waters indicated that, in some cases and at low received levels, tagged blue whales responded to mid-frequency sonar but that those responses were mild and there was a quick return to their baseline activity (Southall *et al.,* 2011; Southall *et al.,* 2012). Goldbogen *et al.* (2013) monitored behavioral responses of tagged blue whales located in feeding areas when exposed to simulated MFA sonar. Responses varied depending on behavioral context, with deep feeding whales being more significantly affected (*i.e.,* generalized avoidance; cessation of feeding; increased swimming speeds; or directed travel away from the source) compared to surface feeding individuals that typically showed no change in behavior. Non-feeding whales also seemed to be affected by exposure. The authors indicate that disruption of feeding and displacement could impact individual fitness and health. However, for this to be true, we would have to assume that an individual whale could not compensate for this lost feeding opportunity by either immediately feeding at another location, by feeding shortly after cessation of acoustic exposure, or by feeding at a later time. There is no indication this is the case for the proposed SURTASS LFA sonar activities, particularly since SURTASS LFA sonar training and testing activities take place offshore in open ocean environments and are fairly spread out and relatively short-term in nature, unconsumed prey would likely still be available in the environment in most cases following the cessation of acoustic exposure. A determination of whether foraging disruptions incur fitness consequences is informed by estimates of the energetic requirements of the individuals and the relationship between prey availability, foraging effort and success, and the life history stage of the animal, but is also based on an understanding of the magnitude and duration of the disruption.

Social Relationships

Social interactions between mammals can be affected by noise via the disruption of communication signals or by the displacement of individuals. Sperm whales responded to military sonar, apparently from a submarine, by dispersing from social aggregations, moving away from the sound source, remaining relatively silent, and becoming difficult to approach (Watkins *et al.,* 1985). In contrast, sperm whales in the Mediterranean that were exposed to submarine sonar continued calling (J. Gordon pers. comm. cited in Richardson *et al.,* 1995). However, social disruptions must be considered in context of the relationships that are affected. While some disruptions may not have deleterious effects, others, such as long-term or repeated disruptions of mother/calf pairs or interruption of mating behaviors, have the potential to affect the growth and survival or reproductive effort/success of individuals.

Vocalizations (Also See Masking Section)

Vocal changes in response to anthropogenic noise can occur across the repertoire of sound production modes used by marine mammals, such as whistling, echolocation click production, calling, and singing. Changes may result in response to a need to compete with an increase in background noise or may reflect an increased vigilance or startle response. For example, in the presence of low-frequency active sonar, humpback whales have been observed to increase the length of their ''songs'' (Miller *et al.,* 2000; Fristrup *et al.,* 2003), possibly due to the overlap in frequencies between the whale song and the low-frequency active sonar. A similar compensatory effect for the presence of low-frequency vessel noise has been suggested for right whales; right whales have been observed to shift the frequency content of their calls upward while reducing the rate of calling in areas of increased anthropogenic noise (Parks *et al.,* 2007). Killer whales off the northwestern coast of the United States have been observed to increase the duration of primary calls once a threshold in observing vessel density (*e.g.,* whale watching) was reached, which has been suggested as a response to increased masking noise produced by the vessels (Foote *et al.,* 2004). In contrast, both sperm and pilot whales potentially ceased sound production during the Heard Island feasibility test (Bowles *et al.,* 1994), although it cannot be absolutely determined whether the inability to acoustically detect the animals was due to the cessation of sound production or the displacement of animals from the area.

Aicken *et al.* (2005) monitored the behavioral responses of marine mammals to a new low-frequency active sonar system used by the British Navy (the United States Navy considers this to be a mid-frequency source as it operates at frequencies greater than 1,000 Hz). During those trials, fin whales, sperm whales, Sowerby's beaked whales, long-finned pilot whales, Atlantic white-sided dolphins, and common bottlenose dolphins were observed and their vocalizations were recorded. These monitoring studies detected no evidence of behavioral responses that the investigators could attribute to exposure to the low-frequency active sonar during these trials.

Avoidance

Avoidance is the displacement of an individual from an area as a result of the presence of a sound. Richardson *et al.* (1995) noted that avoidance reactions are the most obvious manifestations of disturbance in marine mammals. Avoidance is qualitatively different from the flight response, and also differs in the magnitude of the response (*i.e.,* directed movement, rate of travel, etc.). Oftentimes, avoidance is temporary and animals return to the area once the noise has ceased. However, longer-term displacement is possible and can lead to changes in abundance or distribution patterns of the species in the affected region if animals do not become acclimated to the presence of the chronic sound (Blackwell *et al.,* 2004; Bejder *et al.,* 2006; Teilmann *et al.,* 2006). Acute avoidance responses have been observed in captive porpoises and pinnipeds exposed to a number of different sound sources (Kastelein *et al.,* 2001; Finneran *et al.,* 2003; Kastelein *et al.,* 2006a; Kastelein *et al.,* 2006b).

Short-term avoidance of seismic surveys, low-frequency emissions, and acoustic deterrents have also been noted in wild populations of odontocetes (Bowles *et al.,* 1994; Goold, 1996, 1998; Stone *et al.,* 2000; Morton and Symonds, 2002) and to some extent in mysticetes (Gailey *et al.,* 2007), while long-term or repetitive/chronic displacement for some dolphin groups and for manatees has been suggested to result from the presence of chronic vessel noise (Haviland-Howell *et al.,* 2007; Miksis-Olds *et al.,* 2007).

In 1998, the Navy conducted a Low Frequency Sonar Scientific Research Program (LFS SRP) specifically to study behavioral responses of several species of marine mammals to exposure to LF sound, including one phase that focused on the behavior of gray whales to low frequency sound signals. The objective of this phase of the LFS SRP was to determine whether migrating gray whales respond more strongly to received levels (RL), sound gradient, or distance from the source, and to compare whale avoidance responses to an LF source in the center of the migration corridor versus in the offshore portion of the migration corridor. A single source was used to broadcast LFA sonar sounds at RLs of 170–178 dB re 1μPa. The Navy reported that the whales showed some avoidance responses when the source was moored one mile (1.8 km) offshore, and located within the migration path, but the whales returned to their migration path when they were a few kilometers beyond the source. When the source was moored two miles (3.7 km) offshore, outside the migration path, responses were much less even when the source level was increased to achieve the same RLs in the middle of the migration corridor as whales received when the source was located within the migration corridor (Clark *et al.,* 1999). In addition, the researchers noted that the offshore whales did not seem to avoid the louder offshore source.

Also during the LFS SRP, researchers sighted numerous odontocete and pinniped species in the vicinity of the sound exposure tests with LFA sonar. The MF and HF hearing specialists present in the study area showed no immediately obvious responses or changes in sighting rates as a function of source conditions. Consequently, the researchers concluded that none of these species had any obvious behavioral reaction to LFA sonar signals at received levels similar to those that produced only minor short-term behavioral responses in the baleen whales (*i.e.,* LF hearing specialists). Thus, for odontocetes, the chances of injury and/or significant behavioral responses to SURTASS LFA sonar would be low given the MF/HF specialists' observed lack of response to LFA sounds during the LFS SRP and due to the MF/HF frequencies which these animals are adapted to hear (Clark and Southall, 2009).

Maybaum (1993) conducted sound playback experiments to assess the effects of mid-frequency active sonar on humpback whales in Hawaiian waters. Specifically, she exposed focal pods to sounds of a 3.3-kHz sonar pulse, a sonar frequency sweep from 3.1 to 3.6 kHz, and a control (blank) tape while monitoring the behavior, movement, and underwater vocalizations. The two types of sonar signals differed in their effects on the humpback whales, but both resulted in avoidance behavior. The whales responded to the pulse by increasing their distance from the sound source and responded to the frequency sweep by increasing their swimming speeds and track linearity. In the Caribbean, sperm whales avoided exposure to mid-frequency submarine sonar pulses, in the range of 1000 Hz to 10,000 Hz (IWC, 2005).

Kvadsheim *et al.* (2007) conducted a controlled exposure experiment in which killer whales fitted with D-tags were exposed to mid-frequency active sonar (Source A: a 1.0 s upsweep 209 dB @1–2 kHz every 10 sec for 10 minutes; Source B: with a 1.0 s upsweep 197 dB @6–7 kHz every 10 sec for 10 min). When exposed to Source A, a tagged whale and the group it was traveling with did not appear to avoid the source. When exposed to Source B, the tagged whales, along with other whales that had been carousel feeding where killer whales cooperatively herd fish schools into a tight ball towards the surface and feed on the fish which have been stunned by tail slaps and subsurface feeding (Simila, 1997), ceased feeding during the approach of the sonar and moved rapidly away from the source. When exposed to Source B, Kvadsheim and his co-workers reported that a tagged killer whale seemed to try to avoid further exposure to the sound field by performing the following behaviors: Immediately swimming away (horizontally) from the source of the sound; engaging in a series of erratic and frequently deep dives that seemed to take it below the sound field; or swimming away while engaged in a series of erratic and frequently deep dives. Although the sample sizes in this study are too small to support statistical analysis, the behavioral responses of the orcas were consistent with the results of other studies.

In 2007, the first in a series of behavioral response studies (BRS) on deep diving odontocetes, funded by Navy, and supported by NMFS and other scientists, showed one beaked whale (*Mesoplodon densirostris*) responding to an MF active sonar playback. Tyack *et al.* (2011) indicates that the playback began when the tagged beaked whale was vocalizing at depth (at the deepest part of a typical feeding dive), following a previous control with no sound exposure. The whale appeared to stop clicking significantly earlier than usual, when exposed to mid-frequency signals in the 130–140 dB (rms) received level range. After a few more minutes of the playback, when the received level reached a maximum of 140–150 dB, the whale ascended on the slow side of normal ascent rates with a longer than normal ascent, at which point the exposure was terminated. The results are from a single experiment and a greater sample size is needed before robust and definitive conclusions can be drawn.

Tyack *et al.* (2011) also indicate that Blainville's beaked whales (a resident species within the Tongue of the Ocean, Bahamas study area) appear to be sensitive to noise at levels well below the onset of expected TTS (approximately 160 dB re: 1μPa at 1 m). This sensitivity was manifested by an adaptive movement away from a sound source. This response was observed irrespective of whether the signal transmitted was within the bandwidth of MF active sonar, which suggests that beaked whales may not respond to the specific sound signatures. Instead, they may be sensitive to any pulsed sound from a point source in the frequency range of the MF active sonar transmission. The response to such stimuli appears to involve the beaked whale increasing the distance between it and the sound source.

Southall *et al.* (2016) indicates that results from Tyack *et al.* (2011), Miller *et al.* (2015), Stimpert *et al.* (2014), and DeRuiter *et al.* (2013) all demonstrate clear, strong, and pronounced but varied behavioral changes including sustained avoidance with associated energetic swimming and cessation of feeding behavior at quite low received levels (~100 to 135 dB re 1μPa) for exposures to simulated or active MF military sonars (1 to 8 kHz) with sound sources approximately 2 to 5 km away, with a common theme being the context-dependent nature of the behavioral responses.

In the 2010 SOCAL BRS study, researchers again used controlled exposure experiments (CEE) to carefully measure behavioral responses of individual animals to sound exposures of simulated tactical MF active sonar and pseudo-random noise. For each sound type, some exposures were conducted when animals were in a surface feeding (approximately 164 ft (50 m) or less) and/or socializing behavioral state and others while animals were in a deep feeding (greater than 164 ft (50 m)) and/or traveling mode. The researchers conducted the largest number of CEEs on blue whales (n=19) and of these, 11 CEEs involved exposure to the MF active sonar sound type. For the majority of CEE transmissions of either sound type, they noted few obvious behavioral responses detected either by the visual observers or on initial inspection of the tag data. The researchers observed that throughout the CEE transmissions, up to the highest received sound level (absolute RMS value approximately 160 dB re: 1µPa with signal-to-noise ratio values over 60 dB), two blue whales continued surface feeding behavior and remained at a range of around 3,820 ft (1,000 m) from the sound source (Southall *et al.,* 2011). In contrast, another blue whale (later in the day and greater than 11.5 mi (18.5 km; 10 nmi) from the first CEE location) exposed to the same stimulus (MFA) while engaged in a deep feeding/travel state exhibited a different response. In that case, the blue whale responded almost immediately following the start of sound transmissions when received sounds were just above ambient background levels (Southall *et al.,* 2011). The authors note that this kind of temporary avoidance behavior was not evident in any of the nine CEEs involving blue whales engaged in surface feeding or social behaviors, but was observed in three of the ten CEEs for blue whales in deep feeding/travel behavioral modes (one involving MFA sonar; two involving pseudo-random noise) (Southall *et al.,* 2011). Southall *et al.* (2016) provided an overview of the Southern California Behavioral Response Study (SOCAL–BRS). The results of this study, as well as the results of the DeRuiter *et al.* (2013) study of Cuvier's beaked whales discussed above, further illustrate the importance of behavioral context in understanding and predicting behavioral responses.

Flight Response

A flight response is a dramatic change in normal movement to a directed and rapid movement away from the perceived location of a sound source. Relatively little information on flight responses of marine mammals to anthropogenic signals exist, although observations of flight responses to the presence of predators have occurred (Connor and Heithaus, 1996). Flight responses have been speculated as being a component of marine mammal strandings associated with MF active sonar activities (Evans and England, 2001). If marine mammals respond to Navy vessels that are transmitting active sonar in the same way that they might respond to a predator, their probability of flight responses should increase when they perceive that Navy vessels are approaching them directly, because a direct approach may convey detection and intent to capture (Burger and Gochfeld, 1981, 1990; Cooper, 1997, 1998). In addition to the limited data on flight response for marine mammals, there are examples of this response in terrestrial species. For instance, the probability of flight responses in Dall's sheep (*Ovis dalli dalli*) (Frid, 2001), hauled-out ringed seals (*Phoca hispida*) (Born *et al.,* 1999), Pacific brant (*Branta bernicl nigricans*), and Canada geese (*B. Canadensis*) increased as a helicopter or fixed-wing aircraft more directly approached groups of these animals (Ward *et al.,* 1999). Bald eagles (*Haliaeetus leucocephalus*) perched on trees alongside a river were also more likely to flee from a paddle raft when their perches were closer to the river or were closer to the ground (Steidl and Anthony, 1996).

Breathing

Variations in respiration naturally occur with different behaviors. Variations in respiration rate as a function of acoustic exposure can co-occur with other behavioral reactions, such as a flight response or an alteration in diving. However, respiration rates in and of themselves may be representative of annoyance or an acute stress response. Mean exhalation rates of gray whales at rest and while diving were found to be unaffected by seismic surveys conducted adjacent to foraging grounds (Gailey *et al.,* 2007). Studies with captive harbor porpoises showed increased respiration rates upon introduction of acoustic alarms (Kastelein *et al.,* 2001; Kastelein *et al.,* 2006a) and emissions for underwater data transmission (Kastelein *et al.,* 2005). However, exposing the same acoustic alarm to a striped dolphin under the same conditions did not elicit a response (Kastelein *et al.,* 2006a), again highlighting the importance of understanding species differences in the tolerance of underwater noise when determining the potential for impacts resulting from anthropogenic sound exposure.

Continued Pre-Disturbance Behavior and Habituation

Under some circumstances, some of the individual marine mammals that are exposed to active sonar transmissions will continue their normal behavioral activities. In other circumstances, individual animals will respond to sonar transmissions at lower received levels and move to avoid additional exposure or exposures at higher received levels (Richardson *et al.,* 1995).

It is difficult to distinguish between animals that continue their pre-disturbance behavior without stress responses, animals that continue their behavior but experience stress responses (that is, animals that cope with disturbance), and animals that habituate to disturbance (that is, they may have experienced low-level stress responses initially, but those responses abated over time). Watkins (1986) reviewed data on the behavioral reactions of fin, humpback, right and minke whales that were exposed to continuous, broadband low-frequency shipping and industrial noise in Cape Cod Bay. He concluded that underwater sound was the primary cause of behavioral reactions in these species of whales and that the whales responded behaviorally to acoustic stimuli within their respective hearing ranges. Watkins also noted that whales showed the strongest behavioral reactions to sounds in the 15 Hz to 28 kHz range, although negative reactions (avoidance, interruptions in vocalizations, etc.) were generally associated with sounds that were either unexpected, too loud, suddenly louder or different, or perceived as being associated with a potential threat (such as an approaching ship on a collision course). In particular, whales seemed to react negatively when they were within 100 m of the source or when received levels increased suddenly in excess of 12 dB relative to ambient sounds. At other times, the whales ignored the source of the signal and all four species habituated to these sounds. Nevertheless, Watkins concluded that whales ignored most sounds in the background of ambient noise, including sounds from distant human activities even though these sounds may have had considerable energies at frequencies well within the whales' range of hearing. Further, he noted that of the whales observed, fin whales were the most sensitive of the four species, followed by humpback whales; right whales were the least likely to be disturbed and generally did not react to low-amplitude engine noise. By the end of his period of study, Watkins (1986) concluded that fin and humpback whales have generally habituated to the continuous and broadband noise of Cape Cod Bay while right whales did not appear to change their response. As mentioned above, animals that habituate to a particular disturbance may have experienced low-level stress responses initially, but those responses abated over time. In most cases, this likely means a lessened immediate potential effect from a disturbance. However, there is cause for concern where the habituation occurs in a potentially more harmful situation. For example, animals may become more vulnerable to vessel strikes once they habituate to vessel traffic (Swingle *et al.,* 1993; Wiley *et al.,* 1995).

Potential Effects of Behavioral Disturbance

The primary potential impact on marine mammals from exposure to SURTASS LFA sonar is behavioral response. We note here that not all behavioral responses rise to the level of take under the MMPA, and not all take results in significant changes in biologically important behaviors that are expected to impact individual fitness through effects on reproductive success or survival. Complexities associated with evaluation of when behavioral responses are likely to impact energetics or reproductive success, creating the potential for population consequences, are becoming clearer as data are compiled on extensively studied species and energetic models are created (Maresh *et al.,* 2014; New *et al.,* 2014; and Robinson *et al.,* 2012). There are few quantitative marine mammal data relating the exposure of marine mammals to sound to effects on reproduction or survival, though data exist for terrestrial species to which we can draw comparisons for marine mammals. Several authors have reported that disturbance stimuli cause animals to abandon nesting and foraging sites (Sutherland and Crockford, 1993); cause animals to increase their activity levels and suffer premature deaths or reduced reproductive success when their energy expenditures exceed their energy budgets (Daan *et al.,* 1996; Feare, 1976; Mullner *et al.,* 2004); or cause animals to experience higher predation rates when they adopt risk-prone foraging or migratory strategies (Frid and Dill, 2002). Each of these studies addressed the consequences of animals shifting from one behavioral state (*e.g.,* resting or foraging) to another behavioral state (*e.g.,* avoidance or escape behavior) because of human disturbance or disturbance stimuli.

One consequence of behavioral avoidance results in the altered energetic expenditure of marine mammals because energy is required to move and avoid surface vessels or the sound field associated with active sonar (Frid and Dill, 2002). Most animals can avoid that energetic cost by swimming away at slow speeds or speeds that minimize the cost of transport (Miksis-Olds, 2006), as has been demonstrated in Florida manatees (Miksis-Olds, 2006).

Those energetic costs increase, however, when animals shift from a resting state, which is designed to conserve an animal's energy, to an active state that consumes energy the animal would have conserved had it not been disturbed. Marine mammals that have been disturbed by anthropogenic noise and vessel approaches are commonly reported to shift from resting to active behavioral states, which would imply that they incur an energy cost.

Morete *et al.* (2007) reported that undisturbed humpback whale cows that were accompanied by their calves were frequently observed resting while their calves circled them (milling). When vessels approached, the amount of time cows and calves spent resting and milling, respectively, declined significantly. These results are similar to those reported by Scheidat *et al.* (2004) for the humpback whales they observed off the coast of Ecuador.

Constantine and Brunton (2001) reported that bottlenose dolphins in the Bay of Islands, New Zealand, engaged in resting behavior just five percent of the time when vessels were within 300 m, compared with resting 83 percent of the time when vessels were not present. However, Heenehan *et al.* (2016) report that results of a study of the response of Hawaiian spinner dolphins to human disturbance suggest that the key factor is not the sheer presence or magnitude of human activities, but whether the activities are directed and focused on dolphins at rest. This information again illustrates the importance of context in regard to whether an animal will respond to a stimulus. Miksis-Olds (2006) and Miksis-Olds *et al.* (2005) reported that Florida manatees in Sarasota Bay, Florida, reduced the amount of time they spent milling and increased the amount of time they spent feeding when background noise levels increased. Although the acute costs of these changes in behavior are not likely to exceed an animal's ability to compensate, the chronic costs of these behavioral shifts are uncertain.

Attention is the cognitive process of selectively concentrating on one aspect of an animal's environment while ignoring other things (Posner, 1994). Because animals (including humans) have limited cognitive resources, there is a limit to how much sensory information they can process at any time. The phenomenon called ''attentional capture'' occurs when a stimulus (usually a stimulus that an animal is not concentrating on or attending to) ''captures'' an animal's attention. This shift in attention can occur consciously or unconsciously (*e.g.,* when an animal hears sounds that it associates with the approach of a predator) and the shift in attention can be sudden (Dukas, 2002; van Rij, 2007). Once a stimulus has captured an animal's attention, the animal can respond by ignoring the stimulus, assuming a ''watch and wait'' posture, or treating the stimulus as a disturbance and responding accordingly, which includes scanning for the source of the stimulus or ''vigilance'' (Cowlishaw *et al.,* 2004).

Vigilance is normally an adaptive behavior that helps animals determine the presence or absence of predators, assess their distance from conspecifics, or attend to cues from prey (Bednekoff and Lima, 1998; Treves, 2000). Despite those benefits, vigilance comes at a cost; when animals focus their attention on specific environmental cues, they are not attending to other activities, such as foraging. These costs have been documented best in foraging animals, where vigilance has been shown to substantially reduce feeding rates (Saino, 1994; Beauchamp and Livoreil, 1997; Fritz *et al.,* 2002). Animals will spend more time being vigilant, which may translate to less time foraging or resting, when disturbance stimuli approach them more directly, remain at closer distances, have a greater group size (*e.g.,* multiple surface vessels), or when they co-occur with times that an animal perceives increased risk (*e.g.,* when they are giving birth or accompanied by a calf). Most of the published literature suggests that direct approaches will increase the amount of time animals will dedicate to being vigilant. An example of this concept with terrestrial species involved bighorn sheep and Dall's sheep, which dedicated more time to being vigilant, and spent less time resting or foraging, when aircraft made direct approaches over them (Frid, 2001). Vigilance has also been documented in pinnipeds at haul out sites where resting may be disturbed when seals become alerted and/or flush into the water due to a variety of disturbances, which may be anthropogenic (noise and/or visual stimuli) or due to other natural causes such as other pinnipeds (Richardson *et al.,* 1995; Southall *et al.,* 2007;

VanBlaricom, 2010; and Lozano and Hente, 2014).

Several authors have established that long-term and intense disturbance stimuli can cause population effects by reducing the physical condition of individuals that have been disturbed, followed by reduced reproductive success, reduced survival, or both (Daan *et al.,* 1996; Madsen, 1994; White, 1985). For example, Madsen (1994) reported that pink-footed geese (*Anser brachyrhynchus*) in undisturbed habitat gained body mass and had about a 46 percent reproductive success rate compared with geese in disturbed habitat (being consistently scared off the fields on which they were foraging) which did not gain mass and had a 17 percent reproductive success rate. Similar reductions in reproductive success have been reported for other non-marine mammal species; for example, mule deer (*Odocoileus hemionus*) disturbed by all-terrain vehicles (Yarmoloy *et al.,* 1988), caribou (*Rangifer tarandus caribou*) disturbed by seismic exploration blasts (Bradshaw *et al.,* 1998), and caribou disturbed by low-elevation military jet flights (Luick *et al.,* 1996; Harrington and Veitch, 1992). Similarly, a study of elk (*Cervus elaphus*) that were disturbed experimentally by pedestrians concluded that the ratio of young to mothers was inversely related to disturbance rate (Phillips and Alldredge, 2000).

The primary mechanism by which increased vigilance and disturbance appear to affect the fitness of individual animals is by disrupting an animal's time budget, reducing the time they might spend foraging and resting (which increases an animal's activity rate and energy demand while decreasing their caloric intake/energy). As an example of this concept with terrestrial species involved, a study of grizzly bears (*Ursus horribilis*) during July and August 1992 reported that bears disturbed by hikers reduced their energy intake by an average of 12 kilocalories/min (50.2×10^3 kiloJoules/min), and spent energy fleeing or acting aggressively toward hikers (White *et al.,* 1999). Alternately, Ridgway *et al.* (2006) reported that increased vigilance in captive bottlenose dolphins exposed to sound over a five-day period in open-air, open-water enclosures in San Diego Bay did not cause any sleep deprivation or stress effects such as changes in cortisol or epinephrine levels.

On a related note, many animals perform vital functions, such as feeding, resting, traveling, and socializing, on a diel cycle (24-hr cycle). Behavioral reactions to noise exposure (such as disruption of critical life functions, displacement, or avoidance of important habitat) are more likely to be significant for fitness if they last more than one diel cycle or recur on subsequent days (Southall *et al.,* 2007). Consequently, a behavioral response lasting less than one day and not recurring on subsequent days is not considered particularly significant unless it could directly affect reproduction or survival (Southall *et al.,* 2007). It is important to note the difference between behavioral reactions lasting or recurring over multiple days and anthropogenic activities lasting or recurring over multiple days. For example, at-sea SURTASS LFA sonar training and testing activities last for multiple days, but this does not necessarily mean individual animals will be exposed to those exercises for multiple days or exposed in a manner that would result in a sustained behavioral response due to nature of these activities (few vessels spread out in open ocean environments operating fairly sporadically for relatively short term timeframes).

In order to understand how the effects of activities may or may not impact species and stocks of marine mammals, it is necessary to understand not only what the likely disturbances are going to be, but how those disturbances are likely to affect the reproductive success and survivorship of individuals, and then how those impacts to individuals translate to population-level effects. Following on the earlier work of a committee of the U.S. National Research Council (NRC, 2005), an effort by New *et al.* (2014) termed ''Potential Consequences of Disturbance (PCoD)'' outlined an updated conceptual model of the relationships linking disturbance to changes in behavior and physiology, health, vital rates, and population dynamics. In this framework, behavioral and physiological changes can have direct (acute) effects on vital rates, such as when changes in habitat use or increased stress levels raise the probability of mother-calf separation or predation; they can have indirect and long-term (chronic) effects on vital rates, such as when changes in time/energy budgets or increased disease susceptibility affect health, which then later affect vital rates; or they can have no effect to vital rates. In addition to outlining this general framework and compiling the relevant literature that supports it, the authors chose four example species for which extensive long-term monitoring data exist (southern elephant seals, North Atlantic right whales, Ziphidae beaked whales, bottlenose dolphins, harbor porpoise, and others) and developed state-space energetic models that can be used to effectively forecast longer-term, population-level impacts to these species from behavioral changes. An updated study (National Academies, 2017) addressed approaches to understanding the cumulative effects of stressors (*i.e.,* stressors from multiple activities) on marine mammals.

Pirotta *et al.* (2018) reviewed the application of the PCoD framework to marine mammal populations, providing an updated synopsis of studies that have been completed and approaches that have been used to model effects in the framework. Farmer *et al.* (2018) applied the PCoD framework to develop a probabilistic framework for quantitatively assessing the cumulative impacts of oil and sound exposure to sperm whales in the Northern Gulf of Mexico. The authors concluded that uncertainty in their results emphasized a need for further controlled exposure experiments to generate behavioral disturbance dose-response curves and detailed evaluation of individual resilience following disturbance events. While these are very specific models with specific data requirements that cannot yet be applied to project-specific risk assessments or for the majority of species, they are a critical first step towards being able to quantify the likelihood of a population level effect. However, as noted above, due to the nature of the SURTASS LFA sonar training and testing activities, the potential for masking, behavioral effects, and stress would be limited, so the potential for population level effects would also be limited (See relevant sections, above). This potential is further reduced due to implementation of the monitoring and mitigation measures discussed below (See Proposed Mitigation and Proposed Monitoring sections below).

Stranding and Mortality

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

Marine mammals are known to strand for a variety of reasons, such as infectious agents, biotoxicosis, starvation, fishery interaction, ship strike, unusual oceanographic or weather events, sound exposure, or combinations of these stressors sustained concurrently or in series. However, the cause or causes of most strandings are unknown (Geraci *et al.,* 1976; Eaton, 1979; Odell *et al.,* 1980; Best, 1982). Numerous studies suggest that the physiology, behavior, habitat relationships, age, or condition of cetaceans may cause them to strand or might predispose them to strand when exposed to another phenomenon. These suggestions are consistent with the conclusions of numerous other studies that have demonstrated that combinations of dissimilar stressors commonly combine to kill an animal or dramatically reduce its fitness, even though one exposure without the other does not produce the same result (Chroussos, 2000; Creel, 2005; Fair and Becker, 2000; Moberg, 2000; Relyea, 2005a, 2005b, Romero, 2004; Sih *et al.,* 2004).

In 1992, Congress amended the MMPA to establish the Marine Mammal Health and Stranding Response Program (MMHSRP) under authority of NMFS. The MMHSRP was created out of concern over marine mammal mortalities, to formalize the stranding response process, to focus efforts being initiated by numerous local stranding organizations, and as a result of public concern.

Strandings Associated With Active Sonar

Several sources have published lists of mass stranding events of cetaceans in an attempt to identify relationships between those stranding events and military active sonar (Hildebrand, 2004; IWC, 2005; Taylor *et al.,* 2004). For example, based on a review of stranding records between 1960 and 1995, the International Whaling Commission (2005) concluded that, out of eight mass stranding events reported from the mid-1980s to the summer of 2003, most had been coincident with the use of tactical MF active sonar and most involved beaked whales. However, these reports rarely talk about the number of strandings that are not associated with sonar exercises, which number in the thousands. According to Bernaldo de Quiros *et al.* (2019) a review of current knowledge on beaked whale atypical mass strandings associated with MF active sonar suggests that effects vary among individuals or populations, and predisposing factors may contribute to individual outcomes. Differences between tactical MF sonar and SURTASS LFA sonar, as well as the potential for strandings due to SURTASS LFA sonar, are addressed further below.

Over the past 23 years, there have been five mass stranding events coincident with military MF active sonar use in which exposure to sonar is believed to have been a contributing factor: Greece (1996); the Bahamas (2000); Madeira (2000); Canary Islands (2002); and Spain (2006). NMFS refers the reader to DoN (2013) for a report on these strandings associated with Navy sonar activities; Cox *et al.* (2006) for a summary of common features shared by the strandings events in Greece (1996), Bahamas (2000), Madeira (2000), and Canary Islands (2002); and Fernandez *et al.* (2005) for an additional summary of the Canary Islands 2002 stranding event. Additionally, in 2004, during the Rim of the Pacific (RIMPAC) exercises, between 150 and 200 usually pelagic melon-headed whales occupied the shallow waters of Hanalei Bay, Kauai, Hawaii for over 28 hours. NMFS determined that mid-frequency active sonar (MFAS) was a plausible, if not likely, contributing factor in what may have been a confluence of events that led to the Hanalei Bay stranding. A number of other stranding events coincident with the operation of MFAS, including the death of beaked whales or other species (minke whales, dwarf sperm whales, pilot whales), have been reported. However, the majority have not been investigated to the degree necessary to determine the cause of the stranding and only one of these stranding events, the Bahamas (2000), was associated with exercises conducted by the U.S. Navy. Most recently, the Independent Scientific Review Panel investigating potential contributing factors to a 2008 mass stranding of melon-headed whales in Antsohihy, Madagascar, released its final report suggesting that the stranding was likely initially triggered by an industry seismic survey. This report suggests that the operation of a commercial high-powered 12 kHz multi-beam echosounder during an industry seismic survey was a plausible and likely initial trigger that caused a large group of melon-headed whales to leave their typical habitat and then ultimately strand as a result of secondary factors such as malnourishment and dehydration. The report indicates that the risk of this particular convergence of factors and ultimate outcome is likely very low, but recommends that the potential be considered in environmental planning.

