DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 218

[Docket No. 110808485–1534–01]

RIN 0648–BB14

Taking and Importing Marine Mammals: Taking Marine Mammals Incidental to U.S. Navy Operations of Surveillance Towed Array Sensor System Low Frequency Active Sonar

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, by harassment, incidental to conducting operations of Surveillance Towed Array Sensor System (SURTASS) Low Frequency Active (LFA) sonar in areas of the world's oceans (with the exception of Arctic and Antarctic waters and certain geographic restrictions), from August 16, 2012, through August 15, 2017. Pursuant to the Marine Mammal Protection Act (MMPA), NMFS is proposing regulations to govern that take and requests information, suggestions, and comments on these proposed regulations.

DATES: Comments and information must be received no later than February 6, 2012.

ADDRESSES: You may submit comments, identified by 0648–BB14, by any one of the following methods:

- *Electronic Submissions:* Submit all electronic public comments via the Federal eRulemaking Portal: *http://www.regulations.gov.*
- Hand delivery or mailing of paper, disk, or CD–ROM comments should be addressed to P. Michael Payne, Chief, Permits, Conservation and Education Division, Office of Protected Resources, National Marine Fisheries Service, 1315 East-West Highway, Silver Spring, MD 20910.

Instructions: All comments received are a part of the public record and will generally be posted to *http://www.regulations.gov* without change. All Personal Identifying Information (for example, name, address, etc.) voluntarily submitted by the commenter may be publicly accessible. Do not submit Confidential Business Information or otherwise sensitive or protected information.

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, WordPerfect, or Adobe PDF file formats only. To help NMFS process and review comments more efficiently, please use only one method to submit comments.

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

SUPPLEMENTARY INFORMATION:

Availability

The public may obtain an electronic copy of the Navy's application by writing to the address specified above this section (see **ADDRESSES**), telephoning the contact listed above this section (see **FOR FURTHER INFORMATION CONTACT**), or by visiting the Internet at: *http://www.nmfs.noaa.gov/pr/permits/incidental.htm#applications.* The Navy published a **Federal Register** Notice of Availability of a Draft Supplemental Environmental Impact Statement/Supplemental Overseas Environmental Impact Statement (DSEIS/SOEIS) for employment of SURTASS LFA sonar on August 19, 2011. The public may view the document at: *http://www.surtass-lfa-eis.com.* NMFS is participating in the development of the Navy's DSEIS/SOEIS as a cooperating agency under the National Environmental Policy Act of 1972.

Background

Sections 101(a)(5)(A) and (D) of the Marine Mammal Protection Act of 1972, as amended (MMPA; 16 U.S.C. 1361 *et seq.*), direct the Secretary of Commerce (Secretary) 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 during periods of not more than five consecutive years each if certain findings are made and regulations are issued, or if the taking is limited to harassment, a notice of a proposed authorization is provided to the public for review.

Authorization 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 subsistence uses (where relevant). The authorization must set forth the permissible methods of taking, other means of effecting the least practicable adverse impact on the species or stock and its habitat, and requirements pertaining to the mitigation, monitoring and reporting of such taking.

NMFS has defined ''negligible impact'' in 50 CFR 216.103 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.

The National Defense Authorization Act of 2004 (NDAA; Pub. L. 108–136) amended the MMPA by removing the ''small numbers'' and ''specified geographical region'' provisions and amended the definition of ''harassment'' as it applies to a ''military readiness activity'' (as defined in section 315(f) of Public Law 107–314; 16 U.S.C. 703 note) 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 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].

Summary of Request

On August 17, 2011, NMFS received an application from the U.S. Navy requesting authorization for the take of individuals of 94 species of marine mammals (70 cetaceans and 24 pinnipeds), by harassment, incidental to upcoming routine training and testing of the SURTASS LFA sonar system, as well as the use of the system on a maximum of four U.S. Naval ships during military operations in certain areas of the Pacific, Atlantic, and Indian Oceans and the Mediterranean Sea from August 16, 2012 through August 15, 2017. These routine training and testing and military operations are classified as military readiness activities. The Navy states, and NMFS concurs, that these military readiness activities may incidentally take marine mammals present within the Navy's operation areas by exposing them to sound from low-frequency active sonar sources. The Navy requests authorization to take individuals of 94 species of marine mammals by Level A and Level B Harassment, although as discussed later in this document, Level A Harassment will likely be avoided through the implementation of the Navy's proposed mitigation measures.

This is NMFS' third rule making for SURTASS LFA sonar operations under the MMPA. NMFS' current five-year regulations governing incidental takings incidental to SURTASS LFA sonar activities and the related Letters of Authorizations (LOA) expire on August 15, 2012. NMFS published the first rule, effective from August 2002 through August 2007, on July 16, 2002 (67 FR 46712), and published the second rule on August 21, 2007 (72 FR 46846). For this proposed rule making, the Navy is proposing to conduct the same types of sonar activities as they have conducted over the past nine years.

Description of the Specified Activities

Purpose and Background

The Navy's mission is to maintain, train, equip, and operate combat-ready naval forces capable of accomplishing American strategic objectives, deterring maritime aggression, and maintaining freedom of the seas. Section 5062 of Title 10 of the United States Code directs the Secretary of the Navy and Chief of Naval Operations (CNO) to ensure the readiness of the U.S. naval forces.

The Secretary of the Navy and the CNO have established that anti-submarine warfare (ASW) is a critical part of the Navy's mission that requires access to both the open-ocean and littoral environments and continual training to prepare for all potential threats. 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. The range at which the Navy's ASW assets are able to identify submarine threats is decreasing, and at the same time, improvements in torpedo design are extending the effective weapons range of subsea threats to the U.S. naval fleet.

To address these changing requirements for ASW readiness, the Navy developed SURTASS LFA sonar, which provides the Navy with a reliable and dependable system for long-range detection of quieter, harder-to-find submarines. Because low-frequency (LF) sound travels in seawater for greater distances than higher frequency sound, the Navy states that 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 Navy believes that 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 U.S. Navy and national security interests posed by quiet, diesel submarines.

Specified Activities

As previously mentioned, the Navy has requested MMPA authorization to take marine mammals incidental to the operation of up to four SURTASS LFA sonar systems for routine training and testing as well as for the use of the system during military operations from August 16, 2012 through August 15, 2017. The SURTASS LFA sonar system is a long-range, LF sonar (between 100 and 500 Hertz (Hz)) that has both active and passive components (see the Description of SURTASS LFA Sonar section later in this document). Use of the LFA sonar system could occur in the Pacific, Atlantic and Indian Oceans, and the Mediterranean Sea on a maximum of four naval surveillance vessels: the USNS ABLE, USNS EFFECTIVE, USNS IMPECCABLE, and the USNS VICTORIOUS. The Navy states that they will not operate SURTASS LFA sonar in Arctic and Antarctic waters. Further, the Navy also proposes to operate SURTASS LFA sonar such that the sound field does not exceed 180 decibels (dB) within 22 kilometers (km) (13.7 miles (mi); 12 nautical miles (nm) of land; or in proposed offshore biologically important areas (OBIA) for marine mammals, identified later in this document, in the Navy's application, and in the Navy's 2011 DSEIS/SOEIS (see Geographic Restrictions section later in this document).

Because of uncertainties in the world's political climate, the Navy cannot predict a detailed account of future operating locations and conditions. However, for analytical purposes, the Navy has developed a nominal annual deployment schedule and operational concept based on current LFA sonar operations since January 2003 and projected naval fleet requirements (See Table 1).