In the event that Navy personnel (uniformed military, civilian, or contractors conducting Navy work) associated with operating a SURTASS LFA sonar-equipped vessel discover a live or dead stranded marine mammal at sea, the Navy shall report the incident to NMFS in accordance with the *Stranding and Notification Plan,* available at *https://www.fisheries.noaa.gov/action/incidental-take-authorization-us-navy-operations-surveillance-towed-array-sensor-system-0.* In addition, in the event of a ship strike of a marine mammal by any SURTASS LFA sonar-equipped vessel, the Navy will also report the incident to NMFS in accordance with the *Stranding and Notification Plan* (available at *https://www.fisheries.noaa.gov/action/incidental-take-authorization-us-navy-operations-surveillance-towed-array-sensor-system-0*). If NMFS personnel determine that the circumstances of any marine mammal stranding suggests investigation of the association of Navy SURTASS LFA sonar training and testing activities is warranted, and an investigation is being pursued, NMFS would submit a written request to Navy asking that they provide the requested initial information as soon as possible, but not later than seven business days after the request is received, per the *Stranding and Notification Plan.* Finally, in the event of a live stranding (or near-shore atypical milling), NMFS would advise the Navy of the need to implement shutdown procedures for any use of SURTASS LFA sonar within 50 km (27 nmi) of the live stranding.

Shutdown procedures are not related to the investigation of the cause of the stranding and their implementation is not intended to imply that Navy activity is the cause of the stranding. Rather, shutdown procedures are intended to protect marine mammals exhibiting indicators of distress by minimizing their exposure to possible additional stressors, regardless of the factors that contributed to the stranding.

Potential for Stranding From LFA Sonar

There is no empirical evidence of strandings of marine mammals associated with the employment of SURTASS LFA sonar since its use began in the early 2000s. Moreover, both the system acoustic characteristics and the operational parameters of SURTASS LFA sonar differ from MFA sonars. SURTASS LFA sonars use frequencies generally below 1,000 Hz, with relatively long signals (pulses) on the order of 60 sec, while MF sonars use frequencies greater than 1,000 Hz with relatively short signals on the order of 1 sec. SURTASS LFA sonars involve use of one slower-moving vessel operating far from shore, as opposed to the faster-moving, multi-vessel MFA sonar training scenarios operating in closer proximity to shore that have been co-incident with strandings.

As discussed previously, Cox *et al.* (2006) provided a summary of common features shared by the stranding events related to MF sonar in Greece (1996), Bahamas (2000), and Canary Islands (2002). These included deep water close to land (such as offshore canyons), presence of an acoustic waveguide (surface duct conditions), and periodic sequences of transient pulses (*i.e.,* rapid onset and decay times) generated at depths less than 32.8 ft (10 m) by sound sources moving at speeds of 2.6 m/s (5.1 knots) or more during sonar operations (D'Spain *et al.,* 2006). These features are not similar to LFA sonar activities. First, the Navy will not test and train with SURTASS LFA sonar such that RLs are greater than 180 dB within 22 km (12 nmi) of any coastline, ensuring that sound levels are at reduced levels at a sufficient distance from land. Secondly, when transmitting, the ship typically operates at 1.5–2.5 m/s (3–5 knots), speeds that are less than those found in Cox *et al.* (2009). Finally, the center of the vertical line array (source) is at a depth of approximately 400 ft (121.9 m), reducing the sounds that are transmitted at depths above 32.8 ft (10 m). Also, the LFA sonar signal is transmitted at depths well below 32.8 ft (10 m). While there was an LF component in the Greek stranding in 1996, only MF components were present in the strandings in the Bahamas in 2000, Madeira in 2000, and the Canary Islands in 2002. The International Council for the Exploration of the Sea (ICES) in its ''Report of the Ad-Hoc Group on the Impacts of Sonar on Cetaceans and Fish'' raised the same issues as Cox *et al.* (2006), stating that the consistent association of MF sonar in the Bahamas, Madeira, and Canary Islands strandings suggest that it was the MF component, not the LF component, in the NATO sonar that triggered the Greek stranding of 1996 (ICES, 2005). The ICES (2005) report concluded that no strandings, injury, or major behavioral change have been associated with the exclusive use of LF sonar.

Potential Effects of Vessel Movement and Collisions

Vessel movement in the vicinity of marine mammals has the potential to result in either a behavioral response or a direct physical interaction. Both scenarios are discussed below.

Behavioral Responses to Vessels (Movement and Noise)

There are limited data concerning marine mammal behavioral responses to vessel traffic and vessel noise, and a lack of consensus among scientists with respect to what these responses mean or whether they result in short-term or long-term adverse effects. As discussed previously, behavioral responses are context-dependent, complex, and influenced to varying degrees by a number of factors. For example, an animal may respond differently to a sound emanating from a ship that is moving towards the animal than it would to an identical received level coming from a vessel that is moving away, or to a ship traveling at a different speed or at a different distance from the animal. In cases where vessels actively approach marine mammals (*e.g.,* whale watching or dolphin watching boats), scientists have documented that animals exhibit altered behavior such as increased swimming speed, erratic movement, and active avoidance behavior (Bursk, 1983; Acevedo, 1991; Baker and MacGibbon, 1991; Trites and Bain, 2000; Constantine *et al.,* 2003), reduced blow interval (Ritcher *et al.,* 2003), disruption of normal social behaviors (Lusseau, 2003, 2006), and the shift of behavioral activities which may increase energetic costs (Constantine *et al.,* 2003, 2004; Heenehan *et al.,* 2016). However, at greater distances, the nature of vessel movements could also potentially have no, or very little, effect on the animal's response to the sound. In those cases where there is a busy shipping lane or a large amount of vessel traffic, marine mammals may experience acoustic masking (Hildebrand, 2005) if they are present in the area (*e.g.,* killer whales in Puget Sound; Foote *et al.,* 2004; Holt *et al.,* 2008). In any case, a full description of the suite of factors that elicited a behavioral response would require a mention of the vicinity, speed and movement of the vessel, and other factors. A detailed review of marine mammal reactions to ships and boats is available in Richardson *et al.* (1995). For each of the marine mammal taxonomy groups, Richardson *et al.* (1995) provides the following assessment regarding cetacean reactions to vessel traffic:

Toothed whales: Toothed whales sometimes show no avoidance reaction to vessels, and may even approach them; however, avoidance can occur, especially in response to vessels of types used to chase or hunt the animals. Such avoidance may cause temporary displacement, but we know of no clear evidence of toothed whales abandoning significant parts of their range because of vessel traffic.

Baleen whales: Baleen whales seem to ignore low-level sounds from distant or stationary vessels, and some whales even approach the sources of these sounds. When approached slowly and non-aggressively, whales often exhibit slow and inconspicuous avoidance maneuvers. However, in response to strong or rapidly changing vessel noise, baleen whales often interrupt their normal behavior and swim rapidly away, and avoidance is especially strong when a boat heads directly toward the whale.

Behavioral responses to stimuli are complex and influenced to varying degrees by a number of factors, such as species, behavioral contexts, geographical regions, source characteristics (moving or stationary, speed, direction, etc.), prior experience of the animal and physical status of the animal. For example, studies have shown that beluga whales' reactions varied when exposed to vessel noise and traffic. In some cases, naive beluga whales exhibited rapid swimming from ice-breaking vessels up to 80 km (49.7 mi) away, and showed changes in surfacing, breathing, diving, and group composition in the Canadian high Arctic where vessel traffic is rare (Finley *et al.,* 1990). In other cases, beluga whales were more tolerant of vessels, but responded differentially to certain vessels and operating characteristics by reducing their calling rates (especially older animals) in the St. Lawrence River where vessel traffic is common (Blane and Jaakson, 1994). In Bristol Bay, Alaska, beluga whales continued to feed when surrounded by fishing vessels and resisted dispersal even when purposefully harassed (Fish and Vania, 1971).

In reviewing more than 25 years of whale observation data, Watkins (1986) concluded that whale reactions to vessel traffic were ''modified by their previous experience and current activity: Habituation often occurred rapidly, attention to other stimuli or preoccupation with other activities sometimes overcame their interest or wariness of stimuli.'' Watkins noticed that over the years of exposure to ships in the Cape Cod area, minke whales changed from frequent positive interest (*e.g.,* approaching vessels) to generally uninterested reactions; fin whales changed from mostly negative (*e.g.,* avoidance) to uninterested reactions; right whales apparently continued the same variety of responses (negative, uninterested, and positive responses) with little change; and humpbacks dramatically changed from mixed responses that were often negative to reactions that were often strongly positive. Watkins (1986) summarized that whales near shore generally have become less wary of boats and their noises, and they have appeared to be less easily disturbed, even in regions with low vessel traffic. In locations with intense shipping and repeated approaches by boats (such as the whale-watching areas), more whales had positive reactions to familiar vessels, and they also occasionally approached other boats and yachts in the same ways.

Although the radiated sound from Navy vessels will be audible to marine mammals over a large distance, it is unlikely that animals will respond behaviorally (in a manner that NMFS would consider indicative of harassment under the MMPA) to low-level distant ship noise as the animals in the area are likely to be habituated to such noises (Nowacek *et al.,* 2004). In addition, given that SURTASS LFA sonar-equipped vessels are small, relatively quiet, and the fact that they are not idle in one spot nor necessarily encircling to contain animals, a significant disruption of normal behavioral pattern that would make ship movements rise to the level of take by Level B harassment is unlikely. In light of these facts, NMFS does not expect the movements of the Navy's SURTASS LFA sonar vessels to result in take by Level B harassment.

Vessel Strike

Ship strikes of cetaceans can cause immediate death or major injury, which may eventually lead to the death of the animal. An animal at the surface could be struck directly by a vessel, a surfacing animal could hit the bottom of a vessel, or an animal just below the surface could be cut by a vessel's propeller. The severity of injuries typically depends on the size and speed of the vessel (Knowlton and Kraus, 2001; Laist *et al.,* 2001; Vanderlaan and Taggart, 2007).

The most vulnerable marine mammals are those that spend extended periods of time at the surface, often to restore oxygen levels within their tissues after deep dives (*e.g.,* the sperm whale). In addition, some large, slow moving baleen whales, such as the North Atlantic right whale, seem generally unresponsive to vessel sound, making them more susceptible to vessel collisions (Nowacek *et al.,* 2004). Some smaller marine mammals (*e.g.,* bottlenose dolphin) move quickly through the water column and purposefully approach ships to ride the bow wave of large ships without any injury.

An examination of all known ship strikes from all shipping sources (civilian and military) indicates vessel speed is a principal factor in whether a vessel strike results in death (Knowlton and Kraus, 2001; Laist *et al.,* 2001; Jensen and Silber, 2003; Vanderlaan and Taggart, 2007). In assessing records in which vessel speed was known, Laist *et al.* (2001) found a direct relationship between the occurrence of a whale strike and the speed of the vessel involved in the collision, with most deaths occurring when a vessel was traveling in excess of 14.9 mph (24.1 km/hr; 13 kts).

Jensen and Silber (2004) detailed 292 records of known or probable ship strikes of all large whale species from 1975 to 2002. Of these, vessel speed at the time of collision was reported for 58 cases. Of these cases, 39 (or 67 percent) resulted in serious injury or death (19 of those resulted in serious injury as determined by blood in the water; propeller gashes or severed tailstock, and fractured skull, jaw, vertebrae; hemorrhaging; massive bruising or other injuries noted during necropsy and 20 resulted in death). Operating speeds of vessels that struck various species of large whales ranged from 2 to 51 kts, with the majority (79 percent) of these strikes occurring at speeds of 13 kts or greater. The average speed that resulted in serious injury or death was 18.6 kts. Pace and Silber (2005) found that the probability of death or serious injury increased rapidly with increasing vessel speed. Specifically, the predicted probability of serious injury or death increased from 45 percent to 75 percent as vessel speed increased from 10 to 14 kts, and exceeded 90 percent at 17 kts. Higher speeds during collisions result in greater force of impact, but higher speeds also appear to increase the chance of severe injuries or death by pulling whales toward the vessel. While modeling studies have suggested that hydrodynamic forces pulling whales toward the vessel hull increase with increasing vessel speed (Clyne, 1999; Knowlton *et al.,* 1995), this is inconsistent with Silber *et al.* (2010), which demonstrated that there is no such relationship (*i.e.,* hydrodynamic forces are independent of speed).

The Jensen and Silber (2004) report notes that the database represents a minimum number of collisions, because the vast majority probably goes undetected or unreported. In contrast, while ship strike is not likely due to SURTASS LFA sonar training and testing activities due to the slow ship speeds and higly effective monitoring associated with these activities, Navy vessels are likely to detect any strike that would occur (due to monitoring), and they are required to report all ship strikes involving marine mammals. Overall, the percentage of Navy vessel traffic relative to overall large shipping vessel traffic is very small (on the order of two percent). Moreover, as mentioned previously, there are currently only four SURTASS LFA sonar vessels, which would equate to an extremely small percentage of the total vessel traffic. Although the Navy does anticipate additional vessels beginning in year 2024 (year 5), it is not reasonable to assume additional vessels would substantially add to the total vessel traffic.

The Navy's testing and training activities of SURTASS LFA sonar vessels is extremely small in scale compared to the number of commercial ships transiting at higher speeds in the same areas on an annual basis. The probability of vessel and marine mammal interactions occurring during SURTASS LFA sonar activities is unlikely due to the surveillance vessel's slow operational speed, which is typically 3.4 mph (5.6 km/hr; 3 kts). Outside of SURTASS LFA sonar activities, each vessel's cruising speed would be a maximum of approximately 11.5 to 14.9 mph (18.5 to 24.1 km/hr; 10 to 13 kts) which is generally below the speed at which studies have noted reported increases of marine mammal injury or death (Laist *et al.,* 2001).

As a final point, the SURTASS LFA surveillance vessels have a number of other advantages for avoiding ship strikes as compared to most commercial merchant vessels, including the following: The catamaran-type split hull shape and enclosed propeller system of the Navy's T–AGOS ships; the bridge of T–AGOS ships positioned forward of the centerline, offering good visibility ahead of the bow and good visibility aft to visually monitor for marine mammal presence; lookouts posted during activities scan the ocean for marine mammals and must report visual alerts of marine mammal presence to the Deck Officer; lookouts receive extensive training that covers the fundamentals of visual observing for marine mammals and information about marine mammals and their identification at sea; and SURTASS LFA vessels travel at low speed (3–4 kts (approximately 3.4 mph; 5.6 km/hr)) with deployed arrays. Lastly, the use of passive and active acoustic monitoring for marine mammals as mitigation measures to monitor for marine mammals along with visual marine mammal observers would detect cetaceans well in advance of any potential ship strike distance during SURTASS LFA sonar training and testing activities (for a thorough discussion of mitigation measures, please see the Proposed Mitigation section later in this document).

Due to the reasons described above (low probability of vessel/marine mammal interactions; relatively slow vessel speeds; and high probability of detection due to applied mitigation measures), and the fact that there have been no ship strikes in the 17-year history of SURTASS LFA sonar activities, the Navy and NMFS have determined that take of marine mammals by vessel strike is highly unlikely. Therefore, the Navy has not requested any take of marine mammals due to ship strike, nor is NMFS considering any authorization of take due to ship strike.

Results From Past Monitoring

From the commencement of SURTASS LFA sonar use in 2002 through the present, neither LFA sonar, nor operation of the T–AGOS vessels, has been associated with any mass or individual strandings of marine mammals temporally or spatially. In addition, the Navy's required monitoring reports indicate that there have been no apparent avoidance reactions observed, and no takes by Level A harassment due to SURTASS LFA sonar since its use began in 2002. In summary, results of the analyses conducted for SURTASS LFA sonar and the previous 17 years of documented results support the determination that the only takes anticipated would be short-term Level B harassment of affected marine mammal stocks.

Effects on Marine Mammal Habitat Including Prey

Anticipated Effects on Habitat Use—SURTASS LFA sonar activities would not affect the physical characteristics of marine mammal habitats. Based on the following information; the supporting information included in the Navy's application; the 2001, 2007, 2012, and 2017 NEPA documents; and 2018 DSEIS/SOEIS, NMFS has preliminarily determined that SURTASS LFA sonar activities are not likely to adversely impact marine mammal habitat use. For reasons described above, unless the sound source is stationary and/or continuous over a long duration in one area, the effects of the introduction of sound into the environment are generally considered to have a less severe impact on marine mammal habitat than actions involving physical alteration of the habitat. Marine mammals may be temporarily displaced from areas where SURTASS LFA training and testing activities are occurring to avoid noise exposure (see above), *i.e.,* due to impacts on acoustic habitat, but the habitat will not be physically altered and will likely be available for use again after the activities have ceased or moved out of the area. In addition, pings from SURTASS LFA sonar are very sporadic and are not generally repeated in the exact same area. SURTASS LFA training and testing activities would not result in the deposition of materials, change bathymetry, strike/modify features, or cause any physical alterations to marine mammal habitat.

Anticipated Impacts on Prey Species (Invertebrates and Fish)—The Navy's proposed SURTASS LFA sonar activities could potentially affect marine mammal habitat through the introduction of pressure and sound into the water column, which in turn could impact prey species of marine mammals. Among invertebrates, only cephalopods (octopus and squid) and decapods (lobsters, shrimps, and crabs) are known to sense LF sound (Packard *et al.,* 1990; Budelmann and Williamson, 1994; Lovell *et al.,* 2005; Mooney *et al.,* 2010). Popper and Schilt (2008) stated that, like fish, some invertebrate species produce sound, possibly using it for communications, territorial behavior, predator deterrence, and mating. Well known sound producers include the lobster (*Panulirus* spp.) (Latha *et al.,* 2005), and the snapping shrimp (*Alpheus heterochaelis*) (Herberholz and Schmitz, 2001).

Andre *et al.* (2011) exposed four cephalopod species (*Loligo vulgaris, Sepia officinalis, Octopus vulgaris,* and *Ilex coindetii)* to two hours of continuous sound from 50 to 400 Hz at 157 ± 5 dB re: 1 μPa. They reported lesions to the sensory hair cells of the statocysts of the exposed animals that increased in severity with time. These results indicate that cephalopods are particularly sensitive to low-frequency sound. The SURTASS DSEIS/SOEIS (Chapter 4) notes that a follow-on study was conducted with Mediterranean and European squid (*Octopus vulgaris,* and *Ilex coindetii*) that included controls (Solé *et al.,* 2013), which found a similar result as Andre *et al.* (2011) with permanent and substantial alteration of the sensory hair cells of the statocysts. Aguilar de Soto *et al.* (2013) exposed New Zealand scallop larvae (*Pecten novaezeandiae*) to recorded signals from a seismic airgun survey every three seconds for up to 70 hours. They found a delay in development and malformations of the larvae in the noise-exposed samples. However, SURTASS LFA sonar has none of the same characteristics as the acoustic sources used in these studies. The time sequence of exposure from low-frequency sources in the open ocean would be about once every 10 to 15 min for SURTASS LFA sonar. Therefore, the study's sound exposures were longer in duration and higher in energy than any exposure a marine mammal would likely ever receive from SURTASS LFA sonar and acoustically very different than a free field sound to which animals would be exposed in the real world. SURTASS LFA sonar activities would only be expected to have a lasting impact on these animals if they are within a few tens of meters from the source, which is not anticipated to occur due to monitoring and mitigation measures described below. In conclusion, NMFS does not expect any short- or long-term effects to invertebrates from SURTASS LFA sonar activities.

The SURTASS DSEIS/SOEIS includes a detailed discussion of the effects of active sonar on marine fish and several studies on the effects of both Navy sonar and seismic airguns that are relevant to potential effects of SURTASS LFA sonar on *osteichthyes* (bony fish). In the most pertinent of these, the Navy funded independent scientists to analyze the effects of SURTASS LFA sonar on fish (Popper *et al.,* 2007; Halvorsen *et al.,* 2006) and on the effects of SURTASS LFA sonar on fish physiology (Kane *et al.,* 2010).

Several studies on the effects of SURTASS LFA sonar sounds on three species of fish (rainbow trout, channel catfish, and hybrid sunfish) examined long-term effects on sensory hair cells of the ear. In all species, even up to 96 hours post-exposure, there were no indications of damage to sensory cells (Popper *et al.,* 2005a, 2007; Halvorsen *et al.,* 2006). Recent results from direct pathological studies of the effects of LFA sounds on fish (Kane *et al.,* 2010) provide evidence that SURTASS LFA sonar sounds at relatively high received levels (up to 193 dB re: 1 μPa at 1 m) have no pathological effects or short- or long-term effects to ear tissue on the species of fish that have been studied. Therefore, the transmission of SURTASS LFA sonar is unlikely to impact fish populations, and thus would not result in indirect effects on marine mammals by affecting their prey base.

Estimated Take of Marine Mammals

This section indicates the number of takes that NMFS is proposing to authorize, which is based on the amount of take that NMFS anticipates could or is likely to occur, depending on the type of take and the methods used to estimate it, as described in detail below. NMFS coordinated closely with the Navy in the development of their incidental take application, and preliminarily agrees that the methods the Navy has put forth described herein to estimate take (including the model, thresholds, and density estimates), and the resulting numbers estimated for authorization, are appropriate and based on the best available science.

Level B Harassment is the only means of take expected to result from these activities. For military readiness activities, the MMPA defines ''harassment'' 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 behavior 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).

As described previously in the Potential Effects of the Specified Activity on Marine Mammals and their Habitat section, based on the specified activity operational parameters and proposed mitigation, only Level B Harassment is expected to occur and therefore proposed to be authorized. Based on the nature of the activities and the anticipated effectiveness of the mitigation measures, take by Level A Harassment, serious injury, or mortality is neither anticipated nor proposed to be authorized.

Generally speaking, for acoustic impacts we estimate the amount and type of harassment by considering: (1) Acoustic thresholds above which NMFS believes the best available science indicates marine mammals will be taken by Level B harassment (in this case, as defined in the military readiness definition of Level B harassment included above) or incur some degree of temporary or permanent hearing impairment; (2) the area or volume of water that will be ensonified above these levels in a day or event; (3) the density or occurrence of marine mammals within these ensonified areas; and (4) the number of days of activities or events. Below, we describe these components in more detail, as well as the model the Navy used to incorporate these components to predict impacts, and present the take estimate.

Density Estimates

To derive density estimates, direct estimates from line-transect surveys that occurred in or near each of the 15 modeled areas (described in the Description of Marine Mammals in the Area of the Specified Activities section above) were utilized first (*e.g.,* Bradford *et al.,* 2017). When density estimates were not available from a survey in the Study Area, density estimates from a region with similar oceanographic characteristics were extrapolated to the operational area. Densities for some model areas were also derived from the Navy's Marine Species Density Database (DoN, 2018). Last, density estimates are usually not available for rare marine mammal species or for those that have been newly defined (*e.g.,* Deraniyagala's beaked whale). For such species, a low density estimate of 0.0001 animals per square kilometer (animals/km^2) was used in the risk analysis to reflect the low probability of occurrence in a specific model area. Further, density estimates are sometimes pooled for species of the same genus if sufficient data are not available to compute a density for individual species or the species are difficult to distinguish at sea. This is often the case for beaked whales (*Mesoplodon* spp) as well as the pygmy and dwarf sperm whales (*Kogia* spp), which is why densities were pooled for these species in certain model areas. Density estimates are available for these species groups rather than the individual species in model areas 1, 2, 3, 5, 6, and 7 for *Kogia* spp, and in model area 8 for *Mesoplodon* spp. Density information is provided in Tables 2–16 above, and is also available in the Navy's application (Table 3–2, Pages 3–6 through 3–25).

SURTASS LFA Sonar Behavioral Response Function

The Navy uses a behavioral response function to estimate the number of behavioral responses that would qualify as Level B behavioral harassment under the MMPA. A wide range of behavioral reactions may qualify as Level B harassment under the MMPA, including but not limited to avoidance of the sound source, temporary changes in vocalizations or dive patterns, temporary avoidance of an area, or temporary disruption of feeding, migrating, or reproductive behaviors. The estimates calculated using the behavioral response function do not differentiate between the different types of potential behavioral reactions, nor do the estimates provide information regarding the potential fitness or other biological consequences of the reactions on the affected individuals.

The definition of Level B harassment for military readiness activities contemplates the disruption of behavioral patterns to the point where they are abandoned or significantly altered. It is difficult to predict with certainty, given existing data, when exposures that are generally expected are likely to result in significantly altered or abandoned behavioral patterns. Therefore, the Navy's take estimates capture a wider range of impacts, including less significant responses. Moreover, NMFS does not assume that each instance of Level B harassment modeled by the Navy will have, or is likely to have, an adverse impact on an individual's fitness. Rather, NMFS considers the available scientific evidence to determine the likely nature of the modeled behavioral responses and the potential fitness consequences for affected individuals in its negligible impact evaluation. Accordingly, we consider application of this Level B harassment threshold as identifying the maximum number of instances in which marine mammals could be reasonably expected to experience a disruption in behavior patterns to a point where they are abandoned or significantly altered (*i.e.,* Level B harassment). Because this is the most appropriate method for estimating Level B harassment given the best available science and uncertainty on the topic, it is these numbers of Level B harassment by behavioral disturbance that are analyzed in the *Analysis and Negligible Impact Determination* section and are being proposed for authorization.

Estimates of Potential Marine Mammal Exposure

The Navy's acoustic impact analysis for marine mammals represents an evolution that builds upon the analysis and methodology documented in previous SURTASS LFA sonar NEPA efforts (DoN, 2001; 2007; 2012; and 2017), and includes updates of the most current acoustic thresholds and methodology to assess auditory impacts (NMFS, 2018). A detailed discussion of the acoustic impact analysis is provided in Appendix B of the SURTASS DSEIS/SOEIS, but is summarized here.

Using the Acoustic Integration Model (AIM), the Navy modeled 15 representative model areas in the central and western North Pacific and eastern Indian Oceans, representing the acoustic regimes and marine mammal species that may be encountered during SURTASS LFA sonar training and testing activities. Modeling was conducted for one 24-hour period in each of the four seasons in each model area. To predict acoustic exposure, the LFA sonar ship was simulated traveling in a triangular pattern at a speed of 4 knots (kt) (7.4 kilometers per hour (kph), for eight hours in each leg of the triangle. The duration of the LFA sonar transmission was modeled as 24 hours, with a signal duration of 60 seconds and a duty cycle of 10 percent (*i.e.,* the source transmitted for 60 seconds every 10 minutes for 24 hours, which equates to 2.4 active transmission hours and is representative of average actual transmission times based on the past 17 years of SURTASS LFA sonar activities).

The acoustic field around the LFA sonar source was predicted by the Navy standard parabolic equation propagation model using the defined LFA sonar operating parameters. Each marine mammal species potentially occurring in a model area in each season was simulated by creating animats (simulated animals) programmed with behavioral values describing their dive and movement patterns. AIM then integrates the acoustic field created from the underwater transmission of LFA sonar with the three-dimensional (3D) movement of marine mammals to estimate their potential for sonar exposure at each 30-second timestep within the 24-hour modeling period. Thus, the output of AIM is the time history of exposure for each animat.

The Navy assesses the potential impacts on marine mammals by predicting the sound field that a given marine mammal species/stock could be exposed to over time in a potential model area. This is a multi-part process involving: (1) The ability to measure or estimate an animal's location in space and time; (2) the ability to measure or estimate the three-dimensional sound field at these times and locations; (3) the integration of these two data sets into the acoustic impact model to estimate the total acoustic exposure for each animal in the modeled population; and (4) the conversion of the resultant cumulative exposures for a modeled population into an estimate of the risk of a potential injury (*i.e.,* Level A harassment (PTS)), TTS, or disruption of natural behavioral patterns (*i.e.,* a take estimate for Level B harassment).

To estimate the potential impacts for each marine mammal stock on an annual basis, several calculation steps are required. First, the potential impact for one LFA sonar transmission hour is calculated. Second, the number of LFA sonar transmission hours that may occur in each model area for each activity is determined. The third step is to determine the number of model areas in which each stock may occur for each activity, and the fourth step is to select the maximum per-hour impact for each stock that may occur in the model areas for that activity. The final step is to multiply the results of steps two, three, and four to calculate the potential annual impacts per activity, which are then summed across the stocks for a total potential impact for all individual activities. The number of individual marine mammals that may be taken over the seven-year period of the proposed SURTASS LFA sonar training and testing activities was estimated by multiplying the maximum number of instances of exposure for each species/stock calculated annually for each of the two transmission scenarios (496 transmission hours in years 1–4 and 592 transmission hours in years 5–7), and then adding these to calculate a total estimate. For example, for the WNP blue whale, four years of 496 transmission hours (for years 1–4) resulted in 90 Level B harassment takes/year and three years of 592 transmission hours (for years 5–7) resulted in 123 Level B harassment takes/year. Multiplying 90 takes/year by 4 years equals 360 Level B harassment takes for the 496 transmission hour scenario, and multiplying 123 takes/year by 3 years equals 369 Level B harassment takes for the 592 transmission hour scenario. The final step is adding the totals for the two transmission scenarios to arrive at a total (360 + 369 = 729 Level B harassment takes over the 7-year period for WNP blue whales). For additional detail on modelling and take estimation, please refer to Chapter 6.6 (Quantitative Impact Analysis for Marine Mammals) of the Navy's application and Appendix B of the SURTASS DSEIS/SOEIS.

With the implementation of the three-part monitoring programs (visual, passive acoustic, and HF/M3 monitoring, as discussed below), NMFS and the Navy do not expect that marine mammals would be injured by SURTASS LFA sonar because a marine mammal is likely to be detected and active transmissions suspended or delayed to avoid injurious exposure. The probability of detection of a marine mammal by the HF/M3 system within the LFA sonar mitigation zone approaches 100 percent over the course of multiple pings (see the 2001 FOEIS/EIS, Subchapters 2.3.2.2 and 4.2.7.1 for the HF/M3 sonar testing results as well as section 5.4.3 of the SURTASS 2018 DSEIS/SOEIS for a summary of the effectiveness of the HF/M3 system). Quantitatively, modeling output shows zero takes by Level A harassment for all marine mammal stocks in all representative mission areas with mitigation applied. As noted above, all hearing groups of marine mammals except LF cetaceans would need to be within 22 ft (7 m) of the LFA sonar source for an entire LFA transmission (60 seconds), and a LF cetacean would need to be within 135 ft (41 m) for an entire LFA transmission to potentially experience PTS. This is unlikely to occur, especially given the mitigation measures in place and the Navy's proven effectiveness at detecting marine mammals well outside of this range so that shut down measures would be implemented well before marine mammals would be within these ranges. Again, NMFS notes that over the course of the previous three rulemakings from 2002 to 2017, and during the Navy's training and testing activities during the NDE from 2017 to the present, there have been no reported or known incidents of Level A harassment of any marine mammal. This is due to the fact that it would be highly unlikely that a marine mammal would remain close enough to the vessel to experience Level A harassment (see discussion in *Threshold Shift* subsection of the Potential Effects of the Specified Activity on Marine Mammals and their Habitat section above), in combination with the Navy's highly effective detection of marine mammals and shutting down SURTASS LFA sonar prior to the animals entering the Level A harassment zone. Therefore, NMFS does not propose to authorize any Level A takes for any marine mammal species or stocks over the course of the 7-year regulations. Marine mammals could experience TTS at farther distances, but would still need to be within the shutdown distance for that to happen. The distances to the TTS thresholds are less than 50 ft (15 m) for MF and HF cetaceans and otariids; 216 ft (66 m) for phocids; and 1,354 ft (413 m) for LF cetaceans if an animal were to remain at those distances for an entire LFA sonar signal (60 sec). While it is likely that mitigation measures would also avoid TTS, some small subset of the animals may also experience TTS. Any TTS incurred would likely be of a low level and of short duration because we do not expect animals to be exposed for long durations close to the source.

Of note, the estimated number of Level B harassment takes does not necessarily equate to the number of individual animals the Navy expects to harass (which is lower), but rather to the instances of take (*i.e.,* exposures above the Level B harassment threshold) that are anticipated to occur over the seven-year period. Some individuals may experience multiple instances of take (meaning over multiple days) over the course of the year, while some members of a species or stock may not experience take at all, which means that the number of individuals taken is smaller than the total estimated takes. In other words, where the instances of take exceed the number of individuals in the population, repeated takes (on more than one day) of some individuals are predicted. Generally speaking, the higher the number of takes as compared to the population abundance, the more repeated takes of individuals are likely, and the higher the actual percentage of individuals in the population that are likely taken at least once in a year. However, because of the nature of the SURTASS LFA activities (small number of continuously moving vessels spread over a very large area), there are likely fewer repeated takes of the same individuals than would be expected from other more localized or stationary activities.