The Navy anticipates that a normal SURTASS LFA sonar deployment schedule for a single vessel would involve approximately 294 days per year at sea, which includes 240 days of active sonar transmissions and 54 days of transit. SURTASS LFA sonar would operate day and night in a variety of weather conditions. NMFS refers the reader to Table 1 for additional details on the nominal annual deployment schedule for SURTASS LFA sonar vessels.

TABLE 1—EXAMPLE ANNUAL DEPLOYMENT SCHEDULE FOR ONE SURVEILLANCE VESSEL USING SURTASS LFA SONAR

On mission	Days	Off mission	Days
Transit	54	In-Port Upkeep	40
Active Operations: 432 transmission hours based on a 7.5% duty cycle	240	Regular Overhaul	31
Total Days on Mission	294	Total Days off Mission	71

Potential SURTASS LFA Sonar Operational Areas

Figure 1 depicts the potential areas of operation for SURTASS LFA sonar. Based on the Navy's current operational requirements, potential operations for SURTASS LFA sonar vessels from August 2012 through August 2017 would most likely include areas located in the Pacific, Indian, and Atlantic Oceans and Mediterranean Sea.

The Navy will not operate SURTASS LFA sonar in polar regions (i.e., Arctic and Antarctic waters) of the world (see shaded areas in Figure 1). The Arctic Ocean, the Bering Sea (including Bristol Bay and Norton Sound), portions of the Norwegian, Greenland, and Barents Seas north of 72° North (N) latitude, plus Baffin Bay, Hudson Bay, and the Gulf of St. Lawrence would be non-operational areas for SURTASS LFA sonar. In the Antarctic, the Navy will not conduct SURTASS LFA operations in areas south of 60° South (S) latitude. The Navy has excluded polar waters from operational planning because of the inherent inclement weather conditions and the navigational and operational (equipment) danger that icebergs pose to SURTASS LFA sonar vessels.

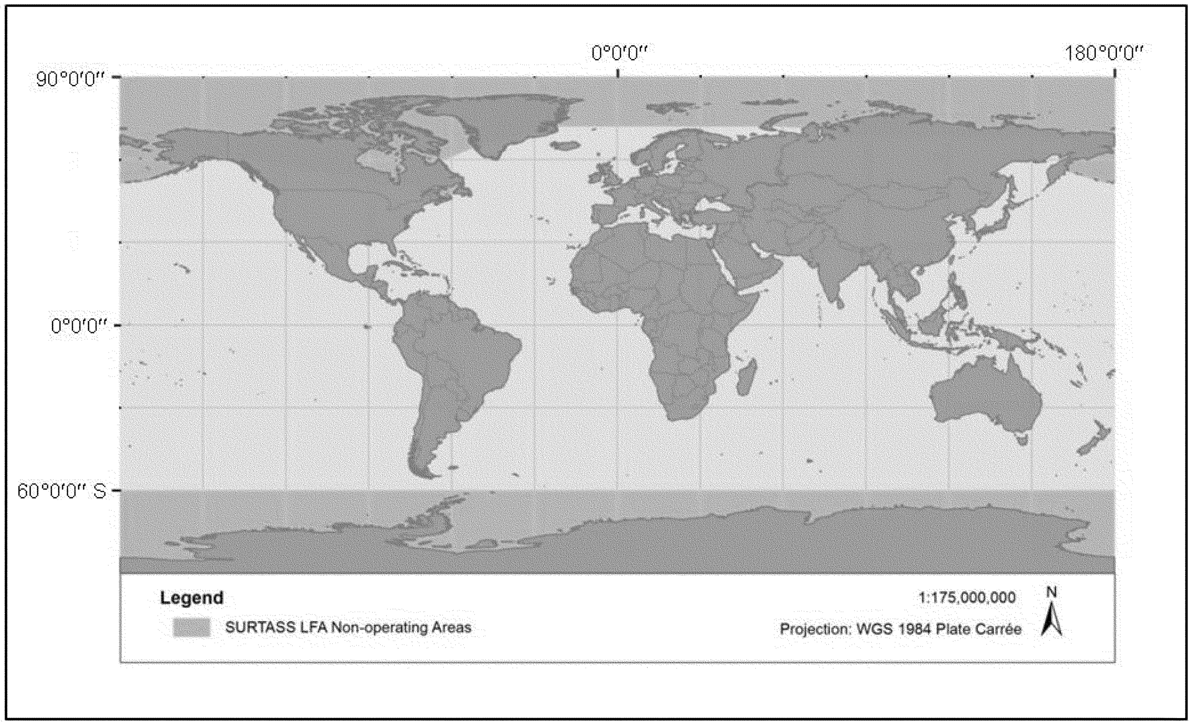

Figure 1 Potential areas of operation for SURTASS LFA sonar (DoN, 2011).

The Navy must anticipate, or predict, where they have to operate in the next five years or so for the MMPA authorization. Naval forces are presently operating in several areas strategic to U.S national and international interests, including areas in the Atlantic Ocean, the Mediterranean Sea, the Indian Ocean and Persian Gulf, and the Pacific Rim. National Security needs may dictate that many of these operational areas will be close to ports and choke points, such as entrances to straits, channels, and canals. It is anticipated that many future naval conflicts are likely to occur within littoral or coastal areas. However, it is infeasible for the Navy to analyze all potential mission areas for all species and stocks for all seasons. Instead, the Navy projects where it intends to test, train, and operate for the next five-year authorization period based on today's political climate and provides NMFS with risk estimates for marine mammal stocks in the proposed areas of operation.

For this third rulemaking, the Navy has modeled and analyzed 19 operational areas for SURTASS LFA operations that would be relevant to U.S. national security interests (see Table 2). They include the following modeled areas: East of Japan; north Philippine Sea; west Philippine Sea; offshore Guam; Sea of Japan; East China Sea; the south China Sea; the northwest Pacific Ocean; the Hawai'i Range Complex; Offshore Southern California in the Southern California (SOCAL) Range Complex; the western Atlantic in the Atlantic Fleet Active Sonar (AFAST) Study Area/Jacksonville (JAX) operational area (OPAREA); the eastern North Atlantic (western approach); the Mediterranean and Ligurian Seas; the Arabian Sea; the Andaman Sea (approaches to the Strait of Malacca); the Panama Canal (western approach); and the northeast Australian Coast.

TABLE 2—POTENTIAL SURTASS LFA SONAR OPERATING AREAS THAT THE NAVY MODELED FOR THE DSEIS/OEIS (DON, 2011) AND THE MMPA LOA APPLICATION

Modeled site	Location (latitude/ longitude)	Modeled site	Location (latitude/ longitude)
East of Japan	38° N, 148° E	Hawaii South (Hawai'i Range Complex)	19.5° N, 158.5° W.
North Philippine Sea	29° N, 136° E	Offshore Southern California (Southern California (SOCAL) Range Complex).	32° N, 120° W.
West Philippine Sea	22° N, 124° E	Western Atlantic (off Florida) (Atlantic Fleet Active Sonar (AFAST) Study Area/Jacksonville.	30° N, 78° W.
Offshore Guam (Mariana Islands Range Complex, outside Mariana Trench).	11° N, 145° E	Eastern North Atlantic (western approach)	56.5° N, 10° W.
Sea of Japan	39° N, 132° E	Mediterranean Sea—Ligurian Sea	43° N, 8° E.
East China Sea	26° N, 125° E	Arabian Sea	20°N, 65°E.
South China Sea	21° N, 119° E	Andaman Sea (approaches to the Strait of Malacca).	7.5° N, 96° E.
NW Pacific 25° to 40° N	30° N, 165° E	Panama Canal (western approach)	5° N, 81° W.
NW Pacific 10° to 25° N	15° N, 165° E	Northeast Australian Coast	23° S, 155° E.
Hawai'i North (Hawai'i Range Complex)	25° N, 158° W		

Acoustic stimuli (i.e., increased underwater sound) generated during the transmission of low-frequency acoustic signals by the SURTASS LFA sonar system has the potential to cause take of marine mammals in the operational areas. The operation of the SURTASS LFA sonar system during at-sea operations would result in the generation of sound or pressure waves in the water at or above levels that NMFS has determined would result in take. This is the principal means of marine mammal taking associated with these military readiness activities and the Navy has requested an authorization to take 94 species of marine mammals by Level A and Level B harassment. At no point are there expected to be more than four systems in use, and thus this proposed rule analyzes the impacts on marine mammals due to the deployment of up to four LFA sonar systems from 2012 through 2017.

In addition to the use of active acoustic sources, the Navy's activities include the operation and movement of vessels that are necessary to conduct the routine training and testing as well as the use of the system during military operations. This document also analyzes the effects of this part of the activities. However, NMFS does not anticipate take to result from collision with any of the four SURTASS LFA vessels because each vessel moves at a relatively slow speed, for a relatively short period of time. It is likely that any marine mammal would be able to avoid the surveillance vessels.

Description of 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.

The SURTASS LFA sonar system is a long-range, all-weather sonar 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 (i.e., a ping) 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 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 then 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 expected water depth at the center of the array is approximately 400 ft (121.9 m). The SURTASS LFA sonar projectors transmit in the low-frequency band (between 100 and 500 Hz) and the Navy will not transmit the SURTASS LFA sonar signal at a frequency greater than 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 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 sound pressure level (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 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 last as short as six seconds (sec) to 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 over the past nine years, 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 the duty cycle is not expected to exceed 20 percent.

Compact LFA Active Component

At present, the USNS IMPECCABLE is the only naval vessel with an operational LFA sonar system. To meet future undersea warfare requirements in littoral waters, the Navy has developed a compact LFA (CLFA) sonar system now deployed on its three smaller surveillance vessels (i.e., the USNS ABLE, EFFECTIVE, and VICTORIOUS). In the application, the Navy indicates that the operational characteristics of the active component CLFA are comparable to the existing LFA systems and that the potential impacts from CLFA will be similar to the effects from the existing LFA sonar system. CLFA consists of smaller projectors that weigh 142,000 lbs (64,410 kilograms (kg)), which is 182,000 lbs (82,554 kg) less that the mission 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). Similar to the active component of the LFA 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 document, 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 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). The SURTASS LFA sonar vessel typically maintains a speed of at least 3.4 mph (5.6 km/hr; 3 knots (kts)) to tow the array astern of the vessel in the correct horizontal configuration.

High-Frequency Active Sonar

Although technically not part of the SURTASS LFA sonar system, the Navy also proposes to use a high-frequency sonar system, called the High Frequency Marine Mammal Monitoring sonar (HF/M3 sonar), developed by the Navy and Scientific Solutions, Inc., to detect and locate marine mammals within the SURTASS LFA sonar operational areas. 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 between 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 proposes to deploy the SURTASS LFA sonar system on a maximum of four U.S. Naval ships: the USNS ABLE (T–AGOS 20), the USNS EFFECTIVE (T–AGOS 21), the USNS IMPECCABLE (T–AGOS 23) and the USNS VICTORIOUS (T–AGOS 19).

The USNS ABLE, EFFECTIVE, and VICTORIOUS, are twin-hulled ocean surveillance ships. Each vessel has a length of 235 feet (ft) (71.6 meters (m)); a beam of 93.6 ft (28.5 m); a maximum draft of 25 ft (7.6 m); and a full load displacement of 3,396 tons (3,451 metric tons). A twin-shaft diesel electric engine provides 3,200 horsepower (hp), which drives two propellers.

The USNS IMPECCABLE, also a twin-hulled ocean surveillance ship, has a length of 281.5 ft (85.8 m); a beam of 95.8 ft (29.2 m); a maximum draft of 26 ft (7.9 m); and a full load displacement of 5,368 tons (5,454 metric tons). A twin-shaft diesel electric engine provides 5,000 hp, which drives two propellers.

The operational speed of each vessel during sonar operations will be approximately 3.4 miles per hour (mph) (5.6 km per hour (km/hr); 3 kts) and each vessel's cruising speed outside of sonar operations would be approximately 11.5 to 14.9 mph (18.5 to 24.1 km/hr; 10 to 13 kts). The expected minimum water depth at which the SURTASS LFA vessel would operate is 656.2 ft (200 m) and the vessel will generally travel in straight lines or in oval-shaped (i.e., racetrack) patterns depending on the operational scenario. Also, each SURTASS LFA sonar vessel would operate independently of, or in conjunction with, other naval air, surface or submarine assets.

Each vessel also has an observation area on the bridge from where lookouts will monitor for marine mammals before and during the proposed sonar operations. When stationed on the bridge of the USNS ABLE, EFFECTIVE, or VICTORIOUS, the lookout's eye level will be approximately 32 ft (9.7 m) above sea level providing an unobstructed view around the entire vessel. For the USNS IMPECCABLE, the lookout's eye level will be approximately 45 ft (13.7 m) above sea level.

Description of Real-Time SURTASS LFA Sonar Sound Field Modeling

This section explains how the Navy will determine the propagation of LFA sonar signals in the ocean and the distance from the SURTASS LFA sonar source to the 180-dB re: 1 µPa at 1 m isopleth (i.e., the basis for the proposed LFA sonar mitigation zone for marine mammals). NMFS provides this description to aid the public's understanding of this action. However, the actual physics governing the propagation of SURTASS LFA sound signals is extremely complex and dependent on numerous in-situ environmental factors.

Prior to commencing and during SURTASS LFA transmissions, the sonar operators on the vessel will measure oceanic conditions (such as sea water temperature, salinity, and depth) in the proposed action area. This information is required for the sonar technicians to accurately determine the speed at which sound travels and to determine the path that the sound would take through the water column at a particular location (i.e., the speed of sound in seawater varies directly with depth, temperature, and salinity).

The sonar operators use the near-real time environmental data and the Navy's underwater acoustic performance prediction models (updated every 12 hours or more frequently when meteorological or oceanographic conditions change) to generate a plot of sound speed versus depth, typically referred to as a sound speed profile (SSP). The SSP enables the technicians to determine the sound field by predicting the received levels of sound at various distances from the SURTASS LFA sonar source location. Modeling of the sound field in near-real time provides the information necessary to modify SURTASS LFA operations, including the delay or suspension of LFA sonar transmissions for mitigation.

Subchapter 3.1.2 of the SURTASS LFA Sonar 2011 DSEIS/SOEIS (DoN, 2011) discusses some of the environmental factors affecting sound propagation. Appendix B of the 2001 SURTASS LFA Sonar FOEIS/EIS (DoN, 2001) also provides an understanding concerning the general conditions of sound speed in the oceans. NMFS refers the public to these documents at *http://www.surtass-lfa-eis.com* for additional information.