More detailed information for each of the steps to quantify take estimates, as well as an illustrative example, are provided in section 6.6 of the Navy's application (Quantitative Impact Analysis for Marine Mammals). A more thorough description of the impact analysis is also provided in the Draft SEIS/SOEIS (DoN, 2018), specifically section 4.5.2.1.3, Marine Mammals (Quantitative Impact Analysis for Marine Mammals subsection) and Appendix B (Marine Mammal Impact Analysis). NMFS has reviewed this information and has accepted the Navy modeling procedure and results. The total maximum potential impact on an annual basis for years 1–4 and years 5–7 as well as the total overall takes for the 7-year period covered by the proposed rulemaking are presented in Table 18 below. These are considered conservative estimates because they are based on the maximum potential impact to a stock across all model areas in which an activity may occur. Therefore, if an activity occurs in a different model area than the area where the maximum potential impact was predicted, the actual potential impact may be less than estimated. However, since the Navy cannot forecast where a specific activity may be conducted this far in advance, this maximum estimate provides the Navy with the flexibility to conduct its training and testing activities across all modeled areas identified for each activity.

TABLE 18—MAXIMUM TOTAL ANNUAL MMPA LEVEL B HARASSMENT PROPOSED FOR AUTHORIZATION FOR YEARS 1–4 AND 5–7, AND TOTAL FOR THE 7-YEAR PERIOD OF THE PROPOSED RULE BY SURTASS LFA SONAR

Species	Stock[1]	Maximum annual Level B harassment, years 1–4		Maximum annual Level B harassment, years 5–7		Total overall Level B harassment for 7-year period
		Instances	Percent species or stock	Instances	Percent species or stock	
Antarctic minke whale	ANT	0	0.00	0	0.00	0
Blue whale	CNP	3	2.39	4	2.85	24
	NIND	0	0.00	1	0.00	3
	WNP	90	0.90	123	1.14	729
	SIND	1	0.07	1	0.07	7
Bryde's whale	ECS	14	10.28	19	14.13	113
	Hawaii	5	0.62	6	0.74	38
	WNP	378	1.94	437	2.26	2,823
	NIND	8	0.07	10	0.10	62
	SIND	7	0.05	9	0.07	55
Common minke whale	Hawaii	572	2.30	682	2.74	4,334
	IND	1,271	0.43	1,748	0.59	10,328
	WNP JW	3	0.12	5	0.17	27
	WNP OE	2,127	8.59	2,404	9.71	15,720
	YS	189	4.20	250	5.57	1,506
Fin whale	ECS	9	1.80	12	2.47	72
	Hawaii	3	2.30	4	2.74	24
	IND	0	0.00	0	0.00	0
	SIND	22	0.05	30	0.07	178
	WNP	2,558	27.55	3,455	37.23	20,597
Humpback whale	CNP stock and Hawaii DPS	487	4.85	611	6.10	3,781
	WAU stock and DPS	1	0.00	1	0.00	7
	WNP stock and DPS	3,103	233.84	4,266	321.49	25,210
North Pacific right whale	WNP	89	9.57	122	13.15	722
Omura's whale	NIND	8	0.07	10	0.10	62
	SIND	5	0.04	7	0.05	41
	WNP	14	0.81	16	0.95	104
Sei whale	Hawaii	19	4.78	22	5.70	142
	SIND	0	0.00	0	0.00	0
	NP	3,172	45.37	4,361	62.37	25,771
	NIND	4	0.04	5	0.05	31
Western North Pacific gray whale.	WNP stock and Western DPS.	0	0.00	1	0.44	3
Baird's beaked whale	WNP	2,747	48.26	3,777	66.36	22,319
Blainville's beaked whale	Hawaii	35	1.83	47	2.40	281
	WNP	269	3.30	311	3.82	2,009
	IND	47	0.27	65	0.37	383
Common bottlenose dolphin	4-Islands	5	2.48	6	2.96	38
	Hawaii Island	0	0.00	0	0.00	0
	Hawaii Pelagic	95	0.41	114	0.49	722
	IA	104	0.11	140	0.15	836

TABLE 18—MAXIMUM TOTAL ANNUAL MMPA LEVEL B HARASSMENT PROPOSED FOR AUTHORIZATION FOR YEARS 1–4 AND 5–7, AND TOTAL FOR THE 7-YEAR PERIOD OF THE PROPOSED RULE BY SURTASS LFA SONAR—Continued

Species	Stock [1]	Maximum annual Level B harassment, years 1–4		Maximum annual Level B harassment, years 5–7		Total overall Level B harassment for 7-year period
		Instances	Percent species or stock	Instances	Percent species or stock	
	IND	1,128	0.14	1,551	0.20	9,165
	Japanese Coastal	1,686	47.94	1,789	50.86	12,111
	Kauai/Niihau	13	7.16	16	8.55	100
	Oahu	38	5.17	46	6.17	290
	WNP Northern Offshore	581	0.57	799	0.78	4,721
	WNP Southern Offshore	2,726	6.63	3,063	7.45	20,093
	WAU	635	21.16	873	29.09	5,159
Common dolphin	IND	52	0.00	72	0.00	424
	WNP	203,871	12.24	275,079	16.08	1,640,721
Cuvier's beaked whale	Hawaii	22	3.03	26	3.62	166
	IND	231	0.85	317	1.17	1,875
	SH	77	0.11	106	0.15	626
	WNP	6,946	7.78	8,980	10.04	54,724
Dall's porpoise	SOJ dalli type	614	0.36	845	0.49	4,991
	WNP dalli ecotype	22,056	13.62	30,327	18.72	179,205
	WNP truei ecotype	487	0.28	670	0.39	3,958
Deraniyagala's beaked whale.	IND	158	0.92	217	1.27	1,283
	NP	190	0.77	222	0.91	1,426
Dwarf sperm whale	Hawaii	655	3.72	782	4.44	4,966
	IND	3	0.05	4	0.07	24
	WNP	486	0.14	635	0.18	3,849
False killer whale	Hawaii Pelagic	58	3.72	69	4.44	439
	IA	252	2.59	341	3.51	2,031
	IND	12	0.01	16	0.00	96
	Main Hawaiian Islands Insular stock and DPS.	1	0.41	1	0.49	7
	Northwestern Hawaiian Islands.	0	0.00	0	0.00	0
	WNP	1,350	8.15	1,596	9.63	10,188
Fraser's dolphin	CNP	546	3.24	686	4.06	4,242
	Hawaii	1,944	3.79	2,320	4.52	14,736
	IND	93	0.05	128	0.07	756
	WNP	2,287	1.16	2,559	1.29	16,825
Ginkgo-toothed beaked whale.	IND	12	0.07	16	0.10	96
	NP	283	1.21	329	1.40	2,119
Harbor porpoise	WNP	366	1.17	503	1.61	2,973
Hubbs' beaked whale	NP	26	0.11	36	0.15	212
Indo-Pacific bottlenose dolphin.	IND	11	0.14	16	0.20	92
Killer whale	Hawaii	6	4.41	8	5.26	48
	IND	397	3.15	546	4.33	3,226
	WNP	10,470	85.37	14,387	117.31	85,041
Kogia spp.[2]	WNP	1,317	0.31	1,494	0.35	9,750
Longman's beaked whale	Hawaii	739	5.01	882	11.59	5,602
	IND	325	1.92	447	2.64	2,641
	WNP	471	6.14	574	7.50	3,606
Melon-headed whale	Hawaiian Islands	181	2.07	216	2.47	1,372
	IND	402	0.64	552	0.88	3,264
	Kohala Resident	9	0.41	11	0.49	69
	WNP	1,605	2.87	1,823	3.27	11,889
Mesoplodon spp.[2]	WNP	10	0.05	14	0.07	82
Northern right whale dolphin	NP	0	0.00	0	0.00	0
Pacific white-sided dolphin	NP	9,530	1.05	12,890	1.41	76,790
Pantropical spotted dolphin	4-Islands	32	14.40	38	17.18	242
	Hawaii Island	23	10.26	27	12.25	173
	Hawaiian Pelagic	297	0.55	355	0.66	2,253
	IND	311	0.05	428	0.07	2,528
	Oahu	23	10.54	28	12.58	176
	WNP	5,105	3.95	5,883	4.53	38,069
Pygmy killer whale	Hawaii	393	3.72	469	4.44	2,979
	IND	60	0.27	82	0.37	486
	WNP	901	2.87	1,035	3.30	6,709
Pygmy sperm whale	Hawaii	266	3.72	318	4.44	2,018
	IND	0	0.00	0	0.00	0

TABLE 18—MAXIMUM TOTAL ANNUAL MMPA LEVEL B HARASSMENT PROPOSED FOR AUTHORIZATION FOR YEARS 1–4 AND 5–7, AND TOTAL FOR THE 7-YEAR PERIOD OF THE PROPOSED RULE BY SURTASS LFA SONAR—Continued

Species	Stock [1]	Maximum annual Level B harassment, years 1–4		Maximum annual Level B harassment, years 5–7		Total overall Level B harassment for 7-year period
		Instances	Percent species or stock	Instances	Percent species or stock	
	WNP	203	0.07	265	0.09	1,607
Risso's dolphin	Hawaii	414	3.58	494	4.28	3,138
	IA	1,045	0.70	1,374	0.92	8,302
	WNP	4,347	3.07	4,914	3.47	32,130
	IND	4,621	1.01	6,354	1.39	37,546
Rough-toothed dolphin	Hawaii	213	0.28	254	0.33	1,614
	IND	41	0.00	57	0.00	335
	WNP	1,439	28.74	1,732	34.56	10,952
Short-finned pilot whale	Hawaii	396	2.00	473	2.38	3,003
	IND	1,526	0.59	2,098	0.81	12,398
	WNP Northern Ecotype	525	2.52	721	3.47	4,263
	WNP Southern Ecotype	5,683	18.03	6,303	19.99	41,641
Southern bottlenose whale	IND	22	0.00	31	0.00	181
Spade-toothed beaked whale.	IND	16	0.09	22	0.12	130
Sperm whale	Hawaii	106	2.34	126	2.80	802
	NIND	33	0.14	46	0.20	270
	NP	1,429	1.28	1,855	1.68	11,281
	SIND	16	0.07	22	0.10	130
Spinner dolphin	Hawaii Island	1	0.21	1	0.25	7
	Hawaii Pelagic	192	5.72	229	6.82	1,455
	IND	240	0.05	330	0.07	1,950
	Kauai/Niihau	83	13.85	99	16.53	629
	Kure/Midway Atoll	0	0.00	0	0.00	0
	Oahu/4-Islands	20	2.88	24	6.66	152
	Pearl and Hermes Reef	0	0.00	0	0.00	0
	WNP	574	0.00	721	0.00	4,459
Stejneger's beaked whale	WNP	201	2.49	276	3.42	1,632
Striped dolphin	Hawaii	269	0.41	321	0.49	2,039
	IND	5,059	0.75	6,957	1.03	41,107
	Japanese Coastal	3,366	17.18	3,571	18.23	24,177
	WNP Northern Offshore	267	0.07	367	0.10	2,169
	WNP Southern Offshore	3,282	6.28	3,729	7.13	24,315
Hawaiian monk seal	Hawaii	10	0.69	13	0.91	79
Northern fur seal	Western Pacific	8,475	1.71	11,653	2.35	68,859
Ribbon seal	NP	15,705	4.30	21,595	5.92	127,605
Spotted seal	Alaska stock/Bering Sea DPS.	80,722	17.53	110,993	24.10	655,867
	Southern stock and DPS	0	0.00	1	0.05	3
Steller sea lion	Western/Asian stock, Western DPS.	2	0.00	3	0.00	17

[1] ANT=Antarctic; CNP=Central North Pacific; NP=North Pacific; NIND=Northern Indian; SIND=Southern Indian; IND=Indian; WNP=Western North Pacific; ECS=East China Sea; WP=Western Pacific; SOJ=Sea of Japan; IA=Inshore Archipelago; WAU=Western Australia; YS=Yellow Sea; OE=Offshore Japan; OW=Nearshore Japan; JW=Sea of Japan/Minke; JE=Pacific coast of Japan; SH=Southern Hemisphere; DPS=distinct population segment.

[2] *Kogia* spp.: Pygmy and dwarf sperm whales are difficult to distinguish at sea, and abundance estimates are pooled for Kogia spp. in Modeled Areas 1, 2, 3, 5, 6, and 7 (reported as pooled in Ferguson and Barlow, 2001 and 2003, and pooled). *Mesoplodon* spp.: No methods are available to distinguish between the species of Mesoplodon beaked whales in the WNP stocks (Blainville's beaked whale (*M. densirostris*), Perrin's beaked whale (*M. perrini*), Lesser beaked whale (*M. peruvianus*), Stejneger's beaked whale (*M. stejnegeri*), Gingko-toothed beaked whale (*M. gingkodens*), and Hubbs' beaked whale (*M. carlhubbsi))* when observed during at-sea surveys (Carretta et al., 2018). As reported in Ferguson and Barlow, 2001 and 2003, data on these species were pooled. These six species are managed as one unit.

Proposed Mitigation

Under section 101(a)(5)(A) of the MMPA, NMFS must set forth the ''permissible methods of taking pursuant to such activity, and other means of effecting the least practicable adverse impact on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of such species or stock for subsistence uses'' (hereinafter referred to as ''LPAI'' or ''least practicable adverse impact''). NMFS does not have a regulatory definition for least practicable adverse impact. The NDAA for FY 2004 amended the MMPA as it relates to military readiness activities and the incidental take authorization process such that a determination of least practicable adverse impact shall include consideration of personnel safety, practicality of implementation, and impact on the effectiveness of the ''military readiness activity.''

Least Practicable Adverse Impact Standard

In *Conservation Council for Hawaii* v. *National Marine Fisheries Service,* 97 F. Supp.3d 1210, 1229 (D. Haw. 2015), the Court stated that NMFS ''appear[s] to think [it] satisfies] the statutory 'least practicable adverse impact' requirement with a 'negligible impact' finding.'' More recently, expressing similar concerns in a challenge to the 2012 SURTASS LFA incidental take rule (77 FR 50290), the Ninth Circuit Court of Appeals in *Natural Resources Defense Council (NRDC)* v. *Pritzker,* 828 F.3d 1125, 1134 (9th Cir. 2016), stated, ''[c]ompliance with the 'negligible impact' requirement does not mean there [is] compliance with the 'least practicable adverse impact' standard.'' As the Ninth Circuit noted in its opinion, however, the Court was interpreting the statute without the benefit of NMFS' formal interpretation. We state here explicitly that NMFS is in full agreement that the ''negligible impact'' and ''least practicable adverse impact'' requirements are distinct, even though both statutory standards refer to species and stocks. With that in mind, we provide further explanation of our interpretation of least practicable adverse impact, and explain what distinguishes it from the negligible impact standard. This discussion is consistent with, and expands upon, previous rules we have issued, such as the Navy Gulf of Alaska rule (82 FR 19530; April 27, 2017); the Navy Atlantic Fleet Testing and Training rule (83 FR 57076; November 14, 2018); and the Navy Hawaii-Southern California Training and Testing rule (83 FR 66846; December 27, 2018).

Before NMFS can issue incidental take regulations under section 101(a)(5)(A) of the MMPA, it must make a finding that the total taking will have a ''negligible impact'' on the affected ''species or stocks'' of marine mammals. NMFS' and USFWS' implementing regulations for section 101(a)(5) both define ''negligible impact'' as an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival (50 CFR 216.103 and 50 CFR 18.27(c)). Recruitment (*i.e.,* reproduction) and survival rates are used to determine population growth rates [1] and, therefore are considered in evaluating population level impacts.

As we stated in the preamble to the final rule for the incidental take implementing regulations, not every population-level impact violates the negligible impact requirement. The negligible impact standard does not require a finding that the anticipated take will have ''no effect'' on population numbers or growth rates: The statutory standard does not require that the same recovery rate be maintained, rather that no significant effect on annual rates of recruitment or survival occurs. The key factor is the significance of the level of impact on rates of recruitment or survival. (54 FR 40338, 40341–42; September 29, 1989).

While some level of impact on population numbers or growth rates of a species or stock may occur and still satisfy the negligible impact requirement—even without consideration of mitigation—the least practicable adverse impact provision separately requires NMFS to prescribe means of effecting the least practicable adverse impact on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, 50 CFR 216.102(b), which are typically identified as mitigation measures.[2]

The negligible impact and least practicable adverse impact standards in the MMPA both call for evaluation at the level of the ''species or stock.'' The MMPA does not define the term ''species.'' However, Merriam-Webster Dictionary defines ''species'' to include ''related organisms or *populations* potentially capable of interbreeding.'' See *www.merriam-webster.com/dictionary/species* (emphasis added). The MMPA defines ''stock'' as a group of marine mammals of the same species or smaller taxa in a common spatial arrangement that interbreed when mature (16 U.S.C. 1362(11)). The definition of ''population'' is a group of interbreeding organisms that represents the level of organization at which speciation begins. *www.merriam-webster.com/dictionary/population.* The definition of ''population'' is strikingly similar to the MMPA's definition of ''stock,'' with both involving groups of individuals that belong to the same species and located in a manner that allows for interbreeding. In fact, the term ''stock'' in the MMPA is interchangeable with the statutory term ''population stock.'' (16 U.S.C. 1362(11). Both the negligible impact standard and the least practicable adverse impact standard call for evaluation at the level of the species or stock, and the terms ''species'' and ''stock'' both relate to populations; therefore, it is appropriate to view both the negligible impact standard and the least practicable adverse impact standard as having a population-level focus.

This interpretation is consistent with Congress's statutory findings for enacting the MMPA, nearly all of which are most applicable at the species or stock (*i.e.,* population) level. *See* 16 U.S.C. 1361 (finding that it is species and population stocks that are or may be in danger of extinction or depletion; that it is species and population stocks that should not diminish beyond being significant functioning elements of their ecosystems; and that it is species and population stocks that should not be permitted to diminish below their optimum sustainable population level). Annual rates of recruitment (*i.e.,* reproduction) and survival are the key biological metrics used in the evaluation of population-level impacts, and accordingly these same metrics are also used in the evaluation of population level impacts for the least practicable adverse impact standard.

Recognizing this common focus of the least practicable adverse impact and negligible impact provisions on the ''species or stock'' does not mean we conflate the two standards; despite some common statutory language, we recognize the two provisions are different and have different functions. First, a negligible impact finding is required before NMFS can issue an incidental take authorization. Although it is acceptable to use the mitigation measures to reach a negligible impact finding (*see* 50 CFR 216.104(c)), no amount of mitigation can enable NMFS to issue an incidental take authorization for an activity that still would not meet the negligible impact standard. Moreover, even where NMFS can reach a negligible impact finding—which we emphasize does allow for the possibility of some ''negligible'' population-level impact—the agency must still prescribe measures that will affect the least practicable amount of adverse impact upon the affected species or stock.

Section 101(a)(5)(A)(i)(II) requires NMFS to issue, in conjunction with its authorization, binding—and enforceable—restrictions (in the form of regulations) setting forth how the activity must be conducted, thus ensuring the activity has the ''least practicable adverse impact'' on the affected species or stocks and their habitat. In situations where mitigation is specifically needed to reach a negligible impact determination, section 101(a)(5)(A)(i)(II) also provides a mechanism for ensuring compliance with the ''negligible impact'' requirement. Finally, we reiterate that the least practicable adverse impact standard also requires consideration of measures for marine mammal habitat, with particular attention to rookeries, mating grounds, and other areas of similar significance, and for subsistence impacts, whereas the negligible impact

[1] A growth rate can be positive, negative, or flat.

[2] For purposes of this discussion, we omit reference to the language in the standard for least practicable adverse impact that says we also must mitigate for subsistence impacts because they are not at issue in this regulation.

standard is concerned solely with conclusions about the impact of an activity on annual rates of recruitment and survival.[3]

In *NRDC* v. *Pritzker,* the Court stated, ''[t]he statute is properly read to mean that even if population levels are not threatened *significantly,* still the agency must adopt mitigation measures aimed at protecting *marine mammals* to the greatest extent practicable in light of military readiness needs.'' *Id.* at 1134 (emphases added). This statement is consistent with our understanding stated above that even when the effects of an action satisfy the negligible impact standard (*i.e.,* in the Court's words, ''population levels are not threatened significantly''), still the agency must prescribe mitigation under the least practicable adverse impact standard. However, as the statute indicates, the focus of both standards is ultimately the impact on the affected ''species or stock,'' and not solely focused on or directed at the impact on individual marine mammals.

We have carefully reviewed and considered the Ninth Circuit's opinion in *NRDC* v. *Pritzker* in its entirety. While the Court's reference to ''marine mammals'' rather than ''marine mammal species or stocks'' in the italicized language above might be construed as a holding that the least practicable adverse impact standard applies at the individual ''marine mammal'' level, *i.e.,* that NMFS must require mitigation to minimize impacts to each individual marine mammal unless impracticable, we believe such an interpretation reflects an incomplete appreciation of the Court's holding. In our view, the opinion as a whole turned on the Court's determination that NMFS had not given separate and independent meaning to the least practicable adverse impact standard apart from the negligible impact standard, and further, that the Court's use of the term ''marine mammals'' was not addressing the question of whether the standard applies to individual animals as opposed to the species or stock as a whole. We recognize that while consideration of mitigation can play a role in a negligible impact determination, consideration of mitigation measures extends beyond that analysis. In evaluating what mitigation measures are appropriate, NMFS considers the potential impacts of the specified activities, the availability of measures to minimize those potential impacts, and the practicability of implementing those measures, as we describe below.

[3] Outside of the military readiness context, mitigation may also be appropriate to ensure compliance with the ''small numbers'' language in MMPA sections 101(a)(5)(A) and (D).

Implementation of Least Practicable Adverse Impact Standard

Given the *NRDC* v. *Pritzker* decision, we discuss here how we determine whether a measure or set of measures meets the ''least practicable adverse impact'' standard. Our separate analysis of whether the take anticipated to result from Navy's activities meets the ''negligible impact'' standard appears in the Analysis and Negligible Impact Determination section below.

Our evaluation of potential mitigation measures includes consideration of two primary factors:

(1) The manner in which, and the degree to which, implementation of the potential measure(s) is expected to reduce adverse impacts to marine mammal species or stocks, their habitat, and their availability for subsistence uses (where relevant). This analysis considers such things as the nature of the potential adverse impact (such as likelihood, scope, and range), the likelihood that the measure will be effective if implemented, and the likelihood of successful implementation; and

(2) The practicability of the measures for applicant implementation. Practicability of implementation may consider such things as cost, impact on activities, and, in the case of a military readiness activity, specifically considers personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity. 16 U.S.C. 1371(a)(5)(A)(iii).

While the language of the least practicable adverse impact standard calls for minimizing impacts to affected species or stocks and their habitats, we recognize that the reduction of impacts to those species or stocks accrues through the application of mitigation measures that limit impacts to individual animals. Accordingly, NMFS' analysis focuses on measures that are designed to avoid or minimize impacts on individual marine mammals that are likely to increase the probability or severity of population-level effects.

While direct evidence of impacts to species or stocks from a specified activity is rarely available, and additional study is still needed to understand how specific disturbance events affect the fitness of individuals of certain species, there have been improvements in understanding the process by which disturbance effects are translated to the population. With recent scientific advancements (both marine mammal energetic research and the development of energetic frameworks), the relative likelihood or degree of impacts on species or stocks may often be inferred given a detailed understanding of the activity, the environment, and the affected species or stocks. This same information is used in the development of mitigation measures and helps us understand how mitigation measures contribute to lessening effects (or the risk thereof) to species or stocks. We also acknowledge that there is always the potential that new information, or a new recommendation that we had not previously considered, becomes available and necessitates reevaluation of mitigation measures (which may be addressed through adaptive management) to see if further reductions of population impacts are possible and practicable.

In the evaluation of specific measures, the details of the specified activity will necessarily inform each of the two primary factors discussed above (expected reduction of impacts and practicability), and are carefully considered to determine the types of mitigation that are appropriate under the least practicable adverse impact standard. Analysis of how a potential mitigation measure may reduce adverse impacts on a marine mammal stock or species, consideration of personnel safety, practicality of implementation, and consideration of the impact on effectiveness of military readiness activities are not issues that can be meaningfully evaluated through a yes/no lens. The manner in which, and the degree to which, implementation of a measure is expected to reduce impacts, as well as its practicability in terms of these considerations, can vary widely. For example, a time/area restriction could be of very high value for decreasing population-level impacts (*e.g.,* avoiding disturbance of feeding females in an area of established biological importance) or it could be of lower value (*e.g.,* decreased disturbance in an area of high productivity but of less firmly established biological importance). Regarding practicability, a measure might involve restrictions in an area or time that impede the Navy's ability to certify a strike group (higher impact on mission effectiveness), or it could mean delaying a small in-port training event by 30 minutes to avoid exposure of a marine mammal to injurious levels of sound (lower impact). A responsible evaluation of ''least practicable adverse impact'' will consider the factors along these realistic scales. Accordingly, the greater the likelihood that a measure will contribute to reducing the probability or severity of adverse impacts to the species or stock or their habitat, the greater the weight that measure is given when considered in combination with practicability to determine the appropriateness of the mitigation measure, and vice versa. We discuss consideration of these factors in greater detail below.

1. *Reduction of adverse impacts to marine mammal species or stocks and their habitat.*[4] The emphasis given to a measure's ability to reduce the impacts on a species or stock considers the degree, likelihood, and context of the anticipated reduction of impacts to individuals (and how many individuals) as well as the status of the species or stock.

The ultimate impact on any individual from a disturbance event (which informs the likelihood of adverse species- or stock-level effects) is dependent on the circumstances and associated contextual factors, such as duration of exposure to stressors. Though any proposed mitigation needs to be evaluated in the context of the specific activity and the species or stocks affected, measures with the following types of effects have greater value in reducing the likelihood or severity of adverse species- or stock-level impacts: Avoiding or minimizing injury or mortality; limiting interruption of known feeding, breeding, mother/young, or resting behaviors; minimizing the abandonment of important habitat (temporally and spatially); minimizing the number of individuals subjected to these types of disruptions; and limiting degradation of habitat. Mitigating these types of effects is intended to reduce the likelihood that the activity will result in energetic or other types of impacts that are more likely to result in reduced reproductive success or survivorship. It is also important to consider the degree of impacts that are expected in the absence of mitigation in order to assess the added value of any potential measures. Finally, because the least practicable adverse impact standard gives NMFS discretion to weigh a variety of factors when determining appropriate mitigation measures and because the focus of the standard is on reducing impacts at the species or stock level, the least practicable adverse impact standard does not compel mitigation for every kind of take, or every individual taken, if that mitigation is unlikely to meaningfully contribute to the reduction of adverse impacts on the species or stock and its habitat, even when practicable for implementation by the applicant.

The status of the species or stock is also relevant in evaluating the appropriateness of potential mitigation measures in the context of least practicable adverse impact. The following are examples of factors that may (either alone, or in combination) result in greater emphasis on the importance of a mitigation measure in reducing impacts on a species or stock: The stock is known to be decreasing or status is unknown, but believed to be declining; the known annual mortality (from any source) is approaching or exceeding the potential biological removal (PBR) level (as defined in 16 U.S.C. 1362(20)); the affected species or stock is a small, resident population; or the stock is involved in a UME or has other known vulnerabilities, such as recovering from an oil spill.

Habitat mitigation, particularly as it relates to rookeries, mating grounds, and areas of similar significance, is also relevant to achieving the standard and can include measures such as reducing impacts of the activity on known prey utilized in the activity area or reducing impacts on physical habitat. As with species- or stock-related mitigation, the emphasis given to a measure's ability to reduce impacts on a species or stock's habitat considers the degree, likelihood, and context of the anticipated reduction of impacts to habitat. Because habitat value is informed by marine mammal presence and use, in some cases there may be overlap in measures for the species or stock and for use of habitat.

We consider available information indicating the likelihood of any measure to accomplish its objective. If evidence shows that a measure has not typically been effective nor successful, then either that measure should be modified or the potential value of the measure to reduce effects should be lowered.

2. *Practicability.* Factors considered may include cost, impact on activities, and, in the case of a military readiness activity, personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity (16 U.S.C. 1371(a)(5)(A)(iii)).

Proposed Mitigation Measures

As with other rulemakings for SURTASS LFA sonar, our consideration of mitigation under the LPAI standard was conducted at scales that take into account the entire rulemaking period and geographic scope of potential areas of SURTASS LFA sonar activities and the types of impacts that could occur under the rule. NMFS reviewed the proposed activities and the proposed mitigation measures as described in the Navy's LOA application and the measures added by NMFS to determine if they would satisfy the standard of LPAI on marine mammal species or stock(s) and their habitat. As described below, and in the SURTASS DSEIS/DOEIS (DoD, 2018), NMFS has preliminarily determined that the following mitigation measures would satisfy the LPAI standard:

(1) 2,000-yard LFA sonar mitigation and buffer zone—LFA sonar training and testing transmissions will be suspended if the Navy detects marine mammals within a distance of 2,000 yards (1.8 km; 1.1 mi; 1.0 nmi) of the LFA sonar source, which encompasses both the approximately 1-km distance of the 180 dB received level mitigation zone and an additional buffer, by any of the following detection methods:

(a) Visual monitoring;

(b) Passive acoustic monitoring; and

(c) Active acoustic monitoring.

(2) Geographic restrictions—LFA sonar training and testing will be conducted such that:

(a) The received level of SURTASS LFA sonar transmissions during training and testing events will not exceed 180 dB within 1 km seaward of any OBIA boundary, as presented in the Final Rule, during the indicated periods of biological importance;

(b) the received level of SURTASS LFA sonar transmissions will not exceed 180 dB within the Coastal Standoff Zone (22 km (12 nmi) from any land);

(c) no activities with the SURTASS LFA sonar system will occur within territorial seas of foreign nations, which are areas up to 12 nmi from shore, depending on the distance that individual nations claim; and

(d) no activities with the SURTASS LFA sonar system will occur within Hawaii state waters (out to 3 nmi) or in the waters of Penguin Bank and ensonification of Hawaii state waters will not be at levels above 145 dB.

Below, we discuss the proposed mitigation measures as agreed upon by the Navy and NMFS. Any mitigation, monitoring, or reporting measures finalized following consideration of public comments would be required by the final regulations and/or associated LOA. For additional details regarding the Navy's mitigation measures, please also see Chapter 5 in the SURTASS 2018 DSEIS/DOEIS.

[4] We recognize the least practicable adverse impact standard requires consideration of measures that will address minimizing impacts on the availability of the species or stocks for subsistence uses where relevant. Because subsistence uses are not implicated for this action, we do not discuss them. However, a similar framework would apply for evaluating those measures, taking into account the MMPA's directive that we make a finding of no unmitigable adverse impact on the availability of the species or stocks for taking for subsistence, and the relevant implementing regulations.

Proposed 2,000-Yard Mitigation Zone (Re-Evaluation of the 180-dB re 1 μPa (RMS) Zone)

The Navy has requested, and NMFS is proposing to include in this rule, a single, fixed 2,000-yard (yd) (0.99 nmi/1,829 m/1.83 km) mitigation zone rather than a combined mitigation and buffer zone (based on real-time propagation modeling) of nominally 1.08 nmi (2 km), which has been required in past rules. This modification will standardize and simplify Navy mitigation and monitoring implementation and includes consideration of updated information on marine mammal injury thresholds. The 180-dB re1μPa (RMS) threshold for the onset of potential injury has been used in the impact assessment for SURTASS LFA sonar since 2001, and the isopleth associated with that threshold has also previously informed the development of mitigation. However, NMFS' 2018 Acoustic Technical Guidance reflects the current state of scientific knowledge regarding the potential impacts of sound on marine mammal hearing. It specifies auditory weighted (SEL_{cum}) values for the onset of PTS (onset of injury) based on marine mammal hearing groups. The NMFS 2018 Acoustic Technical Guidance categorizes marine mammals into five generalized hearing groups with defined hearing ranges and presents the auditory weighting functions developed for each of these hearing groups, reflecting the best available data on hearing, impacts of sound on hearing, and data on equal latency.

When estimating the onset of injury (PTS), NMFS' Acoustic Technical Guidance defines weighted thresholds as sound exposure levels (SEL). As noted previously in the *Metrics Used in this Document* section, the new threshold and its associated metric incorporate a duration component, which means that it is not directly comparable to the previous 180-dB re1μPa (RMS) threshold. To determine what the SEL for each hearing group would be when exposed to a 60-second (the nominal time of an LFA sonar transmission, or one ping), 300 Hz (the center frequency in the possible transmission range of 100–500 Hz) SURTASS LFA sonar transmission, the appropriate auditory weighting function must be applied to account for each of the hearing group's sensitivity. Again, although direct comparisons are difficult, when a 60-second exposure is considered, applying the auditory weighting functions results in the thresholds increasing by approximately 1.5; 46; 56; 15; and 20 dB for the LF, MF, HF, PW, and OW hearing groups, respectively, above the baseline. Consequently, if mitigation is tied to preventing the same type of impact, the distance at which SURTASS LFA sonar transmissions should be mitigated for marine mammals would be the distance associated with LF cetaceans, as the mitigation range would be the greatest for this hearing group. Any mitigation measure developed for LF cetaceans based on PTS onset would be highly conservative for any other marine mammals potentially exposed to SURTASS LFA sonar transmissions.

Applying the duration of a single ping of SURTASS LFA sonar (60 seconds) would result in 17.8 dB being subtracted from the unweighted SEL_{cum} value of 200.5 dB for LF cetaceans, for an SPL of 182.7 dB re1μPa (RMS). The distance to this isopleth would be slightly smaller than that associated with the previously used 180 dB re1μPa (RMS) isopleth. If an LF cetacean was exposed to two full pings of SURTASS LFA sonar, the resulting SPL would be 179.7 dB re1μPa (RMS), which is very close to the 180 dB re1μPa (RMS) RL level, on which previous mitigation measures were based. This exposure is unlikely, as a marine mammal would have to be close to the LFA sonar array for an extended period (approximately 20 minutes) to experience two full pings. Although this is an unlikely scenario, the Navy proposes a mitigation zone that is basically equivalent to the previous zone based on 180 dB re1μPa (RMS) RL as the current mitigation zone for SURTASS LFA sonar training and testing activities in this rule, as described below.

In previous rules, prior to commencing and during SURTASS LFA sonar training and testing transmissions, the Navy determined (in real time) the propagation of LFA sonar signals in the ocean and the distance from the SURTASS LFA sonar source to the 180-dB isopleth (See Description of Real-Time SURTASS LFA Sonar Sound Field Modeling section of the application). The 180-dB isopleth defined the extent of the LFA sonar mitigation zone for marine mammals around the surveillance vessel. If a marine mammal entered the LFA sonar mitigation zone (or the 1-km buffer previously required by NMFS, as described below), the Navy implemented a suspension of SURTASS LFA sonar transmissions. This measure was included in prior rules to reduce or alleviate the likelihood that marine mammals would be exposed to levels of sound that may result in injury (PTS). However, due to the updated criteria in NMFS' 2018 Acoustic Technical Guidance (NMFS 2018), this 180-dB mitigation zone would not only preclude PTS, but almost all TTS and more severe behavioral reactions as well. While not an expansion of the mitigation, the mitigation is now considered more effective at reducing PTS and TTS compared to prior authorizations for SURTASS LFA sonar.

The Navy modeling of the sound field in near-real time conditions provided the information necessary to calculate the mitigation zone for which delay or suspension of LFA sonar transmissions would occur. Acoustic model updates were nominally made every 12 hrs, or as meteorological or oceanographic conditions change. If a marine mammal entered the calculated threshold distance (plus its associated buffer distance), the sonar operator notified the senior military member in charge, who would order the delay or suspension of transmissions. If it were predicted that the SPL threshold distances would change within the next 12-hr period, the senior military member in charge would also be notified in order to take the necessary action to ensure that the sound field criteria would not be exceeded.

As an added protective measure, NMFS previously required the Navy to include a ''buffer zone'' that extends an additional 1 km (0.62 mi; 0.54 nm) beyond the Navy's proposed 180-dB isopleth LFA sonar mitigation zone. This buffer typically coincides with the full detection range of the HF/M3 active sonar for mitigation monitoring (approximately 2 to 2.5 km; 1.2 to 1.5 mi; 1.1 to 1.3 nmi). Thus, implementation of this additional 1 km buffer zone increased the shutdown zone around the LFA sonar array and vessel and, given the highly effective monitoring capabilities (described below), ensured that no marine mammals are exposed to an SPL greater than approximately 174 dB re: 1 μPa. In past applications, the Navy has noted that this additional mitigation is practicable and the Navy has implemented this measure in previous authorizations. In addition, as noted above for the 180-dB mitigation zone, this buffer mitigation is more effective at reducing a broader range of impacts compared to prior authorizations due to the updated criteria in NMFS' Acoustic Technical Guidance (NMFS, 2018). The proposed 2,000 yd (1.83 km) single fixed mitigation/buffer zone would cover virtually all of the previous combined mitigation/buffer zone of nominally 1.08 nmi (2 km), since the difference between 2,000 yd and 2 km is only about 187 yd (or 0.09 nmi (167 m)). Likewise, the difference in the sound field of the combined mitigation/

buffer zones of 2,000 yd (1.83 km) versus 1.08 nmi (2,187 yd; 2 km) would also be negligible. At 2,000 yd (1.83 km), modeling shows that the sound field would be about 174.75 dB while at 1.08 nmi (2 km), the sound field 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.

In summary, Navy requested, and NMFS is proposing to include, a single, fixed, combined mitigation/buffer zone for SURTASS LFA sonar training and testing activities to standardize and simplify implementation of this monitoring requirement using standard Navy metrics (yards not meters). This measure will continue 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 nmi (1 km) (DoN, 2001). With the combined mitigation/buffer zone of 2,000 yd (1.83 km), there is no potential for animals to be exposed to received levels greater than 180 dB rms, or levels above the new injury thresholds identified in NMFS acoustic thresholds, and, therefore, marine mammals are protected from both acoustic injury and more severe occurrences of Level B harassment.

Visual Mitigation Monitoring

Visual monitoring consists of daytime observations for marine mammals from the bridge of SURTASS LFA sonar vessels by lookouts (personnel trained in detecting and identifying marine mammals). Navy shipboard lookouts are highly qualified and experienced observers of the marine environment. Their operational duties require that they report all objects sighted on the water surface to the senior military member in charge (*e.g.,* trash, a periscope, marine mammals, sea turtles) and all disturbances (*e.g.,* surface disturbance, discoloration) that may be indicative of a threat to the vessel and its crew. The objective of visual mitigation monitoring is to maintain location, distance, and movement information about marine mammals observed to ensure that none approach close enough to enter the 2,000-yard LFA mitigation/buffer zone.

Daylight is defined as 30 min before sunrise until 30 min after sunset. Visual monitoring would begin 30 min before sunrise or 30 min before the Navy deploys the SURTASS LFA sonar array. Lookouts will continue to monitor the area until 30 min after sunset or until recovery of the SURTASS LFA sonar array.

The lookouts will maintain a topside watch and marine mammal observation log during daytime activities that employ SURTASS LFA sonar in the active mode. These trained monitoring personnel maintain a topside watch and scan the water's surface around the vessel systematically with standard binoculars (7x) and with the naked eye. If the lookout sights a possible marine mammal, the lookout will use big-eye binoculars (25x) to confirm the sighting and potentially identify the marine mammal species. Lookouts will enter numbers and identification of marine mammals sighted into the log, as well as any unusual behavior. A designated ship's officer will monitor the conduct of the visual watches and periodically review the log entries.

If a lookout observes a marine mammal outside of the 2,000-yard LFA mitigation/buffer zone, the lookout will notify the senior military member in charge of the watch. The senior military member in charge shall then notify the HF/M3 active sonar operator to determine the range and projected track of the marine mammal. If the HF/M3 sonar operator or the lookout determines that the marine mammal will pass within the 2,000-yard LFA mitigation/buffer zone, the senior military member in charge shall order the delay or suspension of SURTASS LFA sonar training and testing transmissions when the animal enters the 2,000-yard LFA mitigation/buffer zone to prevent Level A harassment as well as reduce the potential for TTS and more severe behavioral responses.

If a lookout observes a marine mammal anywhere within the 2,000-yard LFA mitigation/buffer zone (required by NMFS), the senior military member in charge would be notified so that the LFA sonar training and testing transmissions would be immediately shut down or suspended. The lookout will enter his/her observations about sighted marine mammals into the log: Date/time; vessel name; geographic coordinates/position; type and number of marine mammals observed; assessment basis (*i.e.,* observed injury or behavioral response); bearing from vessel; whether activities were delayed, suspended, or terminated; and relevant narrative information.

Marine mammal biologists who are qualified in conducting at-sea marine mammal visual monitoring from surface vessels will train and qualify designated ship personnel to conduct at-sea visual monitoring. This training may be accomplished either in-person or via video training.

Passive Acoustic Mitigation Monitoring

For the second of the three-part mitigation monitoring measures, the Navy will conduct passive acoustic monitoring using the SURTASS towed horizontal line array to detect vocalizing marine mammals as an indicator of their presence. This system serves to augment the visual and active sonar detection systems, and is deployed and operated at all times in which the LFA sonar system could be utilized. If a passive acoustic technician detects a vocalizing marine mammal that may be potentially affected by SURTASS LFA sonar prior to or during transmissions, the technician will notify the senior military member in charge who will immediately alert the HF/M3 active sonar operators and the lookouts. The senior military member in charge will order the delay or suspension of SURTASS LFA sonar transmissions when the animal enters the 2,000-yard LFA mitigation/buffer zone as detected by either the HF/M3 sonar operator or the lookouts. The passive acoustic technician will record all contacts of marine mammals into a log.

Active Acoustic Mitigation Monitoring

Active acoustic monitoring uses the high-frequency marine mammal monitoring (HF/M3) sonar to detect, locate, and track marine mammals that could pass close enough to the SURTASS LFA sonar array to enter the 2,000-yard LFA sonar mitigation/buffer zone. HF/M3 acoustic monitoring may be used at all times of the day or night and begins 30 min before the first SURTASS LFA sonar transmission of a given training or testing activity is scheduled to commence and continues until the Navy terminates LFA sonar transmissions.

If the HF/M3 sonar operator detects a marine mammal contact outside the 2,000-yard LFA sonar mitigation/buffer zone, the HF/M3 sonar operator shall determine the range and projected track of the marine mammal. If the operator determines that the marine mammal will pass within the 2,000-yard LFA sonar mitigation/buffer zone, he/she shall notify the senior military member in charge. The senior military member in charge then immediately orders the delay or suspension of training and testing transmissions when the animal is predicted to enter the 2,000-yard LFA sonar mitigation/buffer zone.

If the HF/M3 sonar operator detects a marine mammal within the 2,000-yard LFA mitigation/buffer zone, he/she shall notify the senior military member in charge who will immediately order the delay or suspension of training and testing transmissions. The HF/M3 sonar operator will record all contacts of marine mammals into the log.

Prior to full-power operations of the HF/M3 active sonar during SURTASS LFA sonar training and testing activities, the Navy will ramp up the HF/M3 sonar power level over a period of 5 min from the source level of 180 dB re 1 µPa at 1 m in 10-dB increments until the HF/M3 system attains full power (if required) to ensure that there are no inadvertent exposures of marine mammals to received levels greater than 180 dB re 1 µPa from the HF/M3 sonar. The Navy will not increase the HF/M3 sonar source level if any of the three monitoring methods detect a marine mammal during ramp-up. Ramp-up of the HF/M3 active sonar may continue once marine mammals are no longer detected by any of the three monitoring methods.

In situations where the HF/M3 sonar system has been powered down for more than 2 min during a training and testing event, the Navy will ramp up the HF/M3 sonar power level over a period of 5 min from the source level of 180 dB re 1 µPa at 1 m in 10-dB increments until the system attains full power.

NMFS' Additional 1-km Buffer Zone Around OBIAs

Similar to the previously-required 1-km buffer around the LFA Sonar Mitigation Zone, NMFS is proposing to require the Navy to include a ''buffer zone'' that extends an additional 1 km (0.62 mi; 0.54 nm) beyond the seaward boundary of any OBIA (discussed in ''Geographic Restrictions'' section immediately below). The Navy has noted that this additional mitigation is practicable in past applications and has implemented this measure in previous authorizations. In addition, as noted above for the 180-dB mitigation zone, this 1-km buffer mitigation is more effective at reducing a broader range of impacts compared to prior authorizations due to the updated criteria in NMFS' Acoustic Technical Guidance (NMFS, 2018).

Geographic Restrictions

As noted above, the Navy will implement geographic restrictions for SURTASS LFA sonar training and testing activities that entail restricting SURTASS LFA sonar activities within these designated areas such that the SURTASS LFA sonar-generated sound field will not exceed 180 dB re: 1 µPa (RL): (1) Within a 1-km seaward buffer of any finalized OBIAs for marine mammals, as required by NMFS; (2) observing a coastal standoff range restricting SURTASS LFA sonar training and testing activities such that the sound field will not exceed 180 dB re: 1µPa (RL) within 22 km (14 mi; 12 nmi) of any emergent land, including islands; (3) the Navy will not conduct SURTASS LFA sonar training and testing activities within the territorial seas of any foreign nation (distance ranging from 0 to 12 km, depending on distance claimed); and (4) the Navy will not operate SURTASS LFA sonar in Hawaii state waters (out to 3 nmi) or in waters of Penguin Bank to the 600-ft (183-m) isobath, and will ensure Hawaii state waters are not ensonified above 145 dB.

As with previous rulemakings for SURTASS LFA sonar, this rulemaking contains a consideration of geographic restrictions, including OBIAs. However, whereas the Navy previously considered SURTASS LFA sonar activities worldwide, they have narrowed the geographic scope of their current application to reflect only those areas of the world's oceans where the Navy anticipates conducting covered SURTASS LFA sonar activities (*i.e.,* training and testing in the central and western North Pacific and eastern Indian Oceans). Therefore, consideration of geographical restrictions is also limited to those areas of the world's oceans where the Navy anticipates conducting covered SURTASS LFA sonar activities, as discussed in more detail below.

Offshore Biologically Important Areas (Background)

Given the unique operational characteristics of SURTASS LFA sonar, Navy and NMFS developed the concept of geographical restrictions for SURTASS LFA sonar in the SURTASS LFA Sonar FOEIS/EIS (DoN, 2001) to include: Delineating a 12 nmi coastal standoff zone where received levels from SURTASS LFA sonar could not exceed 180 dB, and designating OBIAs, where warranted, for areas beyond this coastal standoff zone, wherein received levels could not exceed 180 dB. The coastal standoff and OBIAs are intended to reduce the likelihood and/or degree of impacts on affected marine mammal species or stocks. As noted in the 2012 Final Rule (77 FR 50290; August 20, 2012), over 80 percent of the existing and potential marine protected areas reviewed were within 12 nmi from a coastline, indicating the effectiveness of the coastal standoff as one of the primary mitigation measures for reducing potential impacts to marine mammals. OBIAs expand upon this protection by avoiding or minimizing impacts in areas beyond the coastal standoff distance where marine mammals are known to engage in specific behaviors that may lead to more severe impacts if interrupted; known to congregate in higher densities; and/or known to have a limited range and small abundance that creates more vulnerability for the stock as a whole. These criteria are important when determining whether mitigation would be likely to reduce the probability or severity of effects to individuals that would translate to minimization of impacts at the population level under the LPAI standard. Limiting LFA sonar activities in these important areas is expected to limit the likelihood and/or degree of species or stock effects by minimizing the chances that the activity will result in detrimental energetic effects to individuals (such as those that could occur in known feeding areas) or direct interference in breeding or mother/young interactions (such as those that could occur in reproductive or nursing areas) that could result in reductions in reproductive success or survivorship.

Three OBIAs were identified in the 2001 FOEIS/EIS: 200 m isobaths of the east coast of North America; Costa Rica Dome; and Antarctic Convergence Zone. In 2007, the Navy published a supplemental FEIS/FOEIS that designated six new OBIAs in addition to the three OBIAs that were designated in the 2001 FEIS/FOEIS. The criteria for identifying OBIAs in the 2001 and 2007 rules were originally defined in the 2001 SURTASS LFA Sonar FOEIS/EIS (Subchapter 2.3.2.1) as areas of the world's oceans outside of the geographic stand-off distance (greater than 22 km (12 nmi)) from a coastline (including islands) where marine animals of concern (those animals listed under the ESA and/or marine mammals) carry out biologically important activities, including migration, foraging, breeding, and calving.

For the 2012 rule, the Deputy Assistant Secretary of the Navy for Environment (DASN(E)) determined that the purpose of NEPA and E.O. 12114 would be furthered by the preparation of an additional supplemental analysis related to the employment of SURTASS LFA sonar. Accordingly, the DASN(E) directed that an SEIS/SOEIS (among other things) provide further analysis of potential additional OBIAs in regions of the world where the Navy intended to use the SURTASS LFA sonar systems.

In parallel, for the 2012 rule, NMFS, with Navy input, developed a new process and screening criteria for determining an area's eligibility to be considered as an OBIA nominee for marine mammals. Those screening criteria were: (1) Areas with: (a) High densities of marine mammals; or (b) Known/defined breeding/calving grounds, foraging grounds, migration routes; or (c) Small, distinct populations of marine mammals with limited distributions; and (2) Areas that are outside of the coastal standoff distance and within potential operational areas for SURTASS LFA (*i.e.,* greater than 22 km (13.6 mi; 12 nmi) from any shoreline and not in polar regions).

For the 2012 FSEIS/SOEIS and 2012 rule, NMFS also developed and implemented a robust, systematic screening process for reviewing existing and potential marine protected areas against the OBIA criteria, based on the World Database on Protected Areas (WDPA, 2009), Hoyt (2005), and prior SURTASS LFA sonar OBIAs. This process produced a preliminary list of 403 OBIA nominees. As noted above, and stated in the 2012 Final Rule (77 FR 50290; August 20, 2012), the vast majority of the areas reviewed as potential OBIAs were within 12 nmi from a coastline and therefore already afforded protection due to the coastal standoff zone, indicating the effectiveness of the coastal standoff as one of the primary mitigation measures for reducing potential impacts. The remaining areas were broadly evaluated under the OBIA criteria and, after review, 73 potential OBIAs were considered by the Navy and NMFS.

After the list of potential OBIAs was developed based on information at a broad scale, each of these areas was evaluated at a finer scale to determine whether they qualified for designation as an OBIA. Further analysis of the biological evidence and robustness of the data for each of these recommendations included ranking them in categories using a numbering system ranging from 0 to 4. Any of the nominees that received a ranking of 2 or higher were eligible for continued consideration as an OBIA nominee. A rank score of 2 for designation criteria or for OBIA boundary considerations indicated that the designation was inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or ''gray literature'' (inferred from analyses conducted for purposes other than quantifying OBIA criteria or boundary; see DoN (2012), Section 4.5.2.1). Thus, even areas with somewhat limited data were eligible for further consideration as an OBIA.

The systematic process described here was developed in order to support an orderly and manageable expert review and to ensure some definable information quality in the identification of OBIAs. As a result of this process, 45 areas ranked a 2 or higher.

Although not part of the initial screening criteria for the 2012 rulemaking, consideration of marine mammal hearing frequency sensitivity led NMFS to screen out areas that qualified solely on the basis of their importance for mid- or high-frequency hearing specialists in past rulemaking. This was due to the fact that the LFA sound source is below the range of best hearing sensitivity for MF and HF odontocete hearing specialists. Using the example of harbor porpoises, this means that a sound with a frequency less than 1 kHz would need to be significantly louder (more than 50 dB louder) than a sound in their area of best sensitivity (around 100 kHz) in order for them to hear it. Additionally, during the 1997 to 1998 SURTASS LFA Sonar Low Frequency Sound Scientific Research Program (LFS SRP), numerous odontocete and pinniped species (*i.e.,* MF and HF hearing specialists) were sighted in the vicinity of the sound exposure tests and showed no immediately obvious responses or changes in sighting rates as a function of source conditions, which likely produced received levels similar to those that produced minor short-term behavioral responses in the baleen whales (*i.e.,* LF hearing specialists). NMFS stated that MF and HF odontocete hearing specialists have such reduced sensitivity to the LFA sonar source that limiting ensonification in OBIAs for those animals would not afford protection beyond that which is already incurred by implementing a shutdown when any marine mammal enters the LFA mitigation zone. Therefore, consideration of marine mammal frequency sensitivity led NMFS to screen out areas that qualified solely on the basis of their importance for MF or HF specialists.

In addition to the considerations above, NMFS reviewed Hoyt (2011), which was an update and revision of Hoyt's 2005 earlier work, along with areas recommended in public comments received on the 2012 DSEIS/SOEIS. As a result of this further analysis, NMFS developed a list of OBIAs, which were then further considered in the context of practicability.

In response to public comments on the 2012 proposed rule, NMFS also reevaluated its preliminary decision not to include areas that met the criteria for sperm whales and pinnipeds, and ultimately determined such areas would be appropriate for OBIA designation where information established the criteria were met, and in fact noted that one OBIA (Patagonia Shelf) had already been identified for elephant seals. While no OBIAs had been identified for sperm whales, NMFS committed to considering sperm whales in future analyses should supporting information become available.

As part of the 2017 DSEIS/SOEIS, and as part of the 2017 rulemaking process, NMFS and Navy continued their evaluation of OBIAs. As a result of that work, NMFS and the Navy revised boundaries and designated seven more OBIAs, for a total of 29 OBIAs that were identified and made part of the NDE, under which the Navy is currently conducting SURTASS LFA sonar activities. Two of these OBIAs include protection for sperm whales (OBIA 28, Perth Canyon and OBIA 29, Southwest Australia Canyons).

Since 2012, the Navy and NMFS have maintained a ''watch list'' of potential marine areas for which information or data have not been sufficient to designate as OBIAs, and reviewed new literature to determine if additional areas should be added to the list of potential areas. The watch list is periodically evaluated or re-assessed as additional information and data are available to determine if new information provides adequate support under one of the OBIA biological criteria. NMFS refers the reader to the SURTASS 2018 DSEIS/SOEIS, Chapter 5 and Appendix C for more detail on the analysis of potential OBIAs. As part of the ongoing Adaptive Management component of the 2012 final rule, and in preparation for the 2018 DSEIS/SOEIS, NMFS and Navy reviewed the watch list and other new information to determine the potential for additional OBIAs or expansion of existing OBIAs within the SURTASS LFA sonar study area.

Offshore Biologically Important Areas—Proposal for Current Rulemaking

For the SURTASS 2018 DSEIS and this proposed rule, the following biological, geographic, and LF hearing sensitivity factors are considered in the identification of OBIAs:

Biological Criteria—As with other biological criteria, critical habitat is considered as one of the possible factors in the OBIA process, but designation as critical habitat does not necessarily comport with designation as an OBIA due to differences in the intent of these designations. Critical habitat is defined and used in the ESA and includes specific geographic areas that contain features essential to the conservation of an endangered or threatened species, including areas that are not currently occupied by the relevant species. However, as stated above, the intent of OBIA designation is to expand upon the coastal standoff, and provide protection from potential SURTASS LFA sonar impacts by avoiding or minimizing impacts in areas beyond the coastal standoff distance where marine mammals are known to engage in specific behaviors that may lead to more severe impacts if interrupted; known to congregate in higher densities; and/or known to have a limited range and small abundance that creates more vulnerability for the stock as a whole. Therefore, at least one of the following biological criteria must be met for a marine area to be considered as a marine mammal OBIA for SURTASS LFA sonar. When direct data relevant to one of the following are limited, other available data and information may be used if those data and information, either alone or in combination with limited direct data, are sufficient to establish that at least one of the biological criteria are present:

- *Known Breeding/Calving or Foraging Ground, or Mitigation Route*—an area representing a location of known biologically important activities including defined breeding or calving areas, foraging grounds, or migration routes. Potential designation under this criterion is indicative that these areas are concentrated areas for at least one biologically important activity. ''Concentrated'' means that more of the animals are engaged in the particular behavior at the location (and perhaps time) than are typically engaged in that behavior elsewhere.
- *Small, Distinct Populations of Marine Mammals with Limited Distributions*—geographic areas in which small, distinct populations of marine mammals occur and whose distributional range are limited.
- *High Densities*—an area of high density for one or more species of marine mammal. High density areas are those marine waters where the density within a definable area (and potentially time), measurably and meaningfully exceeds the average density of the species or stock within the region. The exact basis for the identification of high density areas may differ across species/stocks and regions/scales, depending on the available information and should be evaluated on a stock-by-stock basis, although combining species or stocks may be appropriate in some situations. The best source for this type of determination is publically-available, direct measurements from survey data.

Geographic Criteria—For a marine area to be eligible for consideration as an OBIA for marine mammals, the area must be located where training and testing activities of SURTASS LFA sonar would occur and cannot be located within 12 nm (22 km) of any emergent land including islands or island systems (must be outside of the coastal standoff zone, which already receives the same protection as OBIAs).

LF Hearing Sensitivity—SURTASS LFA sonar transmissions are well below the range of best hearing sensitivity for most odontocetes and most pinnipeds based on the measured hearing thresholds (Au and Hastings, 2008; Houser *et al.,* 2008; Kastelein *et al.,* 2009; Mulsow and Reichmuth, 2010; Nedwell *et al.,* 2004; Richardson *et al.,* 1995; Southall *et al.,* 2007). The intent of OBIAs is to protect those marine mammal species, such as baleen whales, most likely to hear and be affected by LFA sonar transmissions and to provide them additional protections during periods when they are conducting biologically significant activities. Thus, the primary focus of the OBIA mitigation measure is on LF hearing specialist species. However, OBIAs have been designated to provide additional mitigation protection for non-LF hearing specialists, such as elephant seals and sperm whales, since the available hearing data for these species indicate an increased sensitivity to LF sound (compared to most odontocetes and pinnipeds).

The biological criteria considered in the identification of OBIAs have changed since the 2001 FOEIS/EIS (and as continued in the 2007 SEIS) in two respects. First, under the 2001 FOEIS/EIS, 2007 SEIS, and the 2007 Final Rule, an area could be designated as an OBIA only if it met a conjunctive test of being an area where: Marine mammals congregate (1) in high densities, and (2) for a biologically important purpose. The current scheme is more protective because any one of the biological criteria alone could be a sufficient basis for designation as an OBIA if it also meets the geographic criterion of falling outside of 12 nmi (22 km) from any coastline. Second, the current biological criteria include ''small, distinct populations with limited distribution'' that also could, standing alone, be a basis for designation.

The 2017 NDE for SURTASS LFA sonar lists the 29 marine mammal OBIAs and their effective periods as geographic mitigation with which the Navy must comply for SURTASS LFA sonar activities. These OBIAs resulted from analyses conducted as part of the 2017 SEIS/SOEIS and application for rulemaking, and retained existing OBIAs; revised/expanded existing OBIAs; and added new OBIAs to those defined as part of the 2012 SURTASS LFA sonar rule (also see the SURTASS 2018 DSEIS/SOEIS, 5.3.6.2 and Appendix C for more detail on OBIAs). Of these 29 OBIAs, four are located within the current SURTASS LFA sonar study area (OBIA 16, Penguin Bank, Hawaiian Islands Humpback Whale NMS; OBIA 20, Northern Bay of Bengal and Head of Swatch-of-No-Ground; OBIA 26, Offshore Sri Lanka; and OBIA 27, Camden Sound/Kimberly Region), as indicated in Table 19, below.

Since the 2017 SEIS/SOEIS and NDE for SURTASS LFA sonar, analysis and assessment of marine areas as potential OBIAs has continued. For this proposed rule, we have applied the OBIA biological, geographic, and hearing sensitivity factors, as well as the practicability criterion, and are considering only areas within the study area (central and western North Pacific and eastern Indian Oceans). This analysis includes review of the OBIA watchlist as well as a review of Important Marine Mammal Areas (IMMAs), Ecologically or Biologically Significant Marine Areas (EBSAs), and the International Union for Conservation of Nature (IUCN) Green List of Protected and Conserved Areas that are located within the study area. More information about IMMAs, EBSAs, and IUCN Green List of Protected and Conservation Areas is provided below followed by a discussion of the review of these areas for consideration as OBIAs, which is ongoing and will be completed for the final rule. In Table 19 we list the OBIAs that were previously identified and are currently proposed for inclusion in this rule (*i.e.,* that fall within the identified area covered by the rule (central and western North Pacific and eastern Indian Oceans)).

TABLE 19—MARINE MAMMAL OBIAS CURRENTLY OBSERVED FOR SURTASS LFA SONAR

OBIA No.	Name of OBIA	Location/water body	Relevant low-frequency marine mammal species	Effectiveness seasonal period
16	Penguin Bank, Hawaiian Islands Humpback Whale NMS.	North-Central Pacific Ocean	Humpback whale	November through April, annually.

TABLE 19—MARINE MAMMAL OBIAS CURRENTLY OBSERVED FOR SURTASS LFA SONAR—Continued

OBIA No.	Name of OBIA	Location/water body	Relevant low-frequency marine mammal species	Effectiveness seasonal period
20	Northern Bay of Bengal and Head of Swatch-of-No-Ground (SoNG).	Bay of Bengal/Northern Indian Ocean.	Bryde's whale	Year-round.
26	Offshore Sri Lanka	North-Central Indian Ocean	Blue whale	December through April, annually.
27	Camden Sound/Kimberly Region.	Southeast Indian Ocean; northwestern Australia.	Humpback whale	June through September, annually.

IMMAs are defined by the Marine Mammal Protected Areas Task Force (MMPATF), which is comprised of partners from the International Union for Conservation of Nature (IUCN) World Commission on Protected Areas (WCPA); IUCN Species Survival Commission (SSC); International Committee on Marine Mammal Protected Areas (ICMMPA); Tethys Research Institute; Whale and Dolphin Conservation (WDC); Global Ocean Biodiversity Initiative (GOBI), and Water Evolution organizations. These areas are defined as discrete portions of habitat that are important to one or more marine mammal species; represent priority sites for marine mammal conservation worldwide without management implications; and merit protection and monitoring. IMMA selection criteria are designed to capture aspects of the biology, ecology, and population structure of marine mammals and a candidate IMMA need only satisfy one of the following criteria and/or sub-criteria to successfully qualify for IMMA status: Criterion A—Species or Population Vulnerability; Criterion B—Distribution and Abundance; Criterion C—Key Life Activities; or Criterion D—Special Attributes. To date, IMMAs have been identified and made publicly available only for the western and central Pacific Ocean and Mediterranean Sea (MMPATF, 2018), six of which are in the North Pacific.

EBSAs are an effort of the Convention on Biological Diversity (Convention), which was initiated by the United Nations Environment Programme (UNEP). The Convention is an international legal instrument for the conservation and sustainable use of biological diversity. EBSAs are defined as special marine areas that serve important purposes that ultimately support the healthy functioning of oceans and thus should have increased protection and sustainable management. Currently there are 278 EBSAs defined worldwide, 129 of which are within the central or western North Pacific or eastern Indian Oceans.

The IUCN Green List of Protected and Conserved Areas has been generated as part of an IUCN program that aims to encourage, achieve, and promote effective, equitable, and successful protected areas with a principal goal of increasing the number of protected and conserved areas that are effectively and equitably managed and deliver conservation outcomes. The basis of the IUCN Green List Programme is the Green List Standard, which is a set of components, criteria, and indicators for successful protected area conservation and international benchmarks for quality to provide improved performance and achievement of conservation objectives (IUCN, 2018). The Programme has recognized 25 protected and conserved areas in eight countries around the world, 11 of which are within the SURTASS LFA sonar study area.

NMFS assessed these areas (IMMAs, EBSAs, and IUCN areas) to determine whether they contained characteristics that matched the criteria necessary for identifying an OBIA. The initial assessment for each marine area was a geospatial analysis to determine if the marine area was located within the study area and outside of the coastal standoff range for SURTASS LFA sonar (*i.e.,* >12 nmi (22 km) from any emergent land). Another key step in the assessment of marine areas for designation as OBIAs is determining the area's relevance specific to marine mammals under NMFS' jurisdiction, as many of the EBSAs and other marine areas are defined for their importance to other marine taxa (fish, invertebrates, etc.), or for their importance for general marine conservation. For example, of the six IMMAs designated in the North Pacific Ocean, three were located in the SURTASS LFA sonar study area but only two were located offshore of the coastal standoff range and were carried forward for consideration as OBIAs; review of the 278 identified EBSAs revealed only 12 EBSAs that were within the SURTASS LFA sonar study area outside of the coastal standoff range, and were of noted importance to marine mammal species for which NMFS has jurisdiction (and one additional EBSA was added for consideration due to other factors, as discussed below); and review of the 25 recognized IUCN Green List of Protected and Conserved Areas identified 11 areas within the SURTASS LFA sonar study area, though none of these encompassed any marine waters, so none of these areas were considered further. A summary of the areas assessed is presented in Table 20, below.