Comments and Responses

On August 30, 2011 NMFS published a notice of receipt of an application for an LOA in the **Federal Register** (76 FR 53884) and requested comments and information from the interested public for 30 days. During the 30-day comment period, NMFS received two comments. One commenter opposed the project on the grounds that it would cause mortality to marine mammals. NMFS notes that the Navy has not requested lethal take of marine mammals in its application and, for the reasons described in this document, NMFS does not anticipate that any mortality will occur as a result of the Navy's activities. Therefore, the proposed rule only envisions the authorization of Level A and Level B harassment of marine mammals. The other comment, from an environmental non-governmental organization, expressed concerns about the geographic mitigation proposed in the Navy's DSEIS/SOEIS, focusing particularly on the process for identifying proposed offshore biologically important areas (OBIAs). NMFS undertook a systematic and scientifically supportable process for identifying OBIAs for this proposed rule making. This process is summarized in the Mitigation section of this proposed rule and detailed in the Navy's DSEIS/SOEIS.

The Marine Mammal Commission (MMC) also submitted comments to the Navy and NMFS. Generally, the MMC agreed that NMFS should propose regulations governing the take of marine mammals incidental to operation of SURTASS LFA sonar for a third five-year period. However, the MMC recommended that the Navy amend its application and related DSEIS/SOEIS to: (1) clarify the Navy's take request for marine mammals by Level A harassment; and (2) specify the numbers of marine mammals that could be taken by Level A and B harassment incidental to operating SURTASS LFA sonar, rather than providing only the probabilities of such takes. With respect to the first point, NMFS notes that the Navy's application specifically requests authorization for Level A harassment of marine mammals incidental to SURTASS LFA sonar operations.

With respect to the MMC's second point, the percentages given in Tables 6 through 27 in the Navy's application are not probabilities, but rather indicate the percent of the affected stock for a specific marine mammal species. For the Navy's Level A and Level B harassment take request, that percentage is then multiplied by the number of animals in the relevant species or stock to arrive at an estimated number of animals that may be harassed by SURTASS LFA sonar operations. The Navy's approach to estimating Level A harassment and Level B harassment takes is consistent with the approach used in previous rules for SURTASS LFA sonar.

This proposed rule does not specify the number of marine mammals that may be taken in the proposed locations because these are determined annually through various inputs such as mission location, mission duration, and season of operation. As with the previous two rulemakings, this proposed rule analyzes a maximum of 12 percent takes by Level B harassment per stock annually that will be taken per stock annually, regardless of the number of LFA sonar vessels operating. The Navy will use the 12 percent cap (i.e., the maximum percentage of a stock that could be taken annually, not the probability of take) to guide its mission planning and annual LOA applications. For the annual applications for LOAs, the Navy proposes to present both the estimated percentage of stock incidentally harassed as well as the estimated number of animals that may be potentially harassed by SURTASS LFA sonar.

Description of Marine Mammals in the Area of the Specified Activities

Ninety-four (94) marine mammal species or populations/stocks have confirmed or possible occurrence within potential SURTASS LFA operational areas in certain areas of the Pacific, Atlantic, and Indian Oceans and the Mediterranean Sea. Twelve species of baleen whales (mysticetes), 58 species of toothed whales, dolphins, or porpoises (odontocetes), and 24 species of seals or sea lions (pinnipeds) could be affected by SURTASS LFA sonar operations.

Fifteen of the 94 marine mammal species are listed as endangered and three of the 94 marine mammal species are listed as threatened under the Endangered Species Act of 1973 (ESA; 16 U.S.C. 1531 *et seq.*). Marine mammal species under NMFS' jurisdiction listed as endangered include: the blue whale (*Balaenoptera musculus*); fin whale (*Balaenoptera physalus*); sei whale (*Balaenoptera borealis*); humpback whale (*Megaptera novaeangliae*); bowhead whale (*Balaena mysticetus*); North Atlantic right whale (*Eubalaena glacialis*); North Pacific right whale (*Eubalaena japonica*); southern right whale (*Eubalaena australis*); gray whale (*Eschrichtius robustus*); sperm whale (*Physeter macrocephalus*); the Cook Inlet stock of beluga whale (*Delphinapterus leucas*); the Southern Resident population of Killer whale (*Orca orcinus*); the western distinct population segment (DPS) of the Steller sea lion (*Eumetopias jubatus*); Mediterranean monk seal (*Monachus monachus*); and Hawaiian monk seal (*Monachus schauinslandi*). Marine mammal species under NMFS' jurisdiction listed as threatened include: the eastern DPS of the Steller sea lion; the Guadalupe fur seal (*Arctocephalus townsendi*) and the southern DPS of the spotted seal (*Phoca largha*). The aforementioned threatened and endangered marine mammal species also are depleted under the MMPA.

In addition, the Hawaiian insular DPS of false killer whale (*Pseudorca crassidens*) is a candidate for proposed listing under the ESA. Also, three of the 94 species are considered depleted under the MMPA. They are: the western north Atlantic coastal stock of bottlenose dolphin (*Tursiops truncatus*); the northeastern offshore stock of the pantropical spotted dolphin (*Stenella attenuata*); and the eastern stock of the spinner dolphin (*Stenella longirostris*).

Ringed seals (*Phoca hispida*), bearded seals (*Erignathus barbatus*), Chinese river dolphins (*Lipotes vexillifer*) and vaquita (*Phocoena sinus*) do not have stocks designated within potential SURTASS LFA sonar operational areas (see Potential SURTASS LFA Operational Areas section). The ringed seal is found in the Northern Hemisphere with a circumpolar distribution ranging from 35° N to the North Pole. Bearded seals have a circumpolar distribution south of 85° N latitude, extending south into the southern Bering Sea in the Pacific and into Hudson Bay and southern Labrador in the Atlantic. The distribution of the Chinese river dolphin is limited to the main channel of a river section between the cities of Jingzhou and Jiangyin. The vaquita's distribution is restricted to the upper portion of the northern Gulf of California, mostly within the Colorado River delta. Based on the rare occurrence of these species in the Navy's designated operational areas (i.e., outside of Arctic waters or outside of the coastal standoff distance of 22 km (13. mi; 11.8 nmi)), the Navy and NMFS do not anticipate any take of ringed seals, bearded seals, Chinese river dolphins, and vaquita and therefore these species are not addressed further in this document.

The U.S. Fish and Wildlife Service (USFWS) is responsible for managing the following marine mammal species: southern sea otter (*Enhydra lutris*), polar bear (*Ursus maritimus*), walrus (*Odobenus rosmarus*), west African manatee (*Trichechus senegalensis*), Amazonian manatee (*Trichechus inunguis*), west Indian manatee (*Trichechus manatus*), and dugong (*Dugong dugon*). None of these species occur in geographic areas that would overlap with SURTASS LFA sonar operational areas. Therefore, the Navy has determined that routine training and testing of SURTASS LFA sonar as well as the use of the system during military operations 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.

Tables 3 through 21 summarize the abundance, status under the ESA, and density estimates of the marine mammals that have confirmed or possible occurrence within 19 SURTASS LFA sonar operating areas in the Pacific, Indian, and Atlantic Oceans and Mediterranean Sea. The Navy states that they selected these 19 areas based on relevance to national security interests for this application. Because it is infeasible for the Navy to model enough representative sites to cover all potential SURTASS LFA sonar operating areas, the Navy provided 19 sites, based on the current political climate, as examples of potential operating areas in their application.

Information on how the density and stock/abundance estimates were derived for the selected mission sites is in the Navy's application. These data are derived from current, published source documentation, and provide general area information for each mission 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 majority of the abundance and density estimates by first using estimates from line-transect surveys that occurred in or near each of the 19 model sites (e.g., Barlow, 2006). When density estimates were not available from a survey in the operating area, the Navy extrapolated density estimates from a region with similar oceanographic characteristics to that operating 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). Further, the Navy pooled density estimates 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.

TABLE 3—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH THE EAST OF JAPAN OPERATIONAL AREA

Species	Stock name [1]	Abundance [2]	Density (animals/ Km^2) [3]	ESA Status [4]
Blue whale (*Balaenoptera musculus*)	NP	9,250	0.0002	EN
Fin whale (*Balaenoptera physalus*)	NP	9,250	0.0002	EN
Sei whale (*Balaenoptera borealis*)	NP	8,600	0.0006	EN
Bryde's whale (*Balaenoptera edeni*)	WNP	20,501	0.0006	NL
Minke whale (*Balaenoptera acutorostrata*)	WNP "O" Stock	25,049	0.0022	NL
North Pacific right whale (*Eubalaena japonica*)	WNP	922	< 0.00001	EN
Sperm whale (*Physeter macrocephalus*)	NP	102,112	0.0010	EN
Pygmy sperm whale (*Kogia breviceps*) Dwarf sperm whale (*Kogia sima*).	NP	350,553	0.0031	NL
Baird's beaked whale (*Berardius bairdii*)	WNP	8,000	0.0029	NL
Cuvier's beaked whale (*Ziphius cavirostris*)	NP	90,725	0.0054	NL
Ginkgo-toothed beaked whale (*Mesoplodon ginkgodens*)	NP	22,799	0.0005	NL
Hubbs beaked whale (*Mesoplodon carhubbsi*)	NP	22,799	0.0005	NL
False killer whale (*Pseudorca crassidens*)	WNP-Pelagic	16,668	0.0036	NL
Pygmy killer whale (*Feresa attenuata*)	WNP	30,214	0.0021	NL
Short-finned pilot whale (*Globicephala macrorhynchus*)	WNP	53,608	0.0128	NL
Risso's dolphin (*Grampus griseus*)	WNP	83,289	0.0097	NL
Common dolphin (*Delphinus delphis*)	WNP	3,286,163	0.0761	NL
Fraser's dolphin (*Lagenodelphis hosei*)	WNP	220,789	0.0040	NL
Bottlenose dolphin (*Tursiops truncatus*)	WNP	168,791	0.0171	NL
Pantropical spotted dolphin (*Stenella attenuata*)	WNP	438,064	0.0259	NL
Striped dolphin (*Stenella coeruleoalba*)	WNP	570,038	0.0111	NL
Spinner dolphin (*Stenella longirostris*)	WNP	1,015,059	0.0005	NL
Pacific white-sided dolphin (*Lagenorhynchus obliquidens*)	WNP	931,000	0.0082	NL
Rough-toothed dolphin (*Steno bredanensis*)	WNP	145,729	0.0059	NL

[1] NP = north Pacific; WNP = western north Pacific.
[2] Refer to Table 5 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 5 of the Navy's application for literature references associated with density estimates presented in this table.
[4] ESA Status: EN = Endangered; T = Threatened; NL = Not Listed.

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

Species	Stock name [1]	Abundance [2]	Density (animals/ Km^2) [3]	ESA Status [4]
Bryde's whale	WNP	20,501	0.0006	NL
Minke whale	WNP "O" Stock	25,049	0.0044	NL
North Pacific right whale	WNP	922	< 0.00001	EN
Sperm whale	NP	102,112	0.0028	EN
Pygmy sperm and Dwarf sperm whale	NP	350,553	0.0031	NL
Cuvier's beaked whale	NP	90,725	0.0054	NL
Blainville's beaked whale (*Mesoplodon densirostris*)	NP	8,032	0.0005	NL
Ginkgo-toothed beaked whale	NP	22,799	0.0005	NL
Killer whale (*Orca orcinus*)	NP	12,256	0.0004	NL
False killer whale	WNP-Pelagic	16,668	0.0029	NL
Pygmy killer whale	WNP	30,214	0.0021	NL
Melon-headed whale (*Peponocephala electra*)	WNP	36,770	0.0012	NL
Short-finned pilot whale	WNP	53,608	0.0153	NL
Risso's dolphin	WNP	83,289	0.0106	NL
Common dolphin	WNP	3,286,163	0.0562	NL
Fraser's dolphin	WNP	220,789	0.0040	NL
Bottlenose dolphin	WNP	168,791	0.0146	NL
Pantropical spotted dolphin	WNP	438,064	0.0137	NL
Striped dolphin	WNP	570,038	0.0329	NL
Spinner dolphin	WNP	1,015,059	0.0005	NL
Pacific white-sided dolphin	WNP	931,000	0.0119	NL
Rough-toothed dolphin	WNP	145,729	0.0059	NL

[1] NP = north Pacific; WNP = western north Pacific.
[2] Refer to Table 5 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 5 of the Navy's application for literature references associated with density estimates presented in this table.
[4] ESA Status: EN = Endangered; T = Threatened; NL = Not Listed.

TABLE 5—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH THE WEST PHILIPPINE SEA OPERATIONAL AREA

Species	Stock name [1]	Abundance [2]	Density (animals/ Km^2) [3]	ESA Status [4]
Fin whale	NP	9,250	0.0002	EN
Bryde's whale	WNP	20,501	0.0006	NL
Minke whale	WNP "O" Stock	25,049	0.0033	NL
Humpback whale	WNP	1,107	0.0008	EN
Sperm whale	NP	102,112	0.0010	EN
Pygmy sperm and Dwarf sperm whale	NP	350,553	0.0017	NL
Cuvier's beaked whale	NP	90,725	0.0003	NL
Blainville's beaked whale	NP	8,032	0.0005	NL
Ginkgo-toothed beaked whale	NP	22,799	0.0005	NL
False killer whale	WNP-Pelagic	16,668	0.0029	NL
Pygmy killer whale	WNP	30,214	0.0021	NL
Melon-headed whale	WNP	36,770	0.0012	NL
Short-finned pilot whale	WNP	53,608	0.0076	NL
Risso's dolphin	WNP	83,289	0.0106	NL
Common dolphin	WNP	3,286,163	0.0562	NL
Fraser's dolphin	WNP	220,789	0.0040	NL
Bottlenose dolphin	WNP	168,791	0.0146	NL
Pantropical spotted dolphin	WNP	438,064	0.0137	NL
Striped dolphin	WNP	570,038	0.0164	NL
Spinner dolphin	WNP	1,015,059	0.0005	NL
Pacific white-sided dolphin	WNP	931,000	0.0245	NL
Rough-toothed dolphin	WNP	145,729	0.0059	NL

[1] NP = north Pacific; WNP = western north Pacific.
[2] Refer to Table 5 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 5 of the Navy's application for literature references associated with density estimates presented in this table.
[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 THE OFFSHORE GUAM OPERATIONAL AREA