TABLE 20—NUMBER AND TYPES OF MARINE AREAS ASSESSED AS POTENTIAL OBIAS

Name/region	Number of areas relevant to marine mammals	Number of areas located within SURTASS LFA sonar study area	Number of areas located outside of coastal standoff range	Number of areas for further consideration
OBIA Watchlist Areas				
—Pacific Remote Islands MNM —Marianas Trench MNM —Papahanaumokuakea MNM				

TABLE 20—NUMBER AND TYPES OF MARINE AREAS ASSESSED AS POTENTIAL OBIAS—Continued

Name/region	Number of areas relevant to marine mammals	Number of areas located within SURTASS LFA sonar study area	Number of areas located outside of coastal standoff range	Number of areas for further consideration
TOTAL OBIA Watchlist Areas For Further Consideration = 3 *				
EBSAs				
Northeast Indian Ocean	5	10	9	2
South and Western Indian Ocean	14	5	4	0
East Asian Seas	11	32	13	7
North Pacific Ocean	15	6	6	4
Western South Pacific Ocean	9	2	2	0
TOTALS	54	55	34	13
IMMAs				
Western and Central North Pacific Ocean	6	3	2	2
IUCN Green List of Protected and Conserved Areas				
Asian Pacific	0	0	0	0

* Four watchlist areas were advanced for further consideration as OBIAs, but for three of these areas (the MNMs), only a portion of the area met the all of the geographic criteria for consideration.

Review of OBIA Watchlist Marine Areas as OBIAs—As noted above, NMFS and the Navy have maintained a watchlist of potential marine areas that have already been identified and reviewed as potential OBIAs, but for which documentation on the importance of the area to marine mammals has not been established or is lacking in sufficient detail. As the watchlist was developed under previous rules that considered worldwide SURTASS LFA sonar operations, the areas are dispersed globally. The majority of these watchlist areas are not located in the current SURTASS LFA sonar study area (central or western North Pacific and eastern Indian Oceans). Only the watchlist areas within the current SURTASS LFA sonar study area have been re-evaluated for consideration as OBIAs including: The Pacific Remote Islands (PRI) Marine National Monument (MNM); Marianas Trench MNM; and the Papahanaumokuakea MNM. The British Indian Ocean Territory (BIOT)-Chagos Islands MPA is large, encompassing an area of 158,605 nmi^2 (544,000 km^2) in the central Indian Ocean, the majority of which lies outside the coastal standoff range for SURTASS LFA sonar. However, little information is available on marine mammals that use these remote waters or of what important biological activities of marine mammals may be conducted in these waters. Available literature and information was researched and reviewed, but the Navy and NMFS' conclusion on this area remains the same, that insufficient data are available to demonstrate that the waters of this MPA are important biologically to marine mammals. Accordingly, the Navy and NMFS are retaining the BIOT-Chagos Islands MPA on the OBIA Watchlist and not moving forward for consideration as an OBIA at this time. Not all areas of these MNMs met the geographic criteria. The Marianas Trench MNM consists of three units, but only one unit (The Islands unit) met the geographic criteria. The Islands unit consists of the waters and submerged lands of the three northernmost Mariana Islands, while the other two units consist solely of submerged lands and include no waters. Additionally, only two of the PRI MNM units (Wake and Johnson atolls) were located wholly within the study area, and only a very small strip of part of a third PRI MNM unit (Kingman Reef/Palmyra Atoll) was within the study area. Therefore, only those areas of the MNMs within the study area were further considered.

Review of EBSAs as OBIAs—EBSAs from five geographic regions, as classified by the Convention (*https://www.cbd.int/ebsa/ebsas*), in the Indian and North Pacific Oceans in which all or part of the SURTASS LFA sonar study area is located were assessed as potential OBIAs. The five pertinent EBSA regions include: North-East Indian Ocean, Southern Indian Ocean, East Asian Seas, North Pacific Ocean, and Western South Pacific Ocean. All EBSAs in these regions were assessed to determine their relevance to marine mammal species under NMFS' jurisdiction. Forty-four of the EBSAs were noted of importance to marine mammals. However, only 13 of these met the preliminary relevance and geographic criteria for OBIAs and were carried forward for further review for consideration as OBIAs. Although the Ogasawara Island EBSA (included in the 13 carried forward for further review) was located entirely within the coastal standoff range, waters beyond the coastal standoff for this area are being further considered to see if an area can be defined in which important reproductive behaviors occurs and sufficient data supports its designation as an OBIA due to the fact that the Ogasawara area is an important reproductive area for the western North Pacific DPS and stock of humpback whale.

Review of IMMAs as OBIAs—Three identified IMMAs are located within the SURTASS LFA sonar study area, including: Northwest Hawaiian Islands; Main Hawaiian Islands; and the Southern Shelf Waters and Slope Edge of Palau IMMAs. However, the geographic extent of the Palau IMMA is located entirely within the coastal standoff range; therefore, two of these three IMMAs were carried forward for consideration as OBIAs.

Review of IUCN Green List of Protected and Conserved Areas as OBIAs—While these areas have been designated in four global geographic regions, only the Asia Pacific region is located within or near the SURTASS LFA sonar study area. Although 11 areas are located in the Asian Pacific region, only one (Montague Island Nature Reserve) is located in the marine environment. However, this area is located entirely on the Island with no adjacent waters conserved. Therefore, none of these areas have importance to marine mammals such that consideration as OBIAs is warranted.

In addition to evaluation of OBIA watch list areas, EBSAs, IMMAs, IUCN Green List of Protected and Conserved Areas (discussed above), and Critical Habitat areas (discussed below), NMFS and the Navy evaluated areas that were suggested as OBIAs in a public comment received on the SURTASS DSEIS/SOEIS. The NRDC's comment on the SURTASS DSEIS/SOEIS recommended 19 areas for consideration as OBIAs. However, six of these areas were already included in the areas under consideration in the SURTASS DSEIS/SOEIS. Additionally, eight of the areas suggested by NRDC did not meet the geographic criteria (*i.e.,* were either located within the coastal standoff or not within the study area), or did not align with OBIA eligibility criteria (area important for marine mammals not under NMFS' jurisdiction (dugong), or suggested area for a DPS not anticipated to occur in the study area (Arabian Sea DPS of humpback whale)). The remaining five areas suggested by NRDC received further consideration for potential as OBIAs. Therefore, 25 areas comprised of 13 EBSAs; 2 IMMAs; 3 OBIA watch list areas; 2 critical habitat areas; and 5 NRDC DSEIS/SOEIS recommendation areas were further considered for potential OBIA designation.

A list of the 25 areas considered for potential designation as new OBIAs for this rulemaking, as described above, is presented in Table 21 below. Further, NMFS and the Navy have identified the subset of these areas that, based on additional preliminary analysis, satisfy at least one of the biological criteria and met the geographic criteria. The 25 areas that were further considered, and the existing information that supports our additional preliminary analysis, are summarized in a document entitled Potential Marine Mammal OBIAs for SURTASS LFA Sonar; Marine Areas Under Consideration, which is incorporated by reference into this proposed rule, and has been posted on NMFS' website at *https://www.fisheries.noaa.gov/action/incidental-take-authorization-us-navy-operations-surveillance-towed-array-sensor-system-0,* as well as the Navy's SURTASS LFA Sonar website at *http://www.surtass-lfa-eis.com.*

TABLE 21—MARINE AREAS FOR FURTHER CONSIDERATION AS MARINE MAMMAL OFFSHORE BIOLOGICALLY IMPORTANT AREAS (OBIAS) FOR SURTASS LFA SONAR

Area #	Name of marine area	Ocean basin	Marine mammal species of concern	Geographic criteria	Biological criteria	Type of marine area	Preliminarily meeting geographic, LF-sensitivity, and biological criteria
1	Papahānaumokuākea Marine National Monument.	Central North Pacific Ocean.	Humpback whale; Hawaiian monk seal.	Majority of area outside coastal standoff range (CSR).	Breeding/calving	Marine National Monument; ESA Designated Critical Habitat for the Hawaiian monk seal also is located in these waters (OBIA Watchlist).	Yes.
2	Marianas Trench Marine National Monument.	Western North Pacific Ocean.	Humpback, Bryde's, sei, common minke, and sperm whales.	38 nmi outside CSR surrounding each of three islands.	Breeding/calving, migration.	Marine National Monument (OBIA Watchlist).	Yes.
3	Trincomalee Canyon and Associated Ecosystems.	Northeast Indian Ocean.	Sperm and blue (pygmy) whales.	Part of area outside CSR.	Foraging, migration	EBSA	Yes.
4	Southern Coastal/Offshore Waters between Galle and Yala National Park.	Northeast Indian Ocean.	Blue (pygmy) whale.	Part of area outside CSR; OBIA #26 overlaps with part of area outside CSR.	Foraging, breeding/calving, migration.	EBSA	Yes.
5	Modification of Bluefin Spawning EBSA.	Western North Pacific Ocean.	Humpback whale	Part of area outside CSR.	Breeding/calving	EBSA	Yes.
6	Convection Zone East of Honshu.	Western North Pacific Ocean.	Gray whale	Outside CSR	Foraging, migration	EBSA	Yes.
7	Ogasawara Islands	Western North Pacific Ocean.	Humpback whale	EBSA inside CSR; examine area surrounding islands > CSR [1].	Breeding/calving	EBSA	Yes.
8	Upper Gulf of Thailand.	Western North Pacific Ocean.	Bryde's whale, dolphins and porpoise.	Part of area outside CSR.	Foraging, Breeding/calving.	EBSA	Yes.
9	Southeast Kamchatka Coastal Waters.	Western North Pacific Ocean.	Gray, killer, humpback, fin, and North Pacific right whales; Steller sea lion.	Small part outside CSR.	Foraging, migration	EBSA	Yes.
10	Northwestern Hawaiian Islands.	Central North Pacific Ocean.	Humpback whale, Hawaiian monk seal; spinner dolphin.	Partially outside of CSR.	Breeding/calving, Small distinct population, critical habitat.	IMMA	Yes.
11	West of Maldives	Central Indian Ocean.	Blue (pygmy), Bryde's whale.	Outside of CSR	Migration, foraging	NRDC DSEIS/SOEIS Recommendation.	Yes.

TABLE 21—MARINE AREAS FOR FURTHER CONSIDERATION AS MARINE MAMMAL OFFSHORE BIOLOGICALLY IMPORTANT AREAS (OBIAS) FOR SURTASS LFA SONAR—Continued

Area #	Name of marine area	Ocean basin	Marine mammal species of concern	Geographic criteria	Biological criteria	Type of marine area	Preliminarily meeting geographic, LF-sensitivity, and biological criteria
12	North Western Australian Shelf.	Southeast Indian Ocean.	Blue (pygmy) whale.	Outside of CSR	Migration	NRDC DSEIS/SOEIS Recommendation.	Yes.
13	Browse Basin (North Western Australia).	Southeast Indian Ocean.	Blue (pygmy) whale.	Outside of CSR	Migration	NRDC DSEIS/SOEIS Recommendation.	Yes.
14	Western Australia (Shark Bay to Exmouth Gulf).	Southeast Indian Ocean.	Humpback whale	Partially outside of CSR.	Migration	NRDC DSEIS/SOEIS Recommendation.	Yes.
15	Pacific Remote Island Marine National Monument (Wake/Johnson/Palmyra atolls and Kingman Reef units only).	Western North Pacific.	Baleen, beaked, and sperm whales; dolphins.	Small part of northern end of Kingman Reef/Palmyra Atoll within LFA Study Area.	Small distinct population.	Marine National Monument (OBIA Watchlist).	No.
16	Hawaiian Monk Seal Critical Habitat.	Central North Pacific.	Hawaiian monk seal.	Within CSR except for Penguin Bank, which is enclosed within OBIA #16 (Penguin Bank).	Breeding/calving, foraging.	ESA Critical Habitat for Hawaiian monk seal.	No.
17	Main Hawaiian Island Insular DPS of False Killer Whale Critical Habitat.	Central North Pacific.	False killer whale	Part of area outside CSR.	High-density where foraging and/or breeding/calving may occur.	ESA Critical Habitat for Main Hawaiian Islands Insular DPS of false killer whale.	No.
18	Kyushu Palau Ridge.	Western North Pacific.	Sperm whale	Outside CSR	Possible foraging	EBSA	No.
19	Raja Ampat and Northern Bird's Head.	Western North Pacific Ocean.	Bryde's, false killer, killer, and sperm whales; dolphins.	Small portion of Bird's Head Seascape occurs within LFA Study Area.	Migration, foraging (Straits outside LFA study area may function in migration).	EBSA	No.
20	North Pacific Transition Zone.	North Pacific Ocean.	Northern elephant seal.	Outside CSR	Foraging	EBSA	No.
21	Peter the Great Bay.	Sea of Japan	Spotted seal	Part of area outside CSR.	Breeding/calving, foraging.	EBSA	No.
22	Moneron Island Shelf.	Sea of Japan	Steller sea lion	Part of area outside CSR.	Breeding/calving	EBSA	No.
23	Kuroshio Current South of Honshu.	Western North Pacific Ocean.	Finless porpoise	Part of area outside CSR.	Breeding/calving	EBSA	No
24	Main Hawaiian Archipelago.	Central North Pacific Ocean.	Hawaiian monk seal, humpback, false killer, Blainville's beaked, Cuvier's beaked, and melon-headed whales.	Part of area outside CSR.	Breeding/calving (humpback whale and Hawaiian monk seal enclosed within OBIA #16, Penguin Bank); small, resident populations.	IMMA	No.
25	Polar/Kuroshio Extension Fronts.	North Pacific Ocean.	Sei whale	Outside CSR	High density, foraging.	NRDC DSEIS/SOEIS Recommendation.	No.

[1] Even though this EBSA boundary is inside the coastal standoff range, since this is such an important reproduction area for the endangered WNP humpback whale, the Navy and NMFS are further evaluating the waters beyond 12 nmi.

NMFS will consider additional information received during the public comment period when further evaluating if these areas satisfy the criteria for OBIA designation. Following the public comment period and consideration of additional information provided, for areas that we conclude satisfy the OBIA criteria, NMFS and the Navy will evaluate the practicability of the measure, which for military readiness activities ‘‘shall include consideration on personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity.’’ In accordance with the LPAI Standard, NMFS' final rule will include the rationale for which areas satisfied the OBIA criteria, a discussion of practicability, and the list of those designated as OBIAs.

Other Geographic Mitigation Considerations

Above, we describe a comprehensive process and set of criteria for identifying OBIAs, which if used in conjunction with the limits on SURTASS LFA sonar transmission levels in and around them described above, we expect to decrease the likelihood and/or scale of impacts on marine mammal species or stocks. However, the inclusion of this focused and systematic process and criteria for designating OBIAs does not mean that other mitigation, including specific time/area restrictions, could not be considered in the context of the LPAI standard. Below we address some other factors that NMFS and the Navy have considered in the development of the proposed rule.

Critical Habitat

Under section 7 of the ESA, all Federal agencies must ensure that any actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of a listed species or destroy or adversely modify its designated critical habitat. Critical habitat is not designated in foreign countries or any other areas outside of U.S. jurisdiction. Critical habitat within the U.S. EEZ implicated by SURTASS LFA sonar activities has been designated for two of the relevant ESA-listed marine mammal species, Hawaiian monk seals and the Main Hawaiian Island (MHI) Insular DPS of false killer whales. Effects to critical habitat are being explicitly addressed through the section 7 consultation process under the ESA. Some of the characteristics of ESA critical habitat are germane to the identification of OBIAs under this rulemaking. However, critical habitat also considers physical as well as biological features and may also consider areas that are currently unoccupied by the species. Therefore, not all critical habitat qualifies as an OBIA, or is otherwise appropriate for time/area restrictions when making determinations under the MMPA. Further, we note that neither of these two ESA-listed species is a low frequency hearing specialist or sensitive to SURTASS LFA in a manner that would otherwise justify designation of a mitigation area on their behalf, given the existing protections of the Navy's three-part detection and shutdown protocols.

Nearly all of the critical habitat for the Hawaiian monk seal lies within the coastal standoff distance for SURTASS LFA sonar. A small area of the monk seal's critical habitat at Penguin Bank extends beyond the 22-km (12-nmi) coastal standoff distance, and is part of the existing Penguin Bank, Hawaiian Islands Humpback Whale NMS (OBIA 16). In addition, per the CZMA consultation with the State of Hawaii for SURTASS LFA sonar, the Navy agreed not to operate SURTASS LFA sonar in state waters (out to 3 nmi) or in waters of Penguin Bank to the 600-ft (183-m) isobath, which is the boundary of the Penguin Bank OBIA for SURTASS LFA sonar. In addition, the Navy also agreed not to ensonify Hawaii state waters at levels above 145 dB. Thus, the critical habitat of the Hawaiian monk seal beyond the coastal standoff range would not be exposed to SURTASS LFA sonar training and testing activities and the small portion of critical habitat that may qualify for consideration as an OBIA is already covered by an existing OBIA. Thus, the entire critical habitat is covered by some form of geographic mitigation.

The critical habitat for the MHI insular false killer whale (MHI IFKW) DPS includes waters from the 148- to 10,499-ft (45-to 3,200-m) depth contours around the MHI from Niihau east to Hawaii. MHI IFKWs are island-associated whales that rely entirely on the productive submerged habitat of the main Hawaiian Islands to support all of their life-history stages, and their range is restricted to the shelf and slope habitat around the MHI, unlike pelagic false killer whales found more in open oceans. Because of the habitat characteristics that are important components to the ecology of these whales, NMFS identified a single feature, (island-associated marine habitat for MHI IFKWs) with four characteristics that support this feature as essential to their conservation. The four characteristics include: (1) Adequate space for movement and use within shelf and slope habitat; (2) prey species of sufficient quantity, quality, and availability to support individual growth, reproduction, and development, as well as overall population growth; (3) waters free of pollutants of a type and amount harmful to MHI IFKWs; and (4) sound levels that will not significantly impair false killer whales' use or occupancy.

Some Navy and other Federal agency areas, such as the Pacific Missile Range Facility offshore ranges, are excluded from the critical habitat designation (NOAA, 2018). In most areas of the waters surrounding the MHI, the coastal standoff range for SURTASS LFA (12 nmi (22 km)) is located closer to shore than the seaward boundary of the critical habitat for the MHI Insular DPS of the false killer whale (*i.e.,* some of the critical habitat is beyond the coastal standoff range). The Penguin Bank OBIA encompasses some of the critical habitat, but a portion of the critical habitat lies beyond, or in deeper waters, than the OBIA. However, as discussed above, part of the CZMA stipulations for SURTASS LFA sonar use in Hawaiian waters required the Navy to agree not to use SURTASS LFA sonar in the waters (out to 3 nmi) or over Penguin Bank to a water depth of 600 ft (183 m) and to limit ensonification within Hawaii state waters to 145 dB.

Regarding prey availability (large pelagic fish and squid) of sufficient quantity, quality, and availability to support individual growth, reproduction, and development, as well as overall population growth of false killer whales, no mortality of marine invertebrates is reasonably expected to occur from exposure to LFA sonar training and testing activities nor are population level effects likely. Thus, marine invertebrates such as squid would not reasonably be adversely affected by SURTASS LFA sonar training and testing activities such that their availability (or other prey availability) would be diminished (also refer to Chapter 3, section 3.4.2.1 of the SURTASS DSEIS/SOEIS for a discussion of why marine invertebrates are not reasonably likely to be adversely impacted by SURTASS LFA sonar training and testing activities). Marine fishes, however, may be affected by exposure to LFA sonar transmissions, but only if they are located within close proximity (<0.54 nmi (<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 LFA sonar is transmitting, but no potential is estimated for fitness level consequences to fish stocks. Since it is highly unlikely that a significant percentage of any prey stock would be in sufficient proximity during LFA sonar transmissions to experience such effects, there is minimal potential for 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 training and testing activities. Accordingly, SURTASS LFA sonar training and testing activities would not significantly impact the biological characteristic of prey availability of the MHI Insular DPS of the false killer whale's designated critical habitat.

Regarding the underwater sound produced by SURTASS LFA sonar, it would not be expected to ''significantly impair false killer whale's use or occupancy'' due both to the small scale of the activity (small number of vessels operating across two ocean basins, meaning that any individual marine mammal would be expected to be exposed for only a short amount of time) and the frequency of the SURTASS signal, which is not in the range of higher sensitivity for this species and would not be expected to interfere with their communication. Further, required shutdowns are expected to minimize false killer whale exposure to high sound levels and the Navy's implementation of a coastal standoff zone means that SURTASS LFA training and testing is not occurring across much of the critical habitat. No aspect of SURTASS LFA sonar training and testing activities would reasonably be expected to impact the spatial use of false killer whales. As a result, the use of SURTASS LFA sonar for training and testing activities in Hawaiian waters would not reasonably be expected to have any impact on the physical characteristics of the false killer whale critical habitat since neither the spatial availability nor sound levels in the continental shelf and slope habitat would be significantly impacted. Accordingly, NMFS is not recommending additional geographic mitigation in this area.

Both the Navy and NMFS Protected Resources Permits and Conservation Division are consulting with NMFS Protected Resources Interagency Cooperation Division on effects on critical habitat pursuant to section 7 of the ESA. Consultations under previous rules and LOAs have resulted in determinations that neither NMFS' nor the Navy's actions are likely to jeopardize the continued existence of any ESA-listed species or destroy or adversely modify designated critical habitat.

Expanded Coastal Standoff Zone

As proposed, the Navy will restrict training and testing activities utilizing SURTASS LFA sonar within 22 km (14 mi; 12 nmi) of any coastline, including islands, such that the SURTASS LFA sonar-generated sound field will not exceed 180 dB re: 1 µPa (RL) at that seaward distance. This measure is intended to minimize both the severity and scale of effects to marine mammals and, by extension, marine mammal species and stocks, by avoiding areas where many biologically important behaviors and higher densities of many species that may be found in coastal areas occur. In the past, some commenters have recommended the Navy implement a larger coastal standoff zone than is currently proposed in this rule. We reiterate that our analysis shows that approximately 80 percent of known and potential marine protected areas are within the 22 km (12 nmi) coastal standoff zone, an indication of this measure's effectiveness, and it is practicable. Additionally, this restriction limits exposures of marine mammals to high-level sounds in the vicinity of geographical features that have been associated with some stranding events (*i.e.,* enclosed bays, narrow channels, etc.) attributed to activities other than SURTASS LFA sonar.

The Navy's 2007 SEIS/SOEIS evaluated increasing the coastal standoff distance up to 46 km (25 nmi) and, based on a six-step analysis process, determined that increasing the coastal standoff range would decrease exposure to higher received levels for concentrations of marine animals closest to shore, but would do so at the expense of increasing exposure levels for shelf break and pelagic species. There have been no changes to the best available information or other indications that the coastal standoff distance should be increased, so there is no change in this mitigation measure from previous rulemakings. In addition, any areas beyond the 12 nmi coastal standoff that are biologically significant are considered as part of the OBIA process.

Commercial and Recreational SCUBA Diving Mitigation Zone

The Navy will establish a mitigation zone for human divers at 145 dB re: 1 µPa at 1 m around all known human commercial and recreational diving sites. Although this geographic restriction is intended to protect human divers, it will also reduce the LFA sound levels received by marine mammals located in the vicinity of known dive sites.

White Paper on ''Identifying Areas of Biological Importance to Cetaceans in Data-Poor Regions''

As described earlier, for the 2012 rulemaking, NMFS convened a panel of subject matter experts (SMEs) to help identify marine mammal OBIAs relevant to the Navy's use of SURTASS LFA sonar. Separately, we consulted a NMFS scientist, who was also on that same SME panel, to help address a recommendation in a public comment that NMFS consider a global habitat model (Kaschner *et al.,* 2006) in the development of OBIAs. In addition to providing the requested input (which essentially concluded that using the Kaschner model was not advisable, for several reasons), the NMFS scientist, in conjunction with other NMFS scientists, went further and provided some guidance for alternate methods for considering ''data poor areas'' and drafted a paper entitled ''Identifying Areas of Biological Importance to Cetaceans in Data-Poor Regions'' (referred to in this notice as the ''White Paper''). NMFS' consideration of the White Paper was discussed in the 9th Circuit's ruling on our 2012 Final Rule, and as a consequence we provide here some additional details and background regarding our consideration of the White Paper recommendations for this proposed rulemaking.

Kaschner et al. (2006) Recommendation

As requested, the White Paper authors reviewed the Kaschner *et al.* (2006) paper in the context of potential mitigation for SURTASS LFA sonar. The Kaschner *et al.* (2006) paper used models based on a synthesis of ''existing and often general qualitative observations about the spatial and temporal relationships between basic environmental conditions and a given species' presence'' to ''develop a generic quantitative approach to predict the average annual geographic ranges'' of marine mammal species on a global scale. Several environmental correlates including depth, sea surface temperature, distance to land, and mean annual distance to ice edge were used in the Kaschner effort. After evaluating four case studies from the Kaschner *et al.* (2006) study for predicting gray whale, northern right whale dolphin, North Atlantic right whale, and narwhal distribution, the authors of the White Paper concluded that ''(t)he predictions from the four case studies . . . included errors of omission (exclusion of areas of known habitat) and commission (inclusion of areas that are not known to be habitat) that could have important implications if the model predictions alone were used for decision making in a conservation or management context.''

Specifically, the White Paper illustrated that the Kaschner *et al.* effort omitted a considerable portion of known gray whale habitat; overestimated the range of suitable habitat for northern right whale dolphins off the U.S. West Coast (noting that species-specific models based on dedicated shipboard surveys more correctly identified suitable habitat); predicted habitat for North Atlantic right whales in large areas where they have never been recorded; and predicted suitable habitat for narwhal that did not correspond with their known distribution. Noting that these significant inaccuracies in the model could result in either under-protection or over-restrictiveness, the authors of the White Paper did not recommend basing the identification of biologically important areas on this modeling. NMFS concurred with this recommendation and elected not to use the Kaschner paper, or other similar predictive envelope models as a basis for identifying additional protective areas in the 2012 SURTASS LFA sonar incidental take rule.

Clarification of Concepts Raised in White Paper

In *NRDC* v. *Pritzker,* referring to the White Paper and its specific recommendations that NMFS did not adopt for identification of OBIAs, the 9th Circuit stated that NMFS, in its 2012 rule, ''did not give adequate protection to areas of the world's oceans flagged by its own experts as biologically important, based on the present lack of data sufficient to meet the Fisheries Service's (OBIA) designation criteria, even though NMFS' own experts acknowledged that (f)or much of the world's oceans, data on cetacean distribution or density do not exist.'' *NRDC* v. *Pritzker,* 828 F.3d at 1142. Although the White Paper authors utilized the term ''biological importance'' in the title of the paper, they clearly stated that ''it must be decided whether the list of OBIAs should be comprehensive (based on a 'precautionary approach') or pure (based on the 'minimalist approach'),'' and explicitly declined to provide an answer to this question. Specifically, they indicated ''it must be decided whether to be precautionary and possibly nominate areas that are of marginal importance in an attempt to minimize the chances of overlooking biologically important areas'' or ''minimize the chances of nominating sites that are of marginal biological importance and, therefore, risk overlooking biologically important areas.'' Then, the authors suggested three general recommendations for decision making based upon a precautionary approach if that is the method selected by the decision maker, as discussed further below.

However, the recommendations of the White Paper present a dichotomous ''precautionary versus non-precautionary'' choice, an interpretation that fails to consider the context of the requirements of the MMPA, the nature of the anticipated effects of the action at issue, and the other mitigation measures. More appropriately, NMFS has fully and independently considered each of the White Paper's three recommendedations in the context of the MMPA's LPAI standard, as described below. In that analysis, we first note the small scale of the anticipated effects of the Navy's request for authorization (496–592 hours/year of SURTASS LFA sonar spread across two ocean basins) and the low magnitude and severity of impacts expected to any individual marine mammals (relatively short-term exposures given the spatial scale of the vessels' movement), even in the absence of mitigation, given the nature of the activities. Then we note the robust shutdown measures that utilize the highly effective visual, passive acoustic, and active acoustic detection methods that are in place for all areas and times to avoid marine mammal injury as well as minimize TTS and more severe behavioral responses, belying claims that we treat data-poor areas as though they are equivalent to zero-density areas or areas of no biological importance. Next, we discuss the coastal standoff zone, which minimizes take of many species with coastal habitat preferences. We then examine the activity restrictions in OBIAs, which further limit potentially more significant impacts in areas that are known to be biologically important to the species that are more susceptible to the SURTASS LFA sonar signal. Finally, we discuss the limited and uncertain additional protective value that the White Paper recommendations would be expected to provide for marine mammal individuals, much less species or stocks. After considering all of this information, in addition to the information provided by the Navy indicating that further restricting SURTASS LFA sonar training and testing in the areas recommended in the White Paper would be impracticable, NMFS determined that the use of the White Paper recommendations was not appropriate.

White Paper Specific Recommendations

While the White Paper authors essentially disqualified the specific extrapolative predictive results of the Kaschner model based on ground-truthing them against known data, they nevertheless recommended broader protections based on fewer environmental variables, to be used if NMFS determined that a ''precautionary approach'' was appropriate. Although the current White Paper recommendations are grounded in some sound broad ecological principles, the ''precautionary approach'' considered by the White Paper authors potentially suffers from some of the same types of weaknesses as the Kaschner model or other ''environmental envelope'' precautionary approaches. In the 2012 SURTASS LFA sonar rule, NMFS evaluated the White Paper solely through the lens of the OBIA process, and determined that the recommendations presented were not appropriate for identification of OBIAs, which may have limited fuller consideration of the recommendation. For this rulemaking, NMFS independently examined the White Paper's specific recommendations in the context of the LPAI standard to determine whether following those recommendations is warranted to minimize the impacts from SURTASS LFA sonar training and testing activities on the affected marine mammal species or stocks. This consideration was done outside of the OBIA designation process, and is consistent with the consideration of criteria described above when determining appropriateness of mitigation measures. The White Paper recommended the following general guidelines based on ecological principles to identify areas of biological importance for cetaceans:

(1) Designation of all continental shelf waters and waters 100 km seaward of the continental slope as biologically important habitat for marine mammals;

(2) Establishment of OBIAs within 100 km of all islands and seamounts that rise within 500 m of the surface; and

(3) Nomination of high productivity regions that are not included in the continental shelf, continental slope, seamount, and island ecosystems above as biologically important areas.

These recommendations are evaluated below in the context of the proposed SURTASS LFA sonar training and testing activities and the mitigation measures that have been and are proposed to be implemented to minimize the impacts on the affected marine mammal species or stocks from these activities.

To reiterate, NMFS has required several mitigation measures for SURTASS LFA training and testing sonar activities that: (1) Minimize or alleviate the likelihood of injury (PTS), TTS, and more severe behavioral responses (the 2,000-yard LFA mitigation/buffer zone)); (2) additionally minimize or avoid behavioral impacts in known important areas (which includes important habitat) that would have a higher potential to have negative energetic effects or deleterious effects on reproduction that could reduce the likelihood of survival or reproductive success (OBIAs); and (3) generally lessen the total number of takes of many species with coastal or shelf habitat preferences (coastal standoff). The nature and context of how LFA sonar is used in training and testing activities (small number of vessels operating in open ocean areas and typically using active sonar only sporadically) is such that impacts to any individual are expected to be limited primarily because of the short duration of exposure to any individual mammal. In addition, as explained above, an animal would need to be fairly close to the source for the entire length of a transmission (60 seconds) to experience injury, and exposures occur in open water areas where animals can more readily avoid the source and find alternate habitat relatively easily. In addition, highly effective mitigation measures would be implemented that further ensure impacts are limited to lower-level responses with limited potential to significantly alter natural behavior patterns in ways that would affect the fitness of individuals and by extension the affected species or stocks.

SURTASS LFA sonar operates at 100 to 500 Hz. This frequency is far below the best hearing sensitivity for MF and HF species. HF species have their best hearing between around 60 and 125 kHz, which means that a sound at 500 Hz (and below) has to be at least 50 dB louder for HF species to hear it as well as a sound in their best hearing range. MF cetaceans have their best hearing between around 40 and 80 kHz, which means that at 500 Hz and below, the sound has to be 40 dB louder, or more, for this group to hear the sound as well as a sound in their best hearing range. In other words, these species have to be much closer to a sound at the frequency of SURTASS LFA sonar to hear it, which means that generally they have to be much closer to the SURTASS sonar source for it to cause PTS, TTS, or a behavioral response. Additionally, during the 1997 to 1998 SURTASS LFA Sonar Low Frequency Sound Scientific Research Program (LFS SRP), numerous odontocete species (*i.e.,* MF and HF hearing specialists) and pinniped species were sighted in the vicinity of the sound exposure tests and showed no immediately obvious responses or changes in sighting rates as a function of source conditions, which likely produced received levels similar to those that produced minor short-term behavioral responses in the baleen whales (*i.e.,* LF hearing specialists).