Species	Stock name [1]	Abundance [2]	Density (animals/ Km^2) [3]	ESA Status [4]
Blue whale	ENP	2,842	0.0001	EN
Fin whale	ENP	9,250	0.0003	EN
Sei whale	NP	8,600	0.0003	EN
Bryde's whale	WNP	20,501	0.0004	NL
Minke whale	WNP "O" Stock	25,049	0.0003	NL
Humpback whale	CNP	10,103	0.0069	EN
Sperm whale	NP	102,112	0.0012	EN
Pygmy sperm and Dwarf sperm whale	NP	350,553	0.0101	NL
Cuvier's beaked whale	NP	90,725	0.0062	NL
Blainville's beaked whale	NP	8,032	0.0012	NL
Ginkgo-toothed beaked whale	NP	22,799	0.0005	NL
Longman's beaked whale (*Indopacetus pacificus*)	CNP	1,007	0.0004	NL
Killer whale	CNP	349	0.0001	NL
False killer whale	WNP-Pelagic	16,668	0.0011	NL
Pygmy killer whale	WNP	30,214	0.0001	NL
Melon-headed whale	WNP	36,770	0.0043	NL
Short-finned pilot whale	WNP	53,608	0.0016	NL
Risso's dolphin	WNP	83,289	0.0010	NL
Common dolphin	WNP	3,286,163	0.0021	NL
Fraser's dolphin	CNP	10,226	0.0042	NL
Bottlenose dolphin	WNP	168,791	0.0002	NL
Pantropical spotted dolphin	WNP	438,064	0.0226	NL
Striped dolphin	WNP	570,038	0.0062	NL
Spinner dolphin	WNP	1,015,059	0.0031	NL
Rough-toothed dolphin	WNP	145,729	0.0003	NL

[1] CNP = central north Pacific; ENP = eastern north Pacific; NP = north Pacific; WNP = western north Pacific.
[2] Refer to Table 5 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 5 of the Navy's application for literature references associated with density estimates presented in this table.
[4] ESA Status: EN = Endangered; T = Threatened; NL = Not Listed.

TABLE 7—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH THE SEA OF JAPAN OPERATIONAL AREA

Species	Stock name [1]	Abundance [2]	Density (animals/ Km^2 [3]	ESA Status[4]
Fin whale	NP	9,250	0.0009	EN
Bryde's whale	WNP	20,501	0.0001	NL
Minke whale	WNP "O" Stock	25,049	0.0004	NL
Minke whale	WNP "J" Stock	893	0.0002	NL
North Pacific right whale	WNP	922	< 0.00001	EN
Gray whale (*Eschrichtius robustus*)	WNP	121	< 0.00001	EN [5]
Sperm whale	NP	102,112	0.0008	EN
Stejneger's beaked whale (*Mesoplodon stejnegeri*)	NP	8,000	0.0014	NL
Baird's beaked whale	WNP	8,000	0.0003	NL
Cuvier's beaked whale	NP	90,725	0.0043	NL
Ginkgo-toothed beaked whale	NP	22,799	0.0005	NL
False killer whale	IA-Pelagic	9,777	0.0027	NL
Melon-headed whale	WNP	36,770	0.00001	NL
Short-finned pilot whale	WNP	53,608	0.0014	NL
Risso's dolphin	WNP	83,289	0.0073	NL
Common dolphin	WNP	3,286,163	0.0860	NL
Bottlenose dolphin	IA	105,138	0.0009	NL
Pantropical spotted dolphin	WNP	219,032	0.0137	NL
Spinner dolphin	WNP	1,015,059	0.00001	NL
Pacific white-sided dolphin	WNP	931,000	0.0030	NL
Dall's porpoise (*Phocoenoides dalli*)	SOJ	76,720	0.0520	NL

[1] IA = Inshore Archipelago; NP = north Pacific; SOJ = Sea of Japan; WNP = western north Pacific.
[2] Refer to Table 5 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 5 of the Navy's application for literature references associated with density estimates presented in this table.
[4] ESA Status: EN = Endangered; T = Threatened; NL = Not Listed.
[5] Only the western Pacific population of gray whale is endangered under the ESA.

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

Species	Stock name [1]	Abundance [2]	Density (animals/ Km^2) [3]	ESA Status [4]
Fin whale	ECS	500	0.0002	EN
Bryde's whale	WNP	20,501	0.0006	NL
Minke whale	WNP "O" Stock	25,049	0.0044	NL
Minke whale	WNP "J" Stock	893	0.0018	NL
North Pacific right whale	WNP	922	< 0.00001	EN
Gray whale	WNP	121	< 0.00001	EN [5]
Sperm whale	NP	102,112	0.0012	EN
Pygmy sperm and Dwarf sperm whale	NP	350,553	0.0031	NL
Cuvier's beaked whale	NP	90,725	0.0062	NL
Blainville's beaked whale	NP	8,032	0.0012	NL
Ginkgo-toothed beaked whale	NP	22,799	0.0005	NL
False killer whale	IA-Pelagic	9,777	0.0011	NL
Pygmy killer whale	WNP	30,214	0.0001	NL
Melon-headed whale	WNP	36,770	0.0043	NL
Short-finned pilot whale	WNP	53,608	0.0016	NL
Risso's dolphin	WNP	83,289	0.0106	NL
Common dolphin	WNP	3,286,163	0.0461	NL
Fraser's dolphin	WNP	220,789	0.0040	NL
Bottlenose dolphin	IA	105,138	0.0146	NL
Pantropical spotted dolphin	WNP	219,032	0.0137	NL
Striped dolphin	WNP	570,038	0.0164	NL
Spinner dolphin	WNP	1,015,059	0.0031	NL
Pacific white-sided dolphin	WNP	931,000	0.0028	NL
Rough-toothed dolphin	WNP	145,729	0.0059	NL

[1] ECS = East China Sea; IA = Inshore Archipelago; NP = north Pacific; WNP = western north Pacific.
[2] Refer to Table 5 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 5 of the Navy's application for literature references associated with density estimates presented in this table.
[4] ESA Status: EN = Endangered; T = Threatened; NL = Not Listed.
[5] Only the western Pacific population of gray whale is endangered under the ESA.

TABLE 9—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH THE SOUTH CHINA SEA OPERATIONAL AREA

Species	Stock name [1]	Abundance [2]	Density (animals/Km^2) [3]	ESA Status [4]
Fin whale	WNP	9,250	0.0002	EN
Bryde's whale	WNP	20,501	0.0006	NL
Minke whale	WNP "O" Stock	25,049	0.0033	NL
North Pacific right whale	WNP	922	< 0.00001	EN
Gray whale	WNP	121	< 0.0001	EN [5]
Sperm whale	NP	102,112	0.0012	EN
Pygmy sperm and Dwarf sperm whale	NP	350,553	0.0017	NL
Cuvier's beaked whale	NP	90,725	0.0003	NL
Blainville's beaked whale	NP	8,032	0.0005	NL
Ginkgo-toothed beaked whale	NP	22,799	0.0005	NL
False killer whale	IA-Pelagic	9,777	0.0011	NL
Pygmy killer whale	WNP	30,214	0.0001	NL
Melon-headed whale	WNP	36,770	0.0043	NL
Short-finned pilot whale	WNP	53,608	0.0016	NL
Risso's dolphin	WNP	83,289	0.0106	NL
Common dolphin	WNP	3,286,163	0.0461	NL
Fraser's dolphin	WNP	220,789	0.0040	NL
Bottlenose dolphin	IA	105,138	0.0146	NL
Pantropical spotted dolphin	WNP	219,032	0.0137	NL
Striped dolphin	WNP	570,038	0.0164	NL
Spinner dolphin	WNP	1,015,059	0.3140	NL
Rough-toothed dolphin	WNP	145,729	0.0040	NL

[1] IA = Inshore Archipelago; NP = north Pacific; WNP = western north Pacific.
[2] Refer to Table 5 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 5 of the Navy's application for literature references associated with density estimates presented in this table.
[4] ESA Status: EN = Endangered; T = Threatened; NL = Not Listed.
[5] Only the western Pacific population of gray whale is endangered under the ESA.

TABLE 10—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH THE OPERATIONAL AREA OFFSHORE JAPAN (25° TO 40° N)

Species	Stock name [1]	Abundance [2]	Density (animals/Km^2) [3]	ESA Status [4]
Blue whale	NP	9,250	0.0003	EN
Fin whale	NP	9,250	0.0001	EN
Sei whale	NP	37,000	0.0003	EN
Bryde's whale	WNP	20,501	0.0004	NL
Minke whale	WNP "O" Stock	25,049	0.0003	NL
Sperm whale	NP	102,112	0.0003	EN
Pygmy sperm and Dwarf sperm whale	NP	350,553	0.0049	NL
Baird's beaked whale	WNP	8,000	0.0001	NL
Cuvier's beaked whale	NP	90,725	0.0017	NL
Mesoplodon spp.	NP	22,799	0.0005	NL
False killer whale	WNP-Pelagic	16,668	0.0036	NL
Pygmy killer whale	WNP	30,214	0.0001	NL
Melon-headed whale	WNP	36,770	0.0012	NL
Short-finned pilot whale	WNP	53,608	0.0001	NL
Risso's dolphin	WNP	83,289	0.0010	NL
Common dolphin	WNP	3,286,163	0.0863	NL
Bottlenose dolphin	WNP	168,791	0.0005	NL
Pantropical spotted dolphin	WNP	438,064	0.0181	NL
Striped dolphin	WNP	570,038	0.0500	NL
Spinner dolphin	WNP	1,015,059	0.00001	NL
Pacific white-sided dolphin	WNP	67,769	0.0048	NL
Rough-toothed dolphin	WNP	145,729	0.0003	NL
Hawaiian monk seal (*Monachus schauinslandi*)	Hawaii	1,129	< 0.00001	EN

[1] NP = north Pacific; WNP = western north Pacific.
[2] Refer to Table 5 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 5 of the Navy's application for literature references associated with density estimates presented in this table.
[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 THE OPERATIONAL AREA OFFSHORE JAPAN (10° TO 25° N)

Species	Stock name [1]	Abundance [2]	Density (animals/ Km²) [3]	ESA Status [4]
Bryde's whale	WNP	20,501	0.0004	NL
Sperm whale	NP	102,112	0.0004	EN
Pygmy sperm and Dwarf sperm whale	NP	350,553	0.0009	NL
Cuvier's beaked whale	NP	90,725	0.0017	NL
False killer whale	WNP-Pelagic	16,668	0.0021	NL
Melon-headed whale	WNP	36,770	0.0012	NL
Short-finned pilot whale	WNP	53,608	0.0009	NL
Risso's dolphin	WNP	83,289	0.0026	NL
Common dolphin	WNP	3,286,163	0.0863	NL
Bottlenose dolphin	WNP	168,791	0.0007	NL
Pantropical spotted dolphin	WNP	438,064	0.0226	NL
Striped dolphin	WNP	570,038	0.0110	NL
Spinner dolphin	WNP	1,015,059	0.0031	NL
Rough-toothed dolphin	WNP	145,729	0.0003	NL

[1] NP = north Pacific; WNP = western north Pacific.
[2] Refer to Table 5 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 5 of the Navy's application for literature references associated with density estimates presented in this table.
[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 THE NORTHERN HAWAII OPERATIONAL AREA

Species	Stock name [1]	Abundance [2]	Density (animals/ Km²) [3]	ESA Status [4]
Blue whale	WNP	1,548	0.0002	EN
Fin whale	Hawaii	2,099	0.0007	EN
Bryde's whale	Hawaii	469	0.0002	NL
Minke whale	WNP	25,000	0.0002	NL
Humpback whale	Hawaii	10,103	< 0.0001	EN
Sperm whale	CNP	6,919	0.0028	EN
Pygmy sperm and Dwarf sperm whale	Hawaii	24,657	0.0101	NL
Cuvier's beaked whale	Hawaii	15,242	0.0062	NL
Blainville's beaked whale	Hawaii	2,872	0.0012	NL
Longman's beaked whale	Hawaii	1,007	0.0004	NL
Killer whale	Hawaii	349	0.0001	NL
False killer whale	Hawaii-Pelagic	484	0.0002	NL
Pygmy killer whale	Hawaii	956	0.0004	NL
Melon-headed whale	Hawaii	2,950	0.0012	NL
Short-finned pilot whale	Hawaii	8,870	0.0036	NL
Risso's dolphin	Hawaii	2,372	0.0010	NL
Fraser's dolphin	Hawaii	10,226	0.0042	NL
Bottlenose dolphin	Hawaii	3,215	0.0013	NL
Pantropical spotted dolphin	Hawaii	8,978	0.0037	NL
Striped dolphin	Hawaii	13,143	0.0054	NL
Spinner dolphin	Hawaii	3,351	0.0014	NL
Rough-toothed dolphin	Hawaii	8,709	0.0036	NL
Hawaiian monk seal	Hawaii	1,129	< 0.0001	EN

[1] CNP = central north Pacific; WNP = western north Pacific.
[2] Refer to Table 5 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 5 of the Navy's application for literature references associated with density estimates presented in this table.
[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 THE SOUTHERN HAWAII OPERATIONAL AREA

Species	Stock name [1]	Abundance [2]	Density (animals/ Km²) [3]	ESA Status [4]
Blue whale	WNP	1,548	0.0002	EN
Fin whale	Hawaii	2,099	0.0007	EN
Bryde's whale	Hawaii	469	0.0002	NL
Minke whale	Hawaii	25,000	0.0002	NL
Humpback whale	Hawaii	10,103	0.0008	EN
Sperm whale	CNP	6,919	0.0028	EN
Pygmy sperm and Dwarf sperm whale	Hawaii	24,657	0.0101	NL

TABLE 13—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH THE SOUTHERN HAWAII OPERATIONAL AREA—Continued

Species	Stock name [1]	Abundance [2]	Density (animals/Km²) [3]	ESA Status [4]
Cuvier's beaked whale	Hawaii	15,242	0.0062	NL
Blainville's beaked whale	Hawaii	2,872	0.0012	NL
Longman's beaked whale	Hawaii	1,007	0.0004	NL
Killer whale	Hawaii	349	0.0001	NL
False killer whale	Hawaii-Pelagic	484	0.0002	NL
Pygmy killer whale	Hawaii	956	0.0004	NL
Melon-headed whale	Hawaii	2,950	0.0012	NL
Short-finned pilot whale	Hawaii	8,870	0.0036	NL
Risso's dolphin	Hawaii	2,372	0.0010	NL
Fraser's dolphin	Hawaii	10,226	0.0042	NL
Bottlenose dolphin	Hawaii	3,215	0.0013	NL
Pantropical spotted dolphin	Hawaii	8,978	0.0037	NL
Striped dolphin	Hawaii	13,143	0.0054	NL
Spinner dolphin	Hawaii	3,351	0.0014	NL
Rough-toothed dolphin	Hawaii	8,709	0.0036	NL
Hawaiian monk seal	Hawaii	1,129	<0.0001	EN