As described in the 2012 rule, NMFS believes that MF and HF odontocete hearing specialists have such reduced sensitivity to the LFA sonar source that limiting ensonification in OBIAs for those animals would not afford meaningful protection beyond that which is already incurred by implementing a shutdown when any marine mammal enters the 2,000-yard LFA mitigation/buffer zone. For the same reason, our discussion of the White Paper recommendations will be limited to lower frequency sensitive species, although it is worth noting that the existing 22 km (14 mi; 12 nmi) coastal standoff ensures a reduced number of potential takes of many MF and HF species with coastal habitat preferences. Moreover, the White Paper's recommendations for mitigation in data-poor areas were made solely for cetaceans.

As noted previously, in evaluating mitigation for species or stocks and their habitat, we consider the expected benefits of the mitigation measures for the species or stocks and their habitats against the practicability of implementation. This consideration includes assessing the manner in which, and the degree to which, the implementation of the measure(s) is expected to reduce impacts to marine mammal species or stocks (including through consideration of expected reduced impacts on individuals), their habitat, and their availability for subsistence uses (where relevant). This analysis will consider such things as the nature of the proposed activity's adverse impact (likelihood, scope, range); the likelihood that the measure will be effective if implemented; the likelihood of successful implementation. Practicability of implementing the measure is also assessed and may involve consideration of such things as cost, impact on operations, and, in the case of a military readiness activity, personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity (16 U.S.C. 1371(a)(5)(A)(ii)).

Taking into account the above considerations, NMFS' evaluation of the recommendations of the White Paper is described below:

Continental Shelf Waters and Waters 100 km Seaward of Continental Slope

Consideration of potential for reduction of adverse impacts to marine mammal species and stocks and their habitat—The Navy already implements a coastal standoff zone of 22 km (14 mi; 12 nmi), which includes large parts of the continental shelf around the world, includes parts of the slope in some areas, and reduces potential takes of many marine mammal species and stocks with coastal habitat preferences. In addition, under this SEIS/OEIS, the Navy is not able to deploy and utilize SURTASS LFA sonar for training and testing within any foreign nations territorial seas, which encompasses an area up to 12 nmi (depending on the distance each nation claims). The White Paper provided little basis for the 100 km buffer seaward of the continental slope and we have found no specific literature to support such a broad buffer in all areas. Therefore, in the context of this evaluation, NMFS first considered if there was evidence of the importance of the continental slope itself, without any consideration for a buffer.

In support of understanding the additional value of expanding this standoff to 100 km beyond the continental slope margin, NMFS assessed known marine mammal density information for lower frequency hearing specialists from the U.S. East (Roberts *et al.,* 2016) and West coasts and compared these densities to bathymetry, specifically looking at areas of high densities compared to the continental shelf and slopes on both coasts (NOAA, 2009). This assessment and comparison focused on the U.S. East and West coasts as an example because relatively more data is available for these waters. The comparison showed that mapped areas of highest densities are not always related to the slope or shelf. For example, while fin whales in the eastern U.S. waters show relatively higher densities on the continental shelf and slope, relatively higher densities of fin whales in western U.S. waters are much farther out to sea from the continental shelf or slope (well beyond 100 km of the slope), and the same was found for sperm whales. Some mysticetes do show higher densities on the continental shelf, and some have higher densities along the continental slope, which may also vary among seasons (*e.g.,* fin whales on the east coast). Generally, density information from the Atlantic showed some enhanced densities along the slope, but only for certain species in certain seasons, and did not indicate universally high densities along the slope. There are many factors that influence the spatial and temporal distribution and abundance of cetaceans, including environmental variables such as physiochemical, climatological, and geomorphological variables operating on times scales ranging from less than a day to millennia; biotic variables, such as prey distribution, competition among other species, reproduction, and predation; and anthropogenic factors, such as historical hunting, pollution, ship activity, etc. (Davis *et al.,* 1998). Humpback whales (especially around Cape Hatteras) seem to show some higher densities around the slope, but also seaward of the slope, especially in winters. However, the slope is closer to the shore around Cape Hatteras than most places along the eastern seaboard, and while humpbacks may show higher densities along the slope in this area, the same cannot be said of humpbacks further south (*i.e.,* in Florida) where the slope is much further offshore. Right whales show higher densities closer to shore along the Atlantic coast, while sperm whales are farther out past the slope on the Atlantic coast, as they are deep divers. Density data from the

Pacific coast show higher densities of blue whales on the shelf and slope, while fin whales and sperm whales are observed in waters beyond the continental slope. Gray whales show higher densities closer to shore along the Pacific coast, while humpbacks seem to be along the slope and beyond in some places. Using the continental United States densities of these lower frequency sensitive species as examples showed that densities are sometimes higher within 100 km of the slope, but are often higher elsewhere (off the slope) and many of these high density areas are highly seasonal.

As stated above, NMFS looked at these areas because relatively more data are available and, since comparisons in these areas do not consistently show strong correlation of high densities with the continental slope, it is reasonable to infer the same inconsistent relationship for other slope/shelf areas where there are even fewer data. As discussed below, there is no scientific basis for NMFS to conclude that geographical restrictions for these data-poor areas would reduce adverse impacts to marine mammal species or stocks or their habitat. Therefore, restricting SURTASS LFA sonar training and testing activities within 100 km of the entire continental shelf and slope is of questionable value as a mitigation measure to avoid areas of higher densities of marine mammal species or stocks, and further, would restrict these activities in large areas of the open ocean that we know don't harbor high densities of marine mammals (especially when the 100-km buffer is considered).

We said in the OBIA context that although we are identifying ''known'' biologically important areas, other biologically important areas have yet to be identified, due to limited data. However, it is important to realize that much more research is conducted close to shore, in the United States and internationally, and typically areas within 100 km of the slope are less likely to be data-poor compared to other areas. In areas where there is extensive data on marine mammal density and use (*e.g.,* in the continental US EEZ), it may be inappropriate to use broader principles that could be helpful in identifying protected areas in data-poor areas. NOAA, Navy, other agencies, and many independent researchers have been conducting marine mammal research throughout the U.S. EEZ (200 mi from shore) for decades. The prevalence of research makes it less likely that important areas closer to shore have been overlooked.

NMFS acknowledges that large ocean areas such as the continental shelf and slope and seamounts may include habitat features that could provide important habitat for marine mammals at certain times—as the White Paper states, the higher primary productivity in these areas could generally be associated with higher densities of marine mammals. However, exposures to any individual animal are expected to be short term and intermittent, since a small number of ships would conduct SURTASS LFA sonar training and testing activities for up to 496 hours (years 1–4) and 592 hours (years 5–7) total for all ships combined annually. In addition, shutdown measures would avoid injury (PTS), most TTS, and severe behavioral responses, and coastal standoff zones and OBIAs would avoid disturbances more likely to lead to fitness impacts by further restricting activities in these areas of known biological importance for marine mammals. Therefore, the other proposed mitigation measures (which are currently in effect) would already limit most take of marine mammals to less severe Level B harassment (*e.g.,* short periods of changes to swim speed or calling patterns; alterations of dive profiles, etc.). As a result, there is little to no indication that there is a risk to marine mammal species or stocks that would be avoided or lessened if waters 100 km seaward of the continental slope were subject to restrictions.

Of note, in many areas the waters of the continental shelf/slope will be afforded significant protection due to the coastal standoff mitigation measure. In addition, review of designated OBIAs reveals that the majority include continental shelf/slope areas and similar coastal waters. Therefore, to the extent that some portion of the shelf/slope waters are important habitats, many are afforded protection due to the geographical restrictions already in place (coastal standoff and OBIAs), and NMFS has determined that the best available information justifies these measures under our evaluation framework set forth above.

Given the proposed mitigation measures, many of which are already in place under the NDE and have been in effect for many years under prior rules, takes of marine mammals would be limited to Level B harassment in the less severe range of behavioral reactions and some TTS, as described above. Consequently, the only additional anticipated value to restricting activities in continental shelf waters and waters 100 km seaward of continental slope would be some, though not a significant, reduction in the number of these less severe behavioral reactions in those areas. As discussed above, in general, not all behavioral responses rise to the level of a take and not all harassment takes result in fitness consequences to individuals that have the potential to translate to population consequences to the species or stock. For example, the energetic costs of short-term intermittent exposures to SURTASS LFA sonar (such as are expected here) would be unlikely to affect the reproductive success or survivorship of individuals. This means there is little to no likelihood that the impacts of the anticipated takes would accrue in a manner that would impact a species or stock even in the absence of any additional mitigation. Therefore, considered with the uncertain potential of this proposed recommendation to provide meaningful incremental reduction of risk or severity of impacts to individual marine mammals, NMFS concludes that this recommendation would not reasonably be expected to provide a reduction in the probability or degree of effects on any marine mammal species or stocks.

In addition to the mitigation measures in place for SURTASS LFA sonar that would already provide protection for continental shelf/slope waters, it is important to note that there are currently a total of four SURTASS LFA sonar ships that would be training and testing with up to a maximum of 496 transmission hours total, pooled across all vessels, per year in years one through four. While the Navy plans to add additional vessels beginning in year 5, the total transmission hours would be capped at 592 hours total regardless of the number of vessels. It is not known, nor does the Navy indicate in its plans, that activities of these existing or proposed new vessels would be focused in any specific area. It is likely, based on past monitoring reports, that the activities of the multiple vessels are spatially separated and not concentrated in a single area, and that they would not necessarily overlap marine mammal high-density areas for an extended period of time.

Consideration of practicability for restrictions in continental shelf waters and waters 100 km seaward of continental slope—NMFS and the Navy evaluated the practicability of implementation of the White Paper's recommended continental shelf, slope, and 100-km seaward restriction. The Navy has indicated, and NMFS concurs, that additional continental shelf, slope, and 100 km seaward restrictions beyond the territorial waters of foreign nations and the existing coastal standoff and OBIAs would unacceptably impact the Navy's national security mission, as large areas of the ocean would be restricted where LFA sonar transmissions are required for training and testing proficiency in order for the ships' crews to understand how the system operates in these varied bathymetry conditions under future operational scenarios.

The submarine forces of several key adversaries are rapidly growing in size, capability, and geographic reach. Due to advancements in quieting technologies in diesel-electric and nuclear submarines, undersea threats are becoming increasingly difficult to locate using traditional passive acoustic technologies. Submarines from many nations are now much more capable and able to stay submerged for a longer period of time than earlier vessels. For both conventional diesel-electric and nuclear submarines, quieting technology has increased stealth and thus operational effectiveness. These technologies include air-independent propulsion (AIP), hull coatings that minimize echoes, sound isolation mounts for machinery, and improved propeller design. What once were unique U.S. design capabilities are now being employed in new submarine projects and as upgrades to older submarines throughout potential adversaries' navies. As this technology has improved, the predominant sources of ship noise (for example propeller noise or other machinery noise) have been reduced. Passive sonar involves listening for sounds emitted by a potentially hostile submarine in order to detect, localize, and track it. As submarines become quieter through improved sound dampening technology and innovative propeller design, the usefulness of passive sonar systems has greatly diminished. These submarines have the ability to carry many different weapons systems, including torpedoes, long-range anti-ship cruise missiles, anti-helicopter missiles, anti-ship mines, and ballistic nuclear missiles. These capabilities make submarines, both nuclear and diesel-electric powered, stealthy and flexible strategic threats.

The destruction of U.S. Carrier Strike Groups (CSGs) and Expeditionary Strike Groups (ESGs) is a focal point in the naval warfare doctrine of many adversaries' navies. The main threat that a carrier strike group must defend against is the undersea threat from enemy submarines. A single diesel-electric submarine that is capable of penetrating U.S. or multinational task force defenses could cause catastrophic damage to those forces, and jeopardize the lives of the thousands of Sailors and Marines onboard Navy ships. Even the threat of the presence of a quiet diesel submarine could effectively deny or delay U.S. or coalition naval forces access to vital operational areas. Long-range detection of threat submarines in near-shore and open ocean environments is critical for this effort.

Adequate and effective training and testing with SURTASS LFA sonar is necessary to ensure crews can operationally detect these quieter and harder to-find foreign submarines at greater distances. The Navy has indicated that if large areas of the continental shelf or slope were restricted beyond what is in the 12nmi/22km coastal standoff, the Navy would not have the benefit of being able to train and test in these challenging environments. Coastal, shallow environments are more acoustically complex and the SURTASS LFA system was designed to penetrate these environments to find quiet assets that may use these distinctive geographic features to their advantage. Year-round access to all of these areas of challenging topography and bathymetry is necessary so that crews learn how the SURTASS LFA system will operate amidst changing oceanographic conditions, including seasonal variations that occur in sound propagation.

Because these assets are forward deployed and can rapidly switch between training and testing activities and operational missions, there is limited flexibility for these ships to maneuver any substantial distance from primary mission areas of responsibility. Therefore, avoiding continental shelf and slope waters plus a 100 km buffer for training and testing activities would constitute a significant deviation in their staging requirements for other missions. Thus implementing this mitigation measure would be highly impracticable and would significantly adversely affect the availability of these assets to conduct their national security mission. Additionally, due to the slow speed at which these vessels transit (3 knots when towing SURTASS, 10–12 knots without) it does not allow for large scale movements on the orders of 100s of km proposed by the mitigation scheme of the White Paper to avoid a 100 km buffer around continental shelf and slope habitat.

Conclusion regarding restrictions in continental shelf waters and waters 100 km seaward of continental slope—In summary, restricting SURTASS LFA sonar use in waters 100 km seaward from the continental slope could potentially reduce individual exposures or behavioral responses for certain species and potentially provide some additional protection to individual animals in preferred habitat in some cases. However, density data indicate that certain mysticetes and sperm whales have higher densities in areas other than the continental slope and potential impacts from moving and focusing activities farther offshore would shift from more coastal species or stocks to more pelagic species or stocks, making any reduction in impacts uncertain. Further, limiting activities in these large areas of uncertain value to marine mammals when activities are comparatively low (small number of ships operating up to a maximum of 496 transmission hours total across all vessels in years 1–4 and 592 total transmission hours in years 5 and beyond pooled across all vessels, spread across several mission areas and over the course of an entire year), given the existing risks to the affected species and stocks are already so low, would provide little, if any, value for lowering the probability or severity of impacts to individual marine mammal fitness, much less species or stocks, or their habitat. Given the limited potential for additional reduction of impacts to marine mammal species beyond what the existing mitigation measures described in this rule provide, and the high degree of impracticability (significant impacts on training and testing effectiveness and the availability of these assets to support other national security missions), NMFS has preliminarily determined that adopting this recommendation is not warranted under the LPAI standard.

Restrictions Within 100 km of All Islands and Seamounts That Rise to Within 500 m of the Surface

Consideration of potential reduction of adverse impacts to marine mammal species and stocks and their habitat—Currently, waters surrounding all islands are included in the coastal standoff zone. Also, all foreign territorial waters have been provided the additional protection in this rulemaking that SURTASS LFA sonar will not be operated within these areas. As discussed previously, this means that SURTASS LFA sonar received levels would not exceed 180 dB re 1µPa within 22 km (12 nmi) from the coastline. Lastly, the Navy has agreed not to utilize SURTASS LFA sonar within Hawaii state waters (out to 3 nmi) or over Penguin Bank, and to limit ensonification of Hawaii state waters to 145 dB.

Regarding seamounts, Morato *et al.* (2010) state that seamounts were found to have higher species diversity within 30–40 km of the summit and tended to aggregate some visitor species (Morato *et al.,* 2008). However, as stated by the authors, the paper did not demonstrate that this behavior can be generalized. Further, the authors note that associations with seamounts have been described for some species of marine mammals (Morato *et al.,* 2008), mostly on an individual seamount scale. Morato *et al.* (2008) examined seamounts for their effect on aggregating visitors and noted that seamounts may act as feeding stations for some visitors, but not all seamounts seem to be equally important for these associations. While Morato *et al.* (2008) only examined seamounts in the Azores, the authors noted that only seamounts shallower than 400 m depth showed significant aggregation effects. Their results indicated that some marine predators (common dolphin (*Delphinus delphis*) and other non-marine mammal species such as fish and invertebrates) were significantly more abundant in the vicinity of some shallow-water seamount summits; there was no demonstrated seamount association for bottlenose dolphins (*Tursiops truncatus*), spotted dolphin (*Stenella frontalis*), or sperm whales (*Physeter macrocephalus*).

Along the northeastern U.S. continental shelf, cetaceans tend to frequent regions based on food preferences (*i.e.,* areas where preferred prey aggregate), with picscivores (fish-eating, *e.g.,* humpback, fin, and minke whales as well as bottlenose, Atlantic white-sided, and common dolphins) being most abundant over shallow banks in the western Gulf of Maine and mid-shelf east of Chesapeake Bay; planktivores (plankton-eating, *e.g.,* right, blue, and sei whales) being most abundant in the western Gulf of Maine and over the western and southern portions of Georges Bank; and teuthivores (squid eaters, *e.g.,* sperm whales) most abundant at the shelf edge (Fiedler, 2002). While there have been observations of humpback whales lingering at seamounts in the middle of the North Pacific on the way to summer feeding grounds in the Gulf of Alaska (Mate *et al.,* 2007), the purpose of these occurrences is not clear, and it may be that they are feeding, regrouping, or simply using them for navigation (Fiedler, 2002; Mate *et al.,* 2007); therefore, the role of the seamount habitat is not clear. According to Pitcher *et al.* (2007), there have been very few observations of high phytoplankton biomass (*i.e.,* high primary production, usually estimated from chlorophyll concentrations) over seamounts. Where such effects have been reported, all were from seamounts with summits shallower than 300 m, and the effects were not persistent, lasting only a few days at most. Therefore, it may be that food sources for many baleen whales are not concentrated in great enough quantities for significant enough time periods to serve as important feeding areas. While some odontocete (toothed) whales have been suggested to utilize seamount features for prey capture (Pitcher *et al.,* 2007), the authors conclude that the available evidence suggests that ''unlike many other members of seamount communities, the vast majority of marine mammal species are probably only loosely associated with particular seamounts.'' We note here that marine mammals being ''loosely associated'' with seamounts, or being observed lingering at certain seamounts, does not necessarily suggest a level of biological importance that would support geographical restrictions to avoid all seamounts, or even the specific seamounts where these loose aggregations occur. Further, as stated above, the short term, intermittent nature of the exposures to SURTASS LFA sonar would be unlikely to impact the fitness (via effects on reproduction or survival) of any individuals, especially given the existing/proposed mitigation. Therefore, considered with the uncertain potential of this proposed measure to provide meaningful additional reduction of impacts to individual marine mammals, this measure is not expected to provide a reduction in the probability or degree of effects on any marine mammal species or stocks.

Consideration of practicability for restrictions within 100 km of all islands and seamounts that rise to within 500 m of the surface—Please see the discussion of practicability for the White Paper recommendation above (protection of continental slope and a 100-km buffer), which is also applicable here. NMFS and the Navy evaluated the practicability of implementation of the White Paper's recommendation regarding island and seamounts that rise to within 500 m of the sea surface. The Navy has indicated, and NMFS concurs, that restrictions within 100 km of all islands and seamounts that rise to within 500 m of the surface beyond the existing coastal standoff and OBIAs would unacceptably impact their national security mission. Adequate and effective training and testing with SURTASS LFA is necessary to ensure crews can operationally detect quieter and harder to-find foreign submarines at greater distances. The Navy has indicated that if large areas of the continental shelf or slope were restricted beyond what is in the 12nmi/22km coastal standoff, the Navy would not have the benefit of being able to train and test in these challenging environments. Coastal, shallow environments are more acoustically complex and the SURTASS LFA system was designed to penetrate these environments to find quiet assets that may use these distinctive geographic features to their advantage. Year-round access to all of these areas of challenging topography and bathymetry is necessary so that crews learn how the SURTASS LFA system will operate amidst changing oceanographic conditions, including seasonal variations that occur in sound propagation.

As discussed previously with respect to a 100 km buffer around continental shelf and slope habitat, similar practicability concerns exist with implementing a 100 km buffer around all islands and seamounts. Because these assets are forward deployed and can rapidly switch between training and testing activities and operational missions, there is limited flexibility for these ships to maneuver any substantial distance from their primary mission areas of responsibility. Since seamounts and other areas of complex bathymetry are important training/testing features avoiding these areas would have negative impacts on training and testing preparedness and realism. Additionally, avoiding island associated and sea mount habitats by 100 km would constitute a significant deviation in the staging of these assets for other missions and would significantly impacting their potential for these vessels to conduct operational missions. Lastly, due to the slow speed at which these vessels transit (3 knots when towing SURTASS, 10–12 knots without) it does not allow for large scale movements on the orders of a 100 km proposed by the mitigation scheme of the White Paper without requiring extensive transmit time on and off station that would reduce training and testing opportunities and the ability of these assets to support other national security missions required of them.

Conclusion regarding restrictions within 100 km of all islands and seamounts that rise to within 500 m of the surface—In summary, while restricting LFA sonar training and testing in areas 100 km seaward from islands and seamounts could potentially reduce incidences of take within a limited number of species in preferred habitat in some cases (potential feeding), available data indicate that marine mammal associations with these areas are limited and the benefits would be at best limited and/or ephemeral. Also, the habitat preferences for these areas seem to be more associated with mid and high frequency species, which are less sensitive to LFA sonar, thereby further lessening concern for the potential effects of LFA sonar. Limiting SURTASS LFA sonar training and testing activities in these large areas when activities are already comparatively low (small number of ships operating up to a maximum of 496 transmission hours total across all vessels in years 1–4 and 592 total transmission hours in years 5 and beyond pooled across all vessels, spread across several mission areas and over the course of an entire year) and the existing risks to the affected species and stocks are already so low, would provide little, if any, value for lowering the probability or severity of impacts to individual marine mammal fitness, much less species or stocks, or their habitat. Given the limited potential for additional reduction of impacts to a small number of marine mammal species and the high degree of impracticability (serious impacts on mission effectiveness), NMFS has determined that adopting this recommendation is not warranted under the LPAI standard.

High Productivity Regions That Are Not Included in the Continental Shelf, Continental Slope, Seamount, and Island Ecosystems

Consideration of potential for reduction of adverse impacts to marine mammal species and stocks and their habitat—Regions of high productivity have the potential to provide good foraging habitat for some species of marine mammals at certain times of the year and could potentially correlate with either higher densities and/or feeding behaviors through parts of their area. Productive areas of the ocean are difficult to consistently define due to interannual spatial and temporal variability. High productivity areas have ephemeral boundaries that are difficult to define and do not always persist interannually or within the same defined region. While there is not one definitive guide to the productive areas of the oceans, NMFS and the Navy examined these areas in the SURTASS LFA sonar study area. For instance, Huston and Wolverton (2009) show areas of high/highest productivity that are either (1) confined to high latitude (polar) areas that are not in the SURTASS LFA sonar study area, or (2) very coastally and typically seasonally associated with areas of high coastal runoff (*i.e.,* by river mouths), which are already encompassed by the coastal standoff range.

Areas of more moderate productivity are typically very large, which means that they are not concentrating high densities or feeding areas throughout their area. In fact, areas of moderate productivity scored within the mean and thus represent ''average'' habitat and would not necessarily be biologically important. These moderately productive habitats are likely to provide ample alternative opportunities for species to move into and take advantage of areas should they avoid the area around the SURTASS LFA sonar vessel. Additionally, as noted above, given the nature of SURTASS LFA sonar activities and the other mitigation for SURTASS LFA sonar, the existing risk to marine mammal species and stocks is low and is limited to less severe Level B harassment.

Consideration of practicability for restrictions for high productivity regions that are not included in the continental shelf, continental slope, seamount, and island ecosystems—NMFS and the Navy evaluated the practicability of implementation of the White Paper's recommended restrictions on high productivity areas. Please see the discussion of practicability for the first white paper recommendation above (continental slope plus buffer), which is also applicable here. The Navy has indicated, and NMFS concurs, that, additional restrictions in high productivity regions that are not included in the continental shelf, continental slope, seamount, and island ecosystems beyond the existing coastal standoff and OBIAs would unacceptably impact its national security mission. Because of the inconsistent and ephemeral boundaries associated with most high productivity regions, it would be difficult to define geographic restrictions that would not impinge upon the long-range detection abilities of the SURTASS LFA sonar system. The mission of SURTASS LFA sonar is to detect quieter and harder-to-find foreign submarines at greater distances. The Navy must train and test in open ocean regions to track relevant targets at long distances. If large areas of the ocean were excluded from potential usage, the Navy would not have the benefit of being able to train and test at the long ranges at which SURTASS LFA sonar has been designed to function most effectively. Further, because high productivity areas are highly variable and ephemeral, implementation would not be operationally practicable for the Navy.

Conclusion regarding restrictions in high productivity regions that are not included in the continental shelf, continental slope, seamount, and island ecosystems—Restricting use of SURTASS LFA sonar training and testing seasonally in high productivity areas could potentially reduce take numbers for certain species in preferred or feeding habitat in some cases. However, as noted above, the size of the primary productivity areas is such that animals could likely easily access adjacent high productivity areas should they be temporarily diverted away from a particular area due to a SURTASS LFA sonar source. In addition, marine mammals are not concentrated through all, or even most, of these large areas for all, or even most, of the time when productivity is highest. Therefore, a broad limitation of this nature would likely unnecessarily limit LFA sonar activities while providing only some slight benefit to a limited number of individuals, which would not rise to the level of value to marine mammal species or stocks. Limiting activities in these large areas when activities are already comparatively low (small number of ships operating up to a maximum of 496 transmission hours total across all vessels in years 1–4 and 592 total transmission hours in years 5 and beyond pooled across all vessels, spread across several mission areas and over the course of an entire year), given the existing risks to the affected species and stocks are already so low, would provide little, if any, value for lowering the probability or severity of impacts to individual marine mammal fitness, much less species or stocks, or their habitat. While we note that subjecting entire ''high productivity regions'' to geographical restrictions would provide little value, we also reiterate that over half of the existing OBIAs previously identified are in areas categorized as Class I (high productivity, >300 gC/m2-yr) or Class II (moderate productivity, 150–300 gC/m2-yr) ecosystems, based on SeaWiFS global primary productivity (see response to NRDC comment 20, 77 FR 50290, 50304 (August 20, 2012)). However, we also note that high productivity/foraging was not necessarily the qualifying criteria for all of these OBIAs, and being classified as a high productivity area does not necessarily mean the area serves as a biologically important area for marine mammal foraging. Given the limited potential for additional reduction of impacts to marine mammal species and the high degree of impracticability (serious impacts on mission effectiveness), NMFS has determined that adopting this recommendation is not warranted under the LPAI standard.

Overall Conclusion Regarding Consideration of the White Paper Recommendations

NMFS has considered the White Paper recommendations and acknowledges that they could potentially reduce the numbers of take for some individual marine mammals within a limited number of species, while in some cases, adopting the White Paper's guidelines could potentially increasing take of others species. NMFS also acknowledges that the White Paper's recommendations may add some small degree of protection in preferred habitat or during feeding behaviors in certain circumstances. However, the potential for impacts on reproduction or survival of any individuals, much less accrual to population level impacts, with the existing mitigation is already very low. As explained above, the minimal training and testing impacts and the anticipated, and demonstrated, success of the significant mitigation measures that the Navy is already implementing provide a large degree of protection and limit takes to less severe Level B harassment. Therefore, the highly limited and uncertain likelihood that the White Paper recommendations will further reduce impacts on individual marine mammal fitness, much less the affected species or stocks, and their habitat does not justify adopting the recommendations, especially when considered in light of the high degree of impracticability for Navy implementation.

Least Practicable Adverse Impact—Preliminary Conclusions

Based on our evaluation of the Navy's proposed mitigation measures as well as other measures considered by NMFS or recommended by the public, NMFS has preliminarily determined that the mitigation measures required by this proposed rule provide the means of effecting the least practicable adverse impact on marine mammals, species, or stock(s) and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, considering personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity.

The 2,000-yard LFA mitigation/buffer (shutdown) zone, based on detection of marine mammals from the highly effective three-part mitigation monitoring efforts (visual, as well as active and passive acoustic monitoring), and geographic restrictions (coastal standoff zone, and OBIAs plus the 1-km buffer) will enable the Navy to: (1) Avoid Level A harassment of marine mammals; (2) minimize the incidences of marine mammals exposed to SURTASS LFA sonar sound levels associated with TTS and more severe behavioral effects under Level B harassment; and (3) minimize marine mammal takes in areas and during times of important behaviors such as feeding, migrating, calving, or breeding or in areas where small resident populations reside or there is high density, further minimizing the likelihood of adverse impacts to species or stocks.

The SURTASS LFA sonar signal is not expected to cause mortality, serious injury, or PTS, due to implementation of the 2,000-yard LFA sonar mitigation/buffer zone, which will ensure that no marine mammals are exposed to an SPL greater than about 174 dB re: 1 µPa rms. As discussed above, a low-frequency cetacean would need to remain within 41 meters (135 ft) for an entire LFA sonar transmission (60 seconds) to potentially experience PTS and within 413 m (1,345 ft) for an entire LFA sonar transmission (60 seconds) to potentially experience TTS, which would be unlikely given typical avoidance behaviors even in the absence of mitigation. In addition to alleviating the likelihood of PTS, the implementation of the 2,000-yard LFA sonar shutdown zone mitigation measure will minimize the number of LF cetaceans likely exposed to LFA sonar at levels associated with the onset of TTS. The best information available indicates that effects from SPLs less than 180 dB re: 1 µPa will be limited to short-term, Level B harassment, and animals are expected to return to behaviors shortly after exposure.

Further, the implementation of OBIA measures and the coastal standoff allows the Navy to minimize or avoid impacts in important areas where behavioral disturbance and other impacts would be more likely to have negative energetic effects, or deleterious effects on reproduction, which could reduce the likelihood of survival or reproductive success (measures to avoid or lessen exposures of marine mammals within the coastal standoff zone and OBIAs); and generally lessen the total number of takes in areas of higher density for some species (coastal standoff measures). These measures, taken together, constitute the means of effecting the least practicable adverse impact on the affected species and stocks in the western and central North Pacific and eastern Indian Oceans in the upcoming seven-year LOA period. As described above, we evaluated the potential inclusion of additional measures (White Paper recommendations, critical habitat, etc.) before reaching this conclusion.

The SURTASS DSEIS/SOEIS evaluated the potential for impacts to marine habitats (marine mammals and otherwise) from SURTASS LFA sonar training and testing activities including critical habitat, essential fish habitat, marine protected areas, and national marine sanctuaries. SURTASS LFA sonar training and testing activities involve introduction of pressure and sound in the water column but will not alter physical habitat. Marine mammal prey will not be exposed to sustained duration and intensity of sound levels that would be expected to result in significant adverse effects to marine mammal food resources. Habitat impacts were considered within the context of the addition of sound energy to the marine environment while SURTASS LFA sonar is transmitting, which represents a vanishingly small percentage of the overall annual underwater acoustic energy budget that would not affect the ambient noise environment of marine habitats (refer to sections 4.4 and 4.5 of the SURTASS DSEIS/SOEIS). Therefore, with regard to habitat, NMFS has not identified any impacts to habitat from SURTASS LFA sonar that persist beyond the time and space that the impacts to marine mammals themselves and the water column could occur. Our mitigation targeted to minimize impacts to species or stocks while in particular habitats (*i.e.,* the coastal standoff and OBIAs) will protect preferred habitat during its use, and therefore is contributing to the means of effecting the LPAI on a species or stock *and* its habitat. Therefore, the mitigation measures that address areas that serve as important habitat for marine mammals in all or part of the year help effectuate the LPAI on marine mammal species and stocks and their habitat.

The Ninth Circuit's *Pritzker* decision faulted NMFS for considering the White Paper mitigation recommendations for ''data-poor areas'' against the OBIA standards NMFS had set for the 2012 rule. We do not read the opinion as holding that the MMPA compelled a change in the criteria and process for evaluating OBIAs. NMFS addressed the Court's decision by separately and independently evaluating the White Paper's recommendations for benefits to the affected species or stocks and practicability, without regard to the OBIA criteria or process. (See NMFS' evaluation of the White Paper in this rule.) Using the best available information, NMFS considered the recommendations in the White Paper under our interpretation of the LPAI standard and determined the measures (as well as a smaller buffer distance) were not warranted, as described in that section.

In reaching the conclusion that NMFS' record for the 2012 rule did not establish the agency had satisfied the LPAI standard, the Court determined that NMFS failed to consider an important aspect of the problem, ''namely the underprotection that accompanies making conclusive data an indispensable component of OBIA designation,'' and that this ''systematic underprotection of marine mammals'' cannot be consistent with the requirement that mitigation measures result in the ''least practicable adverse impact'' on marine mammals.'' *Id.* at 1140. While we have corrected the identified deficiency by evaluating the White Paper measures independent of the OBIA process, we disagree with the suggestion that our mitigation is systematically underprotective.

We first emphasize that NMFS' OBIA informational standards (and other mitigation measures), while data-driven, do not require scientific certainty or conclusive data. This is illustrated by the fact that the OBIA screening criteria allow for consideration of a variety of information sources, including historic whaling data, stranding data, sightings information, and regional expertise, to name a few examples of the ''data'' considered—and, in fact, the only areas that were not considered were those considered to have entirely inconclusive data. As more detailed in Appendix D of the 2012 SEIS/SOEIS, supporting documents that are considered include peer-reviewed articles; scientific committee reports; cruise reports or transects; personal communications or unpublished reports; dissertations or theses; books, government reports, or NGO reports; and notes, abstracts, and conference proceedings. The process set up for the 2012 rule carried forward areas for consideration if they had sufficient scientific support for the relevant criterion based on a ranking of 2 or higher on a scale developed for that purpose, with zero being the lowest and four the highest. Even areas that were ranked ''2'' (''*Supporting information derived from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray (non-peer reviewed) literature, but requires more justification*'') were deemed ''eligible'' for further consideration (77 FR 50290, 50299 (August 20, 2012)).

In fact, NMFS has previously designated OBIAs for areas based on these types of information sources. For example, the Olympic Coast OBIA (OBIA #21) had a ranking of 2 for foraging by humpback whales as documented in one peer-reviewed report (p.D–319, DoN 2012). Based on the results of that study, the Olympic Coast OBIA was reviewed and designated. Other examples include the Southwest Australia Canyons OBIA, which considers past whaling data but also more recent sighting and stranding information; and the boundary for the Eastern Gulf of Mexico OBIA, which was drawn to ''conservatively encompass'' waters where Bryde's whales may occur based on sightings information (as opposed to scientific validation of their occurrence). In addition, even though most available data is only available for inshore waters (within the coastal standoff for SURTASS LFA sonar training and testing activities), NMFS is considering an area adjacent and seaward of these areas in the Ogasawara Island region as an OBIA as part of this rulemaking due to the importance of the nearshore area for humpback whales.

Thus, NMFS does not insist on an ''unattainable'' evidentiary standard of ''conclusive data'' [5] for imposing conservation and management measures for SURTASS LFA sonar, including—though not only—in the case of OBIAs. As another example, the coastal standoff zone uniformly applies not only in areas with supporting data about marine mammals (80 percent of the areas initially identified for OBIA consideration were within the 12 nmi/22 km coastal standoff) but also in areas that could be fairly characterized as data poor.

Finally, because the LPAI standard authorizes NMFS to weigh a variety of factors when evaluating appropriate mitigation measures, it does not compel mitigation for every kind of individual take, even when practicable for implementation by the applicant. Thus, we do not evaluate measures strictly on the basis of whether they will reduce *taking.* The focus is on the relevant contextual factors that more meaningfully assess a measure's value in contributing to the standard of minimizing *impacts to the affected species or stock and its habitat.* It is also relevant to consider a measure in the context of the nature and extent of the expected impacts and the value of other mitigation that will be implemented.

NMFS has evaluated the likely effects of SURTASS LFA sonar training and testing activities and has required measures to minimize the impacts to the affected species or stocks and their habitat to achieve the LPAI. Consistent with our interpretation of LPAI, the LFA shutdown and coastal exclusion zone are practicable for the Navy and effective in minimizing impacts on marine mammals from activities that are likely to increase the probability or severity of population level effects—*wherever* marine mammals occur, even in areas where data are limited. Therefore, as we have said, NMFS' mitigation requirements do not proceed as if the ''no data'' scenario is the equivalent to ''zero population density'' or ''no biological importance.'' [6] The LFA shutdown zone will avoid or minimize auditory impacts and more severe forms of Level B harassment, *wherever* marine mammals occur. The coastal exclusion zone will reduce adverse impacts, specifically higher numbers of take or take in areas of preferred habitat for coastal species that are present in higher numbers, or through lessening the severity of impacts by minimizing take of individuals in shelf or slope areas encompassed by the standoff, when that habitat is preferred by some species (again, when NMFS assessed areas that met the criteria for OBIAs for its 2012 rule, 80 percent of the identified areas fell within the 12 nautical mi coastal exclusion zone.) In addition, NMFS designated OBIAs where supporting information sufficiently demonstrated the areas met the established criteria and they were determined to be practicable, which are expected to reduce the likelihood of impacts that would adversely affect reproduction or survival.

We have assessed all recommendations and the best available science and are aware of no other practicable measures that would further reduce the probability of impacts to species or stocks. In other words, the proposed measures that NMFS included in this proposed rule will effect the least practicable adverse impact on the affected species or stocks. As discussed in the Adaptive Management section, NMFS will systematically consider new information and re-evaluate as necessary if applicable new information becomes available.

Proposed Monitoring

Section 101(a)(5)(A) of the MMPA states that in order to issue an ITA for an activity, NMFS must set forth ''requirements pertaining to the monitoring and reporting of such taking.'' The MMPA implementing regulations at 50 CFR 216.104 (a)(13) indicate that requests for LOAs must include the suggested means of

[5] *NRDC* v. *Pritzker,* 828 F.3d 1125, 1140 (9th Cir. 2016).

[6] White paper at p. 1.

accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species, the level of taking, or impacts on populations of marine mammals that are expected to be present.

Monitoring measures prescribed by NMFS should accomplish one or more of the following general goals:

- An increase in our understanding of how many marine mammals are likely to be exposed to levels of LFA sonar that we associate with specific adverse effects, such as disruption of behavioral patterns and TTS (Level B harassment), or PTS;
- An increase in our understanding of how individual marine mammals respond (behaviorally or physiologically) to LFA sonar (at specific received levels or other stimuli expected to result in take);
- An increase in our understanding of how anticipated takes of individuals (in different ways and to varying degrees) may impact the population, species, or stock (specifically through effects on annual rates of recruitment or survival);
- An increase in knowledge of the affected species;
- An increase in our understanding of the effectiveness of certain mitigation and monitoring measures;
- A better understanding and record of the manner in which the authorized entity complies with the incidental take authorization; and
- An increase in the probability of detecting marine mammals, both within the mitigation zone (thus allowing for more effective implementation of the mitigation) and in general to better achieve the above goals.

In addition to the real-time monitoring associated with mitigation, the Navy is engaging in exploring other monitoring efforts described here:

Marine Mammal Monitoring (M3) Program

Beginning in 1993, the Marine Mammal Monitoring (M3) Program was designed to assess the feasibility of detecting and tracking marine mammals. The M3 program uses the Navy's fixed and mobile passive acoustic monitoring systems to monitor the movements of some large cetaceans (principally baleen whales), including their migration and feeding patterns, by tracking them through their vocalizations. This Program has evolved into a valuable tool by which the acoustic activity levels of vocalizing whales can be quantitatively documented and trends of oceanic ocean noise levels measured over ecologically meaningful ocean scales and time periods under varying noise conditions.

As part of the research and monitoring component of the SURTASS LFA sonar program, M3 data are collected to:

- Document occurrence, distribution, and behaviors of acoustically active whale species over ocean basin and decadal scales;
- Assess changes in marine mammal activity levels under normal conditions (*e.g.,* weather, wind, time of year, or time of day) relative to acoustic conditions with varying levels of anthropogenic noise (*e.g.,* seismic activities, naval sonar, shipping, or fishing activities);
- Inform environmental assessments of current and future anti-submarine warfare systems; and
- Assemble a long-term database of ocean ambient noise data to enable scientifically-based evaluations of potential influences on cetaceans or other species.

Acoustic data collected and archived by the M3 program allow program analysts to statistically quantify how cetacean acoustic behaviors are affected by various factors, such as ocean basin topographic features, hydrographic conditions, seasonality, time, weather conditions, and ambient noise conditions. The compiled acoustic data can be used to estimate the total number of vocalizing whales per unit area as well as document the seasonal or localized movements of individual animals. In addition, observations over time can also show the interaction and influence of noise sources on large whale behavior.

At present, the M3 Program's data are classified, as are the data reports created by M3 Program analysts, due to the inclusion of sensitive national security information. The Navy (OPNAV N974B) continues to assess and analyze M3 Program 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 to the public. Additionally, data summaries are shared with NMFS analysts with appropriate clearances. Progress has been achieved on addressing securing concerns and declassifying a report of fin whale singing and swimming behaviors from which a scientific paper has been submitted to a scientific journal for review (DoN, 2015). In addition, information on detections of western gray whale vocalizations has been shared with the IUCN on possible wintering areas for this species.

Additional Ranked Monitoring Projects Under Consideration

Due to research indicating that beaked whales and harbor porpoises may be particularly sensitive to a range of underwater sound (Southall *et al.,* 2007; Tyack *et al.,* 2011; Kastelein *et al.,* 2012), in the 2012 rule and LOAs for these activities, NMFS included conditions for increasing understanding of the potential effects of SURTASS LFA sonar on these taxa. The Navy convened an independent Scientific Advisory Group (SAG), composed of six scientists affiliated with two universities, one Federal agency (NMFS), and three private research and consultancy firms, to investigate and assess different types of research and monitoring methods that could increase the understanding of the potential effects to beaked whales and harbor porpoises from exposure to SURTASS LFA sonar transmissions. The SAG submitted a report (''Potential Effects of SURTASS LFA sonar on Beaked Whales and Harbor Porpoises'') describing their monitoring and research recommendations. This report was submitted to the Executive Oversight Group (EOG) for SURTASS LFA sonar, which is comprised of representatives from the U.S. Navy (Chair, OPNAV N2/N6F24), Office of the Deputy Assistant Secretary of the Navy for the Environment, Office of Naval Research, Navy Living Marine Resources Program, and the NMFS Office of Protected Resources (OPR) Permits and Conservation Division. The EOG met twice in 2014 to review and further discuss the research recommendations put forth by the SAG, the feasibility of implementing any of the research efforts, and existing budgetary constraints. Representatives from the Marine Mammal Commission also attended EOG meetings as observers. In addition to the SAG recommendations, promising suggestions for monitoring and research were recommended for consideration by the EOG. The EOG considered which efforts would be most effective, given existing budgetary constraints and the Navy has submitted the outcome of this study to NMFS.

In summary, after consideration of the SAG recommendations and the inputs provided by the EOG, the research monitoring studies were ranked as follows. In addition to the topic, the approximate cost of the research effort is also listed. Those study topics which the Navy has invested in since the EOG recommendations are also indicated below.

The category of research recommendations that were ranked highest included those estimated to cost less than $100,000.

1. Desktop study of potential overlap of harbor porpoise habitat by SURTASS LFA sonar transmissions. The Navy funded this study and the report has been submitted to NMFS. In summary the report finds that, while harbor porpoises could potentially be exposed to SURTASS LFA sonar transmissions, exposure is likely to occur at reduced sound levels with limited potential for behavioral responses. The full report is available at *http://www.surtass-lfa-eis.com.*

2. Review existing high frequency acoustic recording package (HARP) data to determine spatiotemporal overlap with SURTASS LFA missions. NMFS contacted Erin Oleson (NOAA) about deployments in the western and central North Pacific and John Hildebrand (Scripps) about deployments in the eastern North Pacific. Since the EOG, Baumann-Pickering *et al.* (2014) presented the results of over eleven cumulative years of HARP deployments in the North Pacific, which may overlap with SURTASS LFA missions. It would be fairly straightforward and require minimal cost to determine the spatiotemporal overlap of HARP deployments and LFA missions. If it was determined that overlap existed, the cost for data analysis would depend on the amount of overlap.

The second-highest ranked group of recommendations consisted of studies that are estimated to cost in the $100,000–$500,000 range, but for which methodologies exist and implementation would extend existing studies.

1. Targeted deployment of one HARP sensor in the western North Pacific for one year; approximate estimated cost of $250,000. The objective of this study would be to document beaked whale vocal behavior before, during, and after LFA sonar transmissions. Careful consideration of lessons learned from previous deployments would be needed to increase the probability of a successful project.

2. Anatomical modeling of LF sound reception by beaked whales; approximate estimated cost of $150,000–$200,000. Since the EOG meetings in 2014, Cranford and Krysl (2015) presented a synthetic audiogram for a fin whale, predicted based predominantly on bone conduction of sound through the head to the ear. NMFS (2016) noted that the predicted audiogram does not match the typical U-shaped audiogram expected with normal hearing in mammals in that there is a ''hump'' at low frequencies and shallow roll-off of sensitivity at high frequencies. Given these difficulties, additional funding would be required to determine the source of the abnormal results. The Navy is continuing to invest in LF cetacean audiogram development and recently released a Broad Agency Announcement in coordination with the Subcommittee on Ocean Science and Technology—Ocean Noise and Marine Life Task force to make further investment in this area.

The final group of recommendations are studies that require additional methodological developments and/or would cost greater than $500,000.

1. Controlled exposure estimates (CEE) for beaked whales with an appropriate LF source. There are many complexities associated with this recommendation, even more so considering the results of the ongoing mid-frequency sonar behavioral response studies (BRS) demonstrating the importance of real-world exposures for characterizing behavioral responses. It is possible that existing LF sources already in use on Navy ranges could be surrogates for SURTASS LFA sonar, but such extrapolations would need to be considered carefully. SURTASS LFA sonar is currently authorized for use in the western and central North Pacific and Indian oceans, regions in which CEEs have not been conducted, making experiments with the LFA system itself particularly difficult. Given the cost and complexities associated with this recommendation, it was ranked as a lower priority. This recommendation should also be revisited with future development of tagging technologies for harbor porpoises.

2. LF behavioral audiograms for harbor porpoise or LF auditory brainstem response/auditory evoked potential (ABR/AEP) audiograms for beaked whales. Since the EOG concluded, the Navy funded a study led by Dr. James Finneran (*http://greenfleet.dodlive.mil/files/2017/05/LMRFactSheet_Project9.pdf*) to correlate AEP measurements of hearing sensitivity with perceived loudness (Muslow *et al.,* 2015). Part of this study included attempts to extend the LF range of AEP measurements, which may be transferable to studies of hearing sensitivity of harbor porpoise or beaked whales. There are difficulties with the transmission of LF sounds, in achieving the required power with manageable laboratory systems and creating a far-field sound field consistent across the measurement experiment. The final results of the study have not been published yet, but the study found that AEPs were only successful down to frequencies of 10 kHz for bottlenose dolphins (where 10 kHz is the upper range of what is considered mid-frequency) and 1 kHz for California sea lions (the upper range of what is considered low-frequency). In addition, the correlation of equal latency contours only applied over a limited frequency range, providing limited benefit beyond the frequency range of auditory thresholds. Therefore, it is currently not feasible to conduct ABR/AEPs at frequencies within the range of SURTASS LFA sonar (100 to 500 Hz). Finally, the Navy funded audiograms and TTS studies for harbor porpoise across its entire frequency range (Kastelein *et al.,* 2017). This study reported the hearing sensitivity of a six-year-old female and a three-year-old male harbor porpoise as measured by using a standard psycho-acoustic technique under low ambient noise conditions. The porpoises' hearing thresholds for 13 narrow-band sweeps with center frequencies between 0.125 and 150 kHz were established. The range of most sensitive hearing (defined as within 10 dB of maximum sensitivity) was from 16 to 140 kHz. Sensitivity declined sharply above 125 kHz. Hearing sensitivity in the low frequencies 125 Hz to 1 kHz were 40–80 dB above their maximum sensitivity.

The Navy has obtained a permit from the NMFS marine mammal health and stranding program to conduct an AEP audiogram on a stranded beaked whale, but to date none have stranded alive in an area with staff suitable to conduct the testing. The Navy will continue to seek opportunities to conduct such research should they arise.

The ranking of research and monitoring recommendations has helped inform Navy and NMFS decision makers of the scientific priority, feasibility, and cost of possible experiments to increase understanding of potential effects of SURTASS LFA sonar on harbor porpoises and beaked whales. Discussions among Navy decision makers from OPNAV N2/N974B/N45, Office of the Deputy Assistant Secretary of the Navy for the Environment, Office of Naval Research, and Navy Living Marine Resources Program will continue to leverage research among various programs. Ongoing discussions between Navy and NMFS will continue to evaluate the most efficient and cost-effective way forward for Navy research and environmental compliance monitoring efforts once the amount of funding authorized is known.

Ambient Noise Data Monitoring

Several efforts (federal and academic) are underway to develop a comprehensive ocean noise budget (*i.e.,* an accounting of the relative contributions of various underwater sources to the ocean noise field) for the world's oceans that includes both anthropogenic and natural sources of noise. Ocean noise distribution and noise budgets are used in marine mammal masking studies, habitat characterization, and marine animal impact analyses.

The Navy will collect ambient noise data when the SURTASS passive towed horizontal line array 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 Navy is exploring the feasibility of declassifying and archiving portions of the ambient noise data for incorporation into appropriate ocean noise budget efforts after all related security concerns have been resolved.

Research

The Navy sponsors significant research for marine living resources to study the potential effects of its activities on marine mammals. OPNAV N974B provides a representative to the Navy's Living Marine Resources advisory board to provide input to future research projects that may address SURTASS LFA sonar needs. The most recently available data are for Fiscal Year 2015, in which the Navy reported that it spent $35.9 million that year on marine mammal research and conservation (Marine Mammal Commission, 2017). This ongoing marine mammal research relates to hearing and hearing sensitivity, auditory effects, marine mammal monitoring and detection, noise impacts, behavioral responses, diving physiology and physiological stress, and distribution. The Navy sponsors a significant portion of U.S. research on the effects of human-generated underwater sound on marine mammals and approximately 50 percent of such research conducted worldwide. These research projects may not be specifically related to SURTASS LFA sonar activities; however, they are crucial to the overall knowledge base on marine mammals and the potential effects from underwater anthropogenic noise. The Navy also sponsors research to determine marine mammal abundances and densities for all Navy ranges and other operational areas. The Navy notes that research and evaluation is being carried out on various monitoring and mitigation methods, including passive acoustic monitoring, and the results from this research could be applicable to SURTASS LFA sonar passive acoustic monitoring. The Navy has also sponsored several workshops to evaluate the current state of knowledge and potential for future acoustic monitoring of marine mammals. The workshops bring together underwater acoustic subject matter experts and marine biologists from the Navy and other research organizations to present data and information on current acoustic monitoring research efforts, and to evaluate the potential for incorporating similar technology and methods on Navy instrumented ranges.

Proposed Reporting

In order to issue an ITA for an activity, section 101(a)(5)(A) of the MMPA states that NMFS must set forth ''requirements pertaining to the monitoring and reporting of such taking.'' Effective reporting is critical both to compliance as well as ensuring that the most value is obtained from the required monitoring. There are several different reporting requirements in these proposed regulations:

Notification of the Discovery of a Stranded Marine Mammal [7]

The Navy will systematically observe SURTASS LFA sonar activities for injured or disabled marine mammals. In addition, the Navy will monitor the principal marine mammal stranding networks and other media to correlate analysis of any whale mass strandings that could potentially be associated with SURTASS LFA sonar activities.

In the event of a live stranding (or near-shore atypical milling) event where a stranding network has confirmed the status and location of the stranding, NMFS (individuals specifically identified in the Stranding Communication Protocol, NMFS Office of Protected Resources (OPR)—HQ senior administrators) would advise the Navy of the need to implement shutdown procedures for any use of SURTASS LFA sonar within 50 km (27 nmi) of the stranding.

Minimization of Harm to Live-Stranded (or Milling) Marine Mammals

In the event of a live stranding (or near-shore atypical milling) event, NMFS would advise the Navy of the need to implement shutdown procedures for any use of SURTASS LFA sonar within 50 km (27 nmi) of the stranding. Following this initial shutdown, NMFS would communicate with the Navy to determine if circumstances support any modification of the shutdown zone. The Navy may decline to implement all or part of the shutdown if the holder of the LOA, or his/her designee, determines that it is necessary for national security. Shutdown procedures for live stranding or milling marine mammals include the following:

- If at any time, the marine mammal(s) die or are euthanized, or if herding/intervention efforts that were occurring are stopped, NMFS (individuals specifically identified in the Stranding Communication Protocol) would immediately advise the Navy that the shutdown around that animal(s)' location is no longer needed;
- Otherwise, shutdown procedures would remain in effect until NMFS (individuals specifically identified in the Stranding Communication Protocol) determines and advises the Navy that all live animals involved have left the area (either of their own volition or following an intervention); and
- If further observations of the marine mammals indicate the potential for re-stranding, additional coordination with the Navy may be required to determine what measures are necessary to minimize that likelihood (*e.g.,* extending the shutdown or moving operations farther away) and to implement those measures as appropriate.

Shutdown procedures are not related to the investigation of the cause of the stranding and their implementation is not intended to imply that Navy activity is the cause of the stranding. Rather, shutdown procedures are intended to protect marine mammals exhibiting indicators of distress by minimizing their exposure to possible additional stressors, regardless of the factors that contributed to the stranding.

Navy Discovery of Any Stranded Marine Mammal

In the event that Navy personnel (uniformed military, civilian, or contractors conducting Navy work) associated with operating a T–AGOS class vessel discover a live or dead stranded marine mammal at sea, the Navy shall report the incident to NMFS (see communication protocols below) as soon as is feasible. The Navy will provide NMFS with:

- Time, date, and location (latitude/longitude) of the first discovery (and

[7] As defined in Title IV of the MMPA, a ''stranding'' is defined as ''*an event in the wild in which (A) a marine mammal is dead and is (i) on a beach or shore of the United States, or (ii) in waters under the jurisdiction of the United States (including any navigable waters); or (B) a marine mammal is alive and is (i) on a beach or shore of the United States and unable to return to the water; (ii) on a beach or shore of the United States and, although able to return to the water, is in need of apparent medical attention; or (iii) in the waters under the jurisdiction of the United States (including any navigable waters), but is unable to return to its natural habitat under its own power or without assistance.*''

updated location information if known and applicable);

- Species identification (if known) or description of the marine mammal(s) involved;
- Condition of the marine mammal(s) (including carcass condition if the marine mammal is dead);
- Observed behaviors of the marine mammal(s), if alive;
- If available, photographs or video footage of the marine mammal(s); and
- General circumstances under which the marine mammal was discovered (*e.g.,* vessel transit).

Vessel Strike

In the event of a ship strike of a marine mammal by any T–AGOS class vessel, the Navy shall immediately report, or as soon as security clearance procedures and safety conditions allow, the information above in *Discovery of Any Stranded Marine Mammal* subsection, to NMFS. As soon as feasible, but no later than seven (7) business days, the Navy shall additionally report to NMFS, the:

- Vessel's speed during and leading up to the incident;
- Vessel's course/heading and what training or testing activity was being conducted (if applicable);
- Status of all sound sources in use (*e.g.,* active sonar);
- Description of avoidance measures/requirements that were in place at the time of the strike and what additional measures were taken, if any, to avoid marine mammal strike;
- Environmental conditions (*e.g.,* wind speed and direction, Beaufort sea state, cloud cover, visibility) immediately preceding the marine mammal strike;
- Estimated size and length of marine mammal that was struck;
- Description of the behavior of the marine mammal immediately preceding and following the strike;
- If available, description of the presence and behavior of any other marine mammals immediately preceding the strike;
- Estimated fate of the marine mammal (*e.g.,* dead, injured but alive, injured and moving, blood or tissue observed in the water, status unknown, disappeared, etc.);
- To the extent practicable, photographs or video footage of the struck marine mammal(s); and
- Any relevant information discovered during Navy's investigation of the ship strike.

Annual Report

The classified and unclassified annual reports, which are due no later than 60 days after the anniversary of the effective date of the seven-year LOA, would provide NMFS with a summary of the year's training and testing transmission hours. Specifically, the classified reports will include dates/times of exercises, location of vessel, mission operational area, location of the mitigation zone in relation to the LFA sonar array, marine mammal observations, and records of any delays or suspensions of activities. Marine mammal observations would include animal type and/or species, number of animals sighted by species, date and time of observations, type of detection (visual, passive acoustic, HF/M3 sonar), the animal's bearing and range from vessel, behavior, and remarks/narrative (as necessary). The classified and unclassified reports would include the Navy's analysis of take by Level B harassment and estimates of the percentage of marine mammal stocks affected for the year by SURTASS LFA sonar training and testing activities. The Navy's estimates of the percentage of marine mammal stocks and number of individual marine mammals affected by exposure to SURTASS LFA sonar transmissions would be derived using acoustic impact modeling based on operating locations, season of missions, system characteristics, oceanographic environmental conditions, and marine mammal demographics.

Additionally, the annual report would include: (1) Analysis of the effectiveness of the mitigation measures with recommendations for improvements where applicable; (2) assessment of any long-term effects from SURTASS LFA sonar activities; and (3) any discernible or estimated cumulative impacts from SURTASS LFA sonar training and testing activities.

Comprehensive Report

NMFS proposes to require the Navy to provide NMFS and the public with a final comprehensive report analyzing the impacts of SURTASS LFA sonar training and testing activities on marine mammal species and stocks. This report would include an in-depth analysis of all monitoring and Navy-funded research pertinent to SURTASS LFA sonar activities conducted during the 7-year period of these regulations, a scientific assessment of cumulative impacts on marine mammal stocks, and an analysis on the advancement of alternative (passive) technologies as a replacement for LFA sonar. This report would be a key document for NMFS' review and assessment of impacts for any future rulemaking.

The Navy will respond to NMFS comments and requests for additional information or clarification on the annual or comprehensive reports. These reports will be considered final after the Navy has adequately addressed NMFS' comments or provided the requested information, or three months after the submittal of the draft if NMFS does not comment within the three-month time period. NMFS will post the annual and comprehensive reports on the internet at: *http://www.nmfs.noaa.gov/pr/permits/incidental.htm#applications.*

Adaptive Management

Our understanding about marine mammals and the potential effects of SURTASS LFA sonar on marine mammals is continually evolving. Reflecting this, the proposed rule again includes an adaptive management framework. This allows the agencies to consider new/revised peer-reviewed and published scientific data and/or other information from qualified and recognized sources within academia, industry, and government/non-government organizations to determine (with input regarding practicability) whether SURTASS LFA sonar mitigation, monitoring, or reporting measures should be modified (including additions or deletions) and to make such modification if new scientific data indicate that they would be appropriate. Under this proposed rule, modifications that are substantial would be made only after a 30-day period of public review and comment. Substantial modifications include a change in training and testing areas or new information that results in significant changes to mitigation.

As discussed in the Mitigation section above, NMFS and Navy have refined the adaptive management process for this rule compared to previous rulemakings. In the 2012 rule, NMFS and the Navy annually considered how new information, from anywhere in the world, should be considered in an adaptive management context—including whether this new information would support the identification of new OBIAs or other mitigation measures. Moving forward, new information will still be considered annually, but for the purposes of OBIA identification, only in the context of the areas covered by the proposed rule. New information will still be considered annually, but only in the western and central North Pacific and eastern Indian Oceans in which SURTASS LFA assets will train and test.

Negligible Impact Analysis and Determination

NMFS has defined negligible impact as an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival (50 CFR 216.103). A negligible impact finding is based on the lack of likely adverse effects on annual rates of recruitment or survival (*i.e.,* population-level effects). An estimate of the number of takes alone is not enough information on which to base an impact determination. In addition to considering the numbers of marine mammals that might be taken through mortality, serious injury, and Level A or Level B harassment (although only Level B harassment is authorized by this proposed rule), NMFS considers other factors, such as the likely nature of any responses (*e.g.,* intensity and duration), the context of any response (*e.g.,* critical reproductive time or location, migration, etc.), as well as effects on habitat, the status of the affected stocks, and the likely effectiveness of the mitigation. We also assess the number, intensity, and context of estimated takes by evaluating this information relative to population status. Consistent with the 1989 preamble for NMFS' implementing regulations (54 FR 40338; September 29, 1989), the impacts from other past and ongoing anthropogenic activities are incorporated into these analyses via their impacts on the environmental baseline (*e.g.,* as reflected in the regulatory status of the species, population size, and growth rate where known, ongoing sources of human-caused mortality, or ambient noise levels).

To avoid repetition, the discussion of our analyses applies to all the stocks listed in Table 18 (including those for which density and take estimates have been pooled), because the anticipated effects of this activity on these different marine mammal stocks are expected to be similar, given the operational parameters of the activity. While there are differences in the hearing sensitivity of different groups, these differences have been factored into the analysis for auditory impairment. However, the nature of their behavioral responses is expected to be similar for SURTASS LFA sonar, especially given the context of their short duration and open ocean exposures. Additionally, with the operational avoidance of areas that are known to be important for specific biologically important reasons and coastal standoff zones and the anticipated low-level effects, there is no need to differentially evaluate species based on varying status. Where there is a notable difference in the proportion of authorized takes (as compared to abundance) for two species, we explicitly address it below.

The Navy has described its specified activities based on best estimates of the number of hours that the Navy will conduct SURTASS LFA training and testing activities. The exact number of transmission hours may vary from year to year, but will not exceed the annual total of 496 transmission hours for all vessels in years 1–4 (currently four vessels), or the annual total of 592 transmission hours for all vessels in years 5–7 regardless of the number of vessels in use. (Previous SURTASS LFA sonar rulemakings evaluated and authorized 432 transmission hours per vessel per year.)

As mentioned previously, NMFS estimates that 46 species of marine mammals representing 139 stocks could be taken by Level B harassment over the course of the seven-year period. For reasons stated previously, no mortalities or injuries are anticipated to occur as a result of the Navy's proposed SURTASS LFA sonar training and testing activities, and none are proposed to be authorized by NMFS. The Navy has operated SURTASS LFA sonar under NMFS regulations for the last 17 years without any reports of serious injury or death. The evidence to date, including recent scientific reports, annual monitoring reports, and 17 years of experience conducting SURTASS LFA activities, further supports the conclusion that the potential for injury, and particularly serious injury, to occur is minimal.

Regarding the potential for mortality, as described previously, neither acoustic impacts resulting in stranding nor ship strikes are expected to result from SURTASS LFA training and testing. There is no empirical evidence of strandings or ship strikes of marine mammals associated spatially or temporally with the employment of SURTASS LFA sonar. Moreover, the sonar system acoustic characteristics differ between LFA sonar and MF sonars that have been associated with strandings: LFA sonars use frequencies from 100 to 500 Hz, with relatively long signals (pulses) on the order of 60 sec, while MF sonars use frequencies greater than 1,000 Hz, with relatively short signals on the order of 1 sec. NMFS also makes a distinction between the common features shared by the stranding events associated with MF sonar in Greece (1996), Bahamas (2000), Madeira (2000), Canary Islands (2002), Hanalei Bay (2004), and Spain (2006), referenced above. These included operation of MF sonar, deep water close to land (such as offshore canyons), presence of an acoustic waveguide (surface duct conditions), and periodic sequences of transient pulses (*i.e.,* rapid onset and decay times) generated at depths less than 32.8 ft (10 m) by sound sources moving at speeds of 2.6 m/s (5.1 knots) or more during sonar operations (D'Spain *et al.,* 2006). None of these features relate to the proposed SURTASS LFA sonar training and testing activities. Regarding the potential for ship strike, given the number of vessels, densities of marine mammals in the area of operation, mitigation, and ship speed, the potential of strike is so low as to be discountable.

NMFS neither anticipates nor proposes to authorize Level A harassment of marine mammals as a result of these activities. The proposed mitigation measures (including visual monitoring along with active and passive acoustic monitoring, which has been shown to be over 98 percent effective at detecting marine mammals, and implementing a shutdown zone of 2,000 yds around the LFA sonar array and vessel) would allow the Navy to avoid exposing marine mammals to received levels of SURTASS LFA sonar or HF/M3 sonar sound that would result in injury (Level A harassment) and, as discussed in the Estimated Take of Marine Mammals section, TTS and more severe behavioral reactions would also be minimized due to mitigation measures, so that the majority of takes would be expected to be in the form of less severe Level B harassment.

As noted above, the context of exposures is important in evaluating the ultimate impacts of Level B harassment on individuals. In the case of SURTASS LFA sonar, the approaching sound source would be moving through the open ocean at low speeds, so concerns of noise exposure are somewhat lessened in this context compared to situations where animals may not be as able to avoid strong or rapidly approaching sound sources. In addition, the duration of the take is important; in the case of SURTASS LFA sonar, the vessel continues to move and any interruption of behavior would be of relatively short duration. Further, NMFS and the Navy have imposed geographic restrictions that minimize behavioral disruption in times and areas where impacts would be more likely to lead to effects on individual fitness that could impact the species or stock.

For SURTASS LFA sonar training and testing activities, the Navy provided information (Table 7–1 of the Navy's application) estimating incidental take numbers and percentages of marine mammal stocks that could potentially occur due to SURTASS LFA sonar training and testing activities based on the 15 model areas in the central and western North Pacific and eastern Indian Oceans. Based on our evaluation, incidental take from the specified activities associated with the proposed SURTASS LFA sonar training and testing activities will most likely fall within the realm of short-term and temporary, or ephemeral, disruption of behavioral patterns (Level B harassment), will not include Level A harassment, and is not expected to impact reproduction or survival of individuals. NMFS bases this assessment on a number of factors (discussed in more detail in previous sections) considered together:

(1) Geographic Restrictions—The coastal standoff and OBIA geographic restrictions on SURTASS LFA sonar training and testing activities are expected to minimize the likelihood of disruption of marine mammals in areas where important behavior patterns such as migration, calving, breeding, feeding, or sheltering occur, or in areas with small resident populations or higher densities of marine mammals. As a result, the takes that occur are less likely to result in energetic effects or disturbances of other important behaviors that would reduce reproductive success or survivorship.

(2) Low Frequency Sonar Scientific Research Program (LFS SRP)—The Navy designed the three-phase LFS SRP study to assess the potential impacts of SURTASS LFA sonar on the behavior of low-frequency hearing specialists, those species believed to be at (potentially) greatest risk due to the presumed overlap in hearing of these species and the frequencies at which SURTASS LFA sonar is operated. This field research addressed three important behavioral contexts for baleen whales: (1) Blue and fin whales feeding in the southern California Bight, (2) gray whales migrating past the central California coast, and (3) humpback whales breeding off Hawaii. These experiments, which exposed baleen whales to received levels ranging from 120 to about 155 dB re: 1 μPa, confirmed that some portion of the total number of whales exposed to LFA sonar responded behaviorally by changing their vocal activity, moving away from the source vessel, or both, but the responses were short-lived and animals returned to their normal activities within tens of minutes after initial exposure. While some of the observed responses would likely be considered ''take'' under the MMPA, these short-term Level B harassment responses do not necessarily constitute significant changes in biologically important behaviors. In addition, these experiments illustrated that the context of an exposure scenario is important for determining the probability, magnitude, and duration of a response. This was shown by the fact that migrating gray whales responded to a sound source in the middle of their migration route but showed no response to the same sound source when it was located offshore, outside the migratory corridor, even when the source level was increased to maintain the same received levels within the migratory corridor.

Although the LFS SRP study is nearly two decades old, the collected behavioral response data remain valid and highly relevant because of the lack of additional studies utilizing this specific source, but also because the data show, as reflected in newer studies with other sound sources, that the context of an exposure (novelty of the sound source, distance from the sound source and activity of the animals experiencing exposure, and whether the source is perceived as approaching or moving away, etc.) is as important, if not sometimes more important than the source level and frequency in terms of assessing reactions (see the Behavioral Response/Disturbance section above for discussion of more recent studies regarding context). Therefore, take estimates for SURTASS LFA sonar are likely conservative (though we analyze them here nonetheless), and takes that do occur will primarily be in the form of lower levels of take by Level B harassment.

(3) Efficacy of the Navy's Three-Part Mitigation Monitoring Program—Review of Final Comprehensive and Annual Reports, from August 2002 through December 2018, indicates that the HF/M3 active sonar system has proven to be the most effective of the mitigation monitoring measures to detect possible marine mammals in proximity to the transmitting LFA sonar array, and use of this system substantially increases the probability of detecting marine mammals within the mitigation zone (and beyond), providing a superior monitoring capability. Because the HF/M3 active sonar is able to monitor marine mammals out to an effective range of 2 to 2.5 km (1.2 to 1.5 mi; 1.1 to 1.3 nmi) from the vessel, it is unlikely that the SURTASS LFA operations would expose marine mammals to an SPL greater than about 174 dB re: 1 μPa at 1 m. Past results of the HF/M3 sonar system tests provide confirmation that the system has a demonstrated probability of single-ping detection of 95 percent or greater for single marine mammals that are 10 m (32.8 ft) in length or larger, and a probability approaching 100 percent for multiple pings of any sized marine mammal (see Chapter 5, section 5.4.3 of the SURTASS 2018 DSEIS/SOEIS for a summary of the effectiveness of the HF/M3 monitoring system). Lastly, as noted above, from the commencement of SURTASS LFA sonar use in 2002 through the present, neither operation of LFA sonar, nor operation of the T–AGOS vessels, has been associated with any mass or individual strandings of marine mammals. In addition, required monitoring reports indicate that there have been no apparent avoidance reactions observed, and no observed exposures to sound levels associated with Level A harassment takes due to SURTASS LFA sonar since its use began in 2002.

In examining the results of the mitigation monitoring procedures over the previous 17 years of SURTASS LFA activities, NMFS has concluded that the mitigation and monitoring measures for triggering shutdowns of the LFA sonar system have been implemented properly and have successfully minimized the potential adverse effects of SURTASS LFA sonar to marine mammals in the 2,000-yard LFA sonar mitigation zone around the vessel. This conclusion is further supported by documentation that no known mortality or injury to marine mammals has occurred over this period.

For reasons discussed in the Potential Effects of the Specified Activity on Marine Mammals and their Habitat section, NMFS anticipates that the effect of masking will be limited and the chances of an LFA sonar sound overlapping whale calls at levels that would interfere with their detection and recognition will be extremely low. Also as discussed in that section, NMFS does not expect any short- or long-term effects to marine mammal food resources from SURTASS LFA sonar training and testing activities. It is unlikely that the activities of the SURTASS LFA sonar vessels transmitting LFA sonar at any place in the action area over the course of a year would implicate all of the areas for a given species or stock in any year. It is anticipated that ample similar nearby habitat areas are available for species/stocks in the event that portions of preferred areas are ensonified. Implementation of the 2,000-yard LFA shutdown zone would ensure that most marine mammal takes are limited to lower-level Level B harassment. Further, in areas of known or likely biological importance for functions such as feeding, reproduction, etc., effects are mitigated by the coastal standoff and OBIAs.

As noted above, because of the nature, scale, and locations of SURTASS LFA sonar training and testing, there is no reason to expect meaningfully differential impacts on any particular species or stock that warrant additional discussion. However, we include the following to ensure understanding of the two cases where the percentages of stocks taken are notably higher compared to other stocks. As also noted previously, the modeling the Navy uses allows for the enumeration of instances of take—each representing an exposure above the Level B harassment threshold of a single marine mammal for some amount of time (likely relatively short) within a single day. The model does not predict how many of these instances for a given species or stock may occur as multiple, or repeated, takes to a single individual. Given the nature (small number of ships and relatively few hours across two ocean basins) and location (beyond coastal exclusion in open ocean, areas where species/stocks are not concentrated as much) of the activity, as well as the relatively small percentages of take compared to abundance for most stocks (the vast majority below 10 percent, 12 stocks in the 10–20 percent range, and a handful ranging from 20–67 percent) and the fact that takes of single stocks are expected across multiple regions, we expect that most individuals taken are taken only once in a year with some small subset taken perhaps a few times in the course of a year. However, two stocks have somewhat higher percentages that we note here. When estimated instances of take are compared to the estimated stock abundances, the percentages are 117 and 321 for the Western North Pacific stock of killer whales and the Western North Pacific stock of humpback whales, respectively. Acknowledging the uncertainty surrounding abundance estimates for the Navy's action area, it is still worth noting that these percentages are notably higher than others, and would suggest that some number of individuals are expected to be taken more than once. It indicates the possibility that some individuals are taken several times within a year, as the percentage exceeds 100%. For example, for the Western North Pacific humpback stock, the average number of takes would be three or more per individual. It is unlikely that takes would be exactly evenly distributed across all individuals and it is therefore more reasonable to assume that some number of individuals would be taken fewer than three times, while others would be taken on more than three days, and we assume up to twice that (*i.e.,* one individual could be taken on six days) for the sake of analysis. Even where one individual may be taken (by Level B harassment in the form of behavioral disturbance or a small degree of TTS) on up to six days within a year, given the nature of the activities, there is no reason to expect that these takes would be likely to occur on sequential days or that this magnitude of exposure within a year would be likely to result in impacts on reproduction or survival, especially given the implementation of mitigation to reduce the severity of impacts.

For the following summarized reasons, pulling in the supporting information both in this section and previous sections, NMFS has made a preliminary finding that the total authorized taking from SURTASS LFA sonar training and testing activities will have a negligible impact on the affected species or stocks based on following:

(1) The small number of SURTASS LFA sonar systems that would be operating world-wide (likely not in close proximity to one another) and the low total number of hours of operation planned across all vessels;

(2) The relatively low duty cycle, short training and testing events, and offshore nature of the SURTASS LFA sonar;

(3) The fact that marine mammals in unspecified migration corridors and open ocean concentrations would be adequately protected from exposure to sound levels that would result in injury, most TTS (and any accrued would be expected to be of a small degree), and more severe levels of behavioral disruption by the historical demonstrated effectiveness of the Navy's three-part monitoring program in detecting marine mammals and triggering shutdowns;

(4) Geographic restrictions requiring the SURTASS LFA sonar sound field not exceed 180 dB re 1μPa within 22 km of any shoreline, including islands, or at a distance of one km from the perimeter of an OBIA, thereby limiting the severity and number of behavioral disturbances; and

(5) The proven effectiveness of the required three-part monitoring and mitigation protocols.

In summary, based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the proposed monitoring and mitigation measures, the authorized takes are not expected to adversely affect any species or stock through impacts on recruitment or survival. Therefore, NMFS preliminarily finds that the total authorized marine mammal take from the proposed activity will have a negligible impact on all affected marine mammal species or stocks.

Subsistence Harvest of Marine Mammals

The Navy will not operate SURTASS LFA sonar in Arctic waters nor in the Gulf of Alaska, or off the Aleutian Island chain where subsistence uses of marine mammals protected under the MMPA occur. Therefore, there are no relevant subsistence uses of marine mammals implicated by this action. Therefore, there would be no impact on subsistence hunting, nor would SURTASS LFA sonar cause abandonment of any harvest/hunting locations, displace any subsistence users, or place physical barriers between marine mammals and the hunters. NMFS has preliminarily determined that the total taking affecting species or stocks would not have an unmitigable adverse impact on the availability of such species or stocks for taking for subsistence purposes.

Endangered Species Act

There are 11 marine mammal species under NMFS' jurisdiction that are listed as endangered or threatened under the ESA with confirmed or possible occurrence in the central and western North Pacific and eastern Indian Oceans: The blue; fin; sei; Western North Pacific distinct population segment (DPS) of humpback; North Pacific right; Western North Pacific DPS of gray; sperm; and Main Hawaiian Islands Insular DPS of false killer, as well as the western DPS of the Steller sea lion; Hawaiian monk seal; and the Southern DPS of spotted seal.

On June 15, 2018, the Navy submitted a Biological Assessment to NMFS to initiate consultation under section 7 of the ESA for the 2019–2026 SURTASS LFA sonar training and testing activities. NMFS' proposed authorization for incidental take under section 101(a)(5)(A) of the MMPA is also a Federal agency action that requires consultation under section 7 of the ESA. NMFS and Navy will conclude consultation with NMFS' Office of Protected Resources, Interagency Cooperation Division prior to making a determination on the issuance of a final rule and LOAs.

The USFWS is responsible for regulating the take of the several marine mammal species including the polar bear, walrus, and dugong. The Navy has determined that none of these species occur in geographic areas that overlap with SURTASS LFA sonar activities and, therefore, that SURTASS LFA sonar activities will have no effect on the endangered or threatened species or the critical habitat of ESA-listed species under the jurisdiction of the USFWS. Thus, no consultation with the USFWS pursuant to Section 7 of the ESA will occur.

Classification

This action does not contain any collection of information requirements for purposes of the Paperwork Reduction Act of 1980 (44 U.S.C. 3501 *et seq.*).

The Office of Management and Budget has determined that this proposed rule is not significant for purposes of Executive Order 12866.

Pursuant to the Regulatory Flexibility Act (RFA), the Chief Counsel for Regulation of the Department of Commerce has certified to the Chief Counsel for Advocacy of the Small Business Administration that this proposed rule, if adopted, would not have a significant economic impact on a substantial number of small entities. The RFA requires a Federal agency to prepare an analysis of a rule's impact on small entities whenever the agency is required to publish a notice of proposed rulemaking. However, a Federal agency may certify, pursuant to 5 U.S.C. 605(b), that the action will not have a significant economic impact on a substantial number of small entities. The Navy is the sole entity that will be affected by this rulemaking and is not a small governmental jurisdiction, small organization, or small business, as defined by the RFA. Any requirements imposed by LOAs issued pursuant to these regulations, and any monitoring or reporting requirements imposed by these regulations, will be applicable only to the Navy.

NMFS does not expect the issuance of these regulations or the associated LOAs to result in any impacts to small entities pursuant to the RFA. Because this action, if adopted, would directly affect the Navy and not a small entity, NMFS concludes the action would not result in a significant economic impact on a substantial number of small entities.

List of Subjects in 50 CFR Part 218

Exports, Fish, Imports, Indians, Labeling, Marine mammals, Penalties, Reporting and recordkeeping requirements, Seafood, Transportation.

Dated: February 21, 2019.

Samuel D. Rauch III,

Deputy Assistant Administrator for Regulatory Programs, National Marine Fisheries Service.

For reasons set forth in the preamble, 50 CFR part 218 is proposed to be amended as follows:

PART 218—REGULATIONS GOVERNING THE TAKING AND IMPORTING OF MARINE MAMMALS

■ 1. The authority citation for part 218 continues to read as follows:

Authority: 16 U.S.C. 1361 *et seq.*

■ 2. Add subpart X to part 218 to read as follows:

Subpart X—Taking and Importing of Marine Mammals; U.S. Navy Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) Sonar Training and Testing in the Central and Western North Pacific and Eastern Indian Oceans

Subpart X—Taking and Importing of Marine Mammals; U.S. Navy Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) Sonar Training and Testing in the Central and Western North Pacific and Eastern Indian Oceans

§ 218.230 Specified activity, level of taking, and species/stocks.

Regulations in this subpart apply to the U.S. Navy (Navy) for the taking of marine mammals that occurs incidental to the Navy's SURTASS LFA sonar training and testing activities under authority of the Secretary of the Navy within the central and western North Pacific and eastern Indian Oceans (SURTASS LFA Sonar Study Area) (Table 1 to § 218.230).

TABLE 1 TO § 218.230—SPECIES/STOCKS PROPOSED FOR AUTHORIZATION BY LEVEL B HARASSMENT FOR THE 7-YEAR PERIOD OF THE PROPOSED RULE BY SURTASS LFA SONAR TRAINING AND TESTING ACTIVITIES

Species	Stock [1]
Antarctic minke whale	ANT.
Blue whale	CNP, NIND, WNP, SIND.
Bryde's whale	ECS, Hawaii, WNP, NIND, SIND.
Common minke whale	Hawaii, IND, WNP JW, WNP OE, YS.
Fin whale	ECS, Hawaii, IND, SIND, WNP.
Humpback whale	CNP stock and Hawaii DPS, WAU stock and DPS, WNP stock and DPS.
North Pacific right whale	WNP.
Omura's whale	NIND, SIND, WNP.
Sei whale	Hawaii, SIND, NP, NIND.
Western North Pacific gray whale	WNP stock and Western DPS.
Baird's beaked whale	WNP.
Blainville's beaked whale	Hawaii, WNP, IND.
Common bottlenose dolphin	4-Islands, Hawaii Island, Hawaii Pelagic, IA, IND, Japanese Coastal, Kauai/Niihau, Oahu, WNP Northern Offshore, WNP Southern Offshore, WAU.
Common dolphin	IND, WNP.
Cuvier's beaked whale	Hawaii, IND, SH, WNP.
Dall's porpoise	SOJ *dalli* type, WNP *dalli* ecotype, WNP *truei* ecotype.
Deraniyagala's beaked whale	IND, NP.
Dwarf sperm whale	Hawaii, IND, WNP.
False killer whale	Hawaii Pelagic, IA, IND, Main Hawaiian Islands Insular stock and DPS, Northwestern Hawaiian Islands, WNP.
Fraser's dolphin	CNP, Hawaii, IND, WNP.
Ginkgo-toothed beaked whale	IND, NP.
Harbor porpoise	WNP.
Hubbs' beaked whale	NP.
Indo-Pacific bottlenose dolphin	IND.

TABLE 1 TO § 218.230—SPECIES/STOCKS PROPOSED FOR AUTHORIZATION BY LEVEL B HARASSMENT FOR THE 7-YEAR PERIOD OF THE PROPOSED RULE BY SURTASS LFA SONAR TRAINING AND TESTING ACTIVITIES—Continued

Species	Stock [1]
Killer whale	Hawaii, IND, WNP.
Kogia spp	WNP.
Longman's beaked whale	Hawaii, IND, WNP.
Melon-headed whale	Hawaiian Islands, IND, Kohala Resident, WNP.
Mesoplodon spp	WNP.
Northern right whale dolphin	NP.
Pacific white-sided dolphin	NP.
Pantropical spotted dolphin	4-Islands, Hawaii Island, Hawaiian Pelagic, IND, Oahu, WNP.
Pygmy killer whale	Hawaii, IND, WNP.
Pygmy sperm whale	Hawaii, IND, WNP.
Risso's dolphin	Hawaii, IA, WNP, IND.
Rough-toothed dolphin	Hawaii, IND, WNP.
Short-finned pilot whale	Hawaii, IND, WNP Northern Ecotype, WNP Southern Ecotype.
Southern bottlenose whale	IND.
Spade-toothed beaked whale	IND.
Sperm whale	Hawaii, NIND, NP, SIND.
Spinner dolphin	Hawaii Island, Hawaii Pelagic, IND, Kauai/Niihau, Kure/Midway Atoll, Oahu/4-Islands, Pearl and Hermes Reef, WNP.
Stejneger's beaked whale	WNP.
Striped dolphin	Hawaii, IND, Japanese Coastal, WNP Northern Offshore, WNP Southern Offshore.
Hawaiian monk seal	Hawaii.
Northern fur seal	Western Pacific.
Ribbon seal	NP.
Spotted seal	Alaska stock/Bering Sea DPS, Southern stock and DPS.
Steller sea lion	Western/Asian stock, Western DPS.

[1] ANT=Antarctic; CNP=Central North Pacific; NP=North Pacific; NIND=Northern Indian; SIND=Southern Indian; IND=Indian; WNP=Western North Pacific; ECS=East China Sea; WP=Western Pacific; SOJ=Sea of Japan; IA=Inshore Archipelago; WAU=Western Australia; YS=Yellow Sea; OE=Offshore Japan; OW=Nearshore Japan; JW=Sea of Japan/Minke; JE=Pacific coast of Japan; SH=Southern Hemisphere; DPS=distinct population segment.

§ 218.231 Effective dates.

Regulations in this subpart are effective from August 13, 2019, through August 12, 2026.

§ 218.232 Permissible methods of taking.

Under a Letter or Letters of Authorization (LOA) issued pursuant to § 216.106 of this chapter and § 218.237, the Holder of the LOA (hereinafter ''Navy'') may incidentally, but not intentionally, take marine mammals within the area described in § 218.230 by Level B harassment associated with SURTASS LFA sonar training and testing provided the activity is in compliance with all terms, conditions, and requirements of the regulations in this subpart and the applicable LOA.

§ 218.233 Prohibitions.

Notwithstanding takings contemplated in § 218.230 and authorized by a LOA issued under §§ 216.106 of this chapter and 218.237, no person in connection with the activities described in § 218.230 may:

(a) Violate, or fail to comply with, the terms, conditions, and requirements of this subpart or a LOA issued under §§ 216.106 of this chapter and 218.237;

(b) Take any marine mammal not specified in such LOAs;

(c) Take any marine mammal specified in such LOAs in any manner other than Level B harassment;

(d) Take any marine mammal specified in the LOA if NMFS makes a determination that such taking is having, or may have, more than a negligible impact on the species or stocks concerned; or

(e) Take a marine mammal specified in the LOA if NMFS determines such taking is having, or may have, an unmitigable adverse impact on availability of the species or stock for taking for subsistence uses.

§ 218.234 Mitigation.

When conducting activities identified in § 218.230, the mitigation measures described in this section and in any LOA issued under §§ 216.106 of this chapter and 218.237 must be implemented.

(a) *Personnel training*—Lookouts: The Navy will utilize one or more trained marine biologists qualified in conducting at-sea marine mammal visual monitoring to conduct at-sea marine mammal visual monitoring training and qualify designated ship personnel to conduct at-sea visual monitoring. Training will ensure quick and effective communication within the command structure in order to facilitate implementation of protective measures if they detect marine mammals and may be accomplished either in-person, or via video training.

(b) *General operating procedures.* (1) Prior to SURTASS LFA sonar activities, the Navy will promulgate executive guidance for the administration, execution, and compliance with the environmental regulations under these regulations and LOA.

(2) The Navy must not transmit the SURTASS LFA sonar signal at a frequency greater than 500 Hz.

(c) *2,000-yard LFA sonar mitigation/buffer zone; Suspension and Delay.* If a marine mammal is detected, through monitoring required under § 218.235, within or about to enter within 2,000 yards of the SURTASS LFA source (*i.e.,* the LFA mitigation/buffer zone), the Navy must immediately delay or suspend SURTASS LFA sonar transmissions.

(d) *Resumption of SURTASS LFA sonar transmissions.* (1) The Holder of a LOA may not resume SURTASS LFA sonar transmissions earlier than 15 minutes after:

(i) All marine mammals have left the area of the 2,000-yard LFA sonar mitigation zone; and

(ii) There is no further detection of any marine mammal within the 2,000-yard LFA sonar mitigation zone as determined by the visual, passive, and high frequency monitoring described in § 218.235.

(2) [Reserved]

(e) *Ramp-up procedures for the high-frequency marine mammal monitoring (HF/M3) sonar required under § 218.235.* (1) The Navy must ramp up the HF/M3 sonar power level beginning at a maximum source sound pressure level of 180 dB: re 1 μPa at 1 meter in 10-dB increments to operating levels over a period of no less than five minutes:

(i) At least 30 minutes prior to any SURTASS LFA sonar transmissions; and

(ii) Anytime after the HF/M3 source has been powered down for more than two minutes.

(2) The Navy must not increase the HF/M3 sound pressure level once a marine mammal is detected; ramp-up may resume once marine mammals are no longer detected.

(f) *Geographic restrictions on the SURTASS LFA sonar sound field.* (1) LFA sonar training and testing activities must be conducted such that:

(i) The received level of SURTASS LFA sonar transmissions will not exceed 180 dB within 22 km (12 nmi) from any emergent land, including offshore islands;

(ii) The received level of SURTASS LFA sonar transmissions will not exceed 180 dB re: 1 μPa (rms) at a distance less than 1 km (0.5 nmi) seaward of the outer perimeter of any Offshore Biologically Important Area (OBIA) designated in § 218.234(f)(2), or subsequently identified through the Adaptive Management process specified in § 218.241, during the period specified. The boundaries and periods of such OBIAs will be kept on file in NMFS' Office of Protected Resources and on its website at *https://www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-military-readiness-activities.*

(iii) No activities with the SURTASS LFA system will occur within territorial seas of foreign nations, which are areas from 0 up to 12 nmi from shore, depending on the distance that individual nations claim; and

(iv) No activities with the SURTASS LFA system will occur within Hawaii state waters (out to 3 nmi) or in the waters of Penguin Bank and ensonification of Hawaii state waters will not be at levels above 145 dB.

(2) Offshore Biologically Important Areas (OBIAs) for marine mammals (with specified periods) for SURTASS LFA sonar training and testing activities include the following (Table 1 to paragraph (f)(2):

TABLE 1 TO PARAGRAPH (f)(2)—OFFSHORE BIOLOGICALLY IMPORTANT AREAS (OBIA)

[Note: This table will be updated to include a finalized list of OBIAs for the Final Rule after continued coordination with Navy and review of information received from the Proposed Rule to finalize consideration of the candidate OBIAs.]

Name of area	Location of area	Months of importance
Penguin Bank, Hawaiian Islands Humpback Whale NMS.	North-Central Pacific Ocean	November through April, annually.
Northern Bay of Bengal and Head of Swatch-of-No-Ground (SoNG).	Bay of Bengal/Northern Indian Ocean	Year-round.
Offshore Sri Lanka	North-Central Indian Ocean	December through April, annually.
Camden Sound/Kimberly Region	Southeast Indian Ocean; northwestern Australia.	June through September, annually.

(g) *Minimization of additional harm to live-stranded (or milling) mammals.* The Navy must consult the Notification and Reporting Plan, which sets out the requirements for when live stranded marine mammals are reported in the Study Area. The Stranding and Notification Plan is available at: *https://www.fisheries.noaa.gov/action/incidental-take-authorization-us-navy-operations-surveillance-towed-array-sensor-system-0.*

§ 218.235 Requirements for monitoring.

(a) The Navy must:

(1) Conduct visual monitoring from the ship's bridge during all daylight hours (30 minutes before sunrise until 30 minutes after sunset). During training and testing activities that employ SURTASS LFA sonar in the active mode, the SURTASS vessels must have lookouts to maintain a topside watch with standard binoculars (7x) and with the naked eye.

(2) Use the passive SURTASS sonar component to detect vocalizing marine mammals; and

(3) Use the HF/M3 sonar to locate and track marine mammals in relation to the SURTASS LFA sonar vessel and the sound field produced by the SURTASS LFA sonar source array, subject to the ramp-up requirements in § 216.234(e) of this chapter.

(b) Monitoring under paragraph (a) of this section must:

(1) Commence at least 30 minutes before the first SURTASS LFA sonar training and testing transmission;

(2) Continue between transmission pings; and

(3) Continue either for at least 15 minutes after completion of the SURTASS LFA sonar training and testing transmission, or, if marine mammals are exhibiting unusual changes in behavioral patterns, for a period of time until behavior patterns return to normal or conditions prevent continued observations.

(c) The Navy must designate qualified on-site individuals to conduct the mitigation, monitoring and reporting activities specified in these regulations and LOA issued under §§ 216.106 of this chapter and 218.237.

(d) The Navy must continue to assess data from the Marine Mammal Monitoring Program and work toward making some portion of that data, after appropriate security reviews, available to scientists with appropriate clearances. Any portions of the analyses conducted by these scientists based on these data that are determined to be unclassified after appropriate security reviews will be made publically available.

(e) The Navy must collect ambient noise data and will explore the feasibility of declassifying and archiving the ambient noise data for incorporation into appropriate ocean noise budget efforts.

(f) The Navy must conduct all monitoring required under LOAs.

§ 218.236 Requirements for reporting.

(a) The Navy must submit classified and unclassified annual mission reports to the Director, Office of Protected Resources, NMFS, no later than 60 days after the end of each year covered by the LOA beginning on the date of effectiveness of a LOA. Each annual mission report will include a summary of all active-mode missions completed during that year. At a minimum, each classified mission report must contain the following information:

(1) Dates, times, and location of each vessel during each mission;

(2) Information on sonar transmissions during each mission;

(3) Results of the marine mammal monitoring program specified in the LOA; and

(4) Estimates of the percentages of marine mammal species and stocks affected (both for the year and cumulatively for each successive year) covered by the LOA.

(b) The seventh annual report must be prepared as a final comprehensive report, which will include information for the final year as well as the prior six years of activities under the rule. This final comprehensive report must also contain an unclassified analysis of new passive sonar technologies and an assessment of whether such a system is feasible as an alternative to SURTASS LFA sonar, and be submitted to the Director, Office of Protected Resources, NMFS as described in this paragraph (b).

(c) The Navy will continue to assess the data collected by its undersea arrays and work toward making some portion of that data, after appropriate security reviews, available to scientists with appropriate clearances. Any portions of the analyses conducted by these scientists based on these data that are determined to be unclassified after appropriate security reviews will be made publically available.

(d) The Navy must consult the Notification and Reporting Plan, which sets out notification, reporting, and other requirements for when dead, injured, or live stranded marine mammals are reported in the Study Area. The Stranding and Notification Plan is available at: *https://www.fisheries.noaa.gov/action/incidental-take-authorization-us-navy-operations-surveillance-towed-array-sensor-system-0.*

§ 218.237 Letter of Authorization.

(a) To incidentally take marine mammals pursuant to these regulations, Navy must apply for and obtain a Letter of Authorization (LOA).

(b) An LOA, unless suspended or revoked, may be effective for a period of time not to exceed the expiration date of these regulations.

(c) If an LOA expires prior to the expiration date of these regulations, Navy may apply for and obtain a renewal of the LOA.

(d) In the event of projected changes to the activity or to mitigation and monitoring measures required by an LOA (excluding changes made pursuant to the adaptive management provision of § 218.239), the Navy must apply for and obtain a modification of the LOA as described in § 218.238.

(e) The LOA shall set forth:

(1) Permissible methods of incidental taking;

(2) Means of effecting the least practicable adverse impact on the species, its habitat, and on the availability of the species for subsistence uses (*i.e.,* mitigation); and

(3) Requirements for monitoring and reporting.

(f) Issuance of the LOA will be based on a determination that the level of taking will be consistent with the findings made for the total taking allowable under these regulations.

(g) Notice of issuance or denial of an LOA will be published in the **Federal Register** within thirty days of a determination.

§ 218.238 Renewals and modifications of a Letter of Authorization.

(a) An LOA issued under § 216.106 of this chapter and § 218.237 for the activity identified in § 218.230 may be renewed or modified upon request by the applicant, provided that:

(1) The planned specified activity and mitigation, monitoring, and reporting measures, as well as the anticipated impacts, are the same as those described and analyzed for the regulations in this subpart (excluding changes made pursuant to the adaptive management provision in paragraph (c)(1) of this section); and

(2) NMFS determines that the mitigation, monitoring, and reporting measures required by the previous LOA(s) were implemented.

(b) For LOA modification or renewal requests by the applicant that include changes to the activity or to the mitigation, monitoring, or reporting measures (excluding changes made pursuant to the adaptive management provision in paragraph (c)(1) of this section) that do not change the findings made for the regulations or result in no more than a minor change in the total estimated number of takes (or distribution by species or stock or years), NMFS may publish a notice of planned LOA in the **Federal Register**, including the associated analysis of the change, and solicit public comment before issuing the LOA.

(c) An LOA issued under § 216.106 of this chapter and § 218.237 may be modified by NMFS under the following circumstances:

(1) *Adaptive management.* After consulting with the Navy regarding the practicability of the modifications, NMFS may modify (including adding or removing measures) the existing mitigation, monitoring, or reporting measures if doing so creates a reasonable likelihood of more effectively accomplishing the goals of the mitigation and monitoring.

(i) Possible sources of data that could contribute to the decision to modify the mitigation, monitoring, or reporting measures in an LOA include:

(A) Results from the Navy's monitoring from the previous year(s);

(B) Results from other marine mammal and/or sound research or studies; or

(C) Any information that reveals marine mammals may have been taken in a manner, extent, or number not authorized by the regulations in this subpart or subsequent LOAs.

(ii) If, through adaptive management, the modifications to the mitigation, monitoring, or reporting measures are substantial, NMFS will publish a notice of planned LOA in the **Federal Register** and solicit public comment.

(2) *Emergencies.* If NMFS determines that an emergency exists that poses a significant risk to the well-being of the species or stocks of marine mammals specified in LOAs issued pursuant to § 216.106 of this chapter and § 218.237, an LOA may be modified without prior notice or opportunity for public comment. Notice would be published in the **Federal Register** within thirty days of the action.

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