[1] CNP = central north Pacific; WNP = western north Pacific.
[2] Refer to Table 5 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 5 of the Navy's application for literature references associated with density estimates presented in this table.
[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 THE OPERATIONAL AREA OFFSHORE SOUTHERN CALIFORNIA (SOCAL OPAREA)

Species	Stock name [1]	Abundance [2]	Density (animals/Km²) [3]	ESA Status [4]
Blue whale	ENP	2,842	0.0014	EN
Fin whale	CA/OR/WA	2,099	0.0018	EN
Sei whale	ENP	98	0.0001	EN
Bryde's whale	ENP	13,000	0.00001	NL
Northern minke whale	CA/OR/WA	823	0.0007	NL
Humpback whale	CA/OR/WA	942	0.0008	EN
Gray whale	ENP	18,813	0.051	EN [5]
Sperm whale	CA/OR/WA	1,934	0.0017	EN
Pygmy sperm whale	CA/OR/WA	1,237	0.0011	NL
Stejneger's beaked whale	CA/OR/WA	1,177	0.0010	NL
Baird's beaked whale	CA/OR/WA	1,005	0.0009	NL
Cuvier's beaked whale	CA/OR/WA	4,342	0.0038	NL
Blainville's beaked whale	CA/OR/WA	1,177	0.0010	NL
Ginkgo-toothed beaked whale	CA/OR/WA	1,177	0.0010	NL
Hubbs beaked whale	CA/OR/WA	1,177	0.0010	NL
Longman's beaked whale	Hawaii	1,177	0.0010	NL
Perrin's beaked whale (*Mesoplodon perrini*)	CA/OR/WA	1,177	0.0010	NL
Pygmy beaked whale (*Mesoplodon peruvianus*)	CA/OR/WA	1,177	0.0010	NL
Killer whale (offshore)	ENP	810	0.0007	NL
Short-finned pilot whale	CA/OR/WA	350	0.0003	NL
Risso's dolphin	CA/OR/WA	11,910	0.0105	NL
Long-beaked common dolphin (*Delphinus capensis*)	CA/OR/WA	21,902	0.0192	NL
Short-beaked common dolphin (*Delphinus delphis*)	CA/OR/WA	352,069	0.3094	NL
Bottlenose dolphin (offshore)	CA/OR/WA	2,026	0.0018	NL
Striped dolphin	CA/OR/WA	18,976	0.0167	NL
Pacific white-sided dolphin	CA/OR/WA	23,817	0.0209	NL
Northern right whale dolphin (*Lissodelphis borealis*)	CA/OR/WA	11,097	0.0098	NL
Dall's porpoise	CA/OR/WA	85,955	0.0753	NL
Guadalupe fur seal (*Arctocephalus townsendi*)	Mexico	7,408	0.007	NL
Northern fur seal (*Callorhinus ursinus*)	SMI	9,424	0	NL
California sea lion (*Zalophus californianus*)	California	238,000	0.54	NL
California sea lion	California	238,000	0	NL
Harbor seal (*Phoca vitulina*)	California	34,233	0.0095	NL
Northern elephant seal (*Mirounga angustirostris*)	CA-Breeding	124,000	0.0045	NL
Northern elephant seal	CA-Breeding	124,000	0	NL

[1] CA/OR/WA = California, Oregon, and Washington; ENP = eastern north Pacific; SMI = San Miguel Island.
[2] Refer to Table 5 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 5 of the Navy's application for literature references associated with density estimates presented in this table.
[4] ESA Status: EN = Endangered; T = Threatened; NL = Not Listed.
[5] Only the western Pacific population of gray whale is endangered under the ESA.

TABLE 15—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH THE NORTHWESTERN ATLANTIC OPERATIONAL AREA OFF FLORIDA (JAX OPAREA)

Species	Stock name [1]	Abundance [2]	Density (animals/Km^2) [3]	ESA Status [4]
Humpback whale	WNA	11,570	0.0006	EN
North Atlantic right whale (on shelf)	WNA	438	0.0012	EN
Sperm whale (on shelf)	WNA	4,804	0	EN
Sperm whale (off shelf)	WNA	4,804	0.0005	EN
Pygmy sperm and Dwarf sperm whale	WNA	580	0.0010	NL
Beaked whales (on shelf)	WNA	3,513	0	NL
Beaked whales (off shelf)	WNA	3,513	0.0006	NL
Cuvier's beaked whale	WNA	3,513	0.0006	NL
Blainville's beaked whale	WNA	3,513	0.0006	NL
Gervais' beaked whale (*Mesoplodon europaeus*)	WNA	3,513	0.0006	NL
Sowerby's beaked whale (*Mesoplodon bidens*)	WNA	3,513	0.0006	NL
True's beaked whale (*Mesoplodon mirus*)	WNA	3,513	0.0006	NL
Short-finned pilot whale (on shelf)	WNA	31,139	0.00004	NL
Short-finned pilot whale (off shelf)	WNA	31,139	0.0271	NL
Risso's dolphin (on shelf)	WNA	20,479	0.0009	NL
Risso's dolphin (off shelf)	WNA	20,479	0.0181	NL
Common dolphin	WNA	120,743	0.00002	NL
Bottlenose dolphin (on shelf)	WNA	81,588	0.2132	NL
Bottlenose dolphin (off shelf)	WNA	81,588	0.1163	NL
Pantropical spotted dolphin	WNA	12,747	0.0223	NL
Striped dolphin	WNA	94,462	0.00003	NL
Atlantic spotted dolphin (on shelf) (*Stenella frontalis*)	WNA	50,978	0.4435	NL
Atlantic spotted dolphin (off shelf)	WNA	50,978	0.0041	NL
Clymene dolphin (*Stenella clymene*)	WNA	6,086	0.0106	NL
Rough-toothed dolphin	WNA	274	0.0005	NL

[1] WNA = western north Atlantic.
[2] Refer to Table 5 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 5 of the Navy's application for literature references associated with density estimates presented in this table.
[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 THE OPERATIONAL AREA IN THE NORTHEASTERN ATLANTIC OFF THE UNITED KINGDOM.

Species	Stock name [1]	Abundance [2]	Density (animals/Km^2) [3]	ESA Status [4]
Blue whale	ENA	100	0.00001	EN
Fin whale	ENA	10,369	0.0031	EN
Sei whale	ENA	14,152	0.0113	EN
Northern minke whale	ENA	107,205	0.0068	NL
Humpback whale	ENA	4,695	0.0019	EN
Sperm whale	ENA	6,375	0.0049	EN
Pygmy sperm and Dwarf sperm whale	ENA	580	0.0001	NL
Cuvier's beaked whale	ENA	3,513	0.0013	NL
Blainville's beaked whale	ENA	3,513	0.0013	NL
Sowerby's beaked whale	ENA	3,513	0.0013	NL
Northern bottlenose whale (*Hyperodon ampullatus*)	ENA	5,827	0.0003	NL
Killer whale	ENA	6,618	0.0001	NL
False killer whale	ENA	484	0.0001	NL
Long-finned pilot whale (*Globicephala melas*)	ENA	778,000	0.0121	NL
Risso's dolphin	ENA	20,479	0.0063	NL
Common dolphin	ENA	273,150	0.238	NL
Bottlenose dolphin	ENA	81,588	0.0094	NL
Striped dolphin	ENA	94,462	0.0765	NL
Atlantic white-sided dolphin (*Lagenorhynchus acutus*)	ENA	11,760	0.0027	NL
White-beaked dolphin (*Lagenorhynchus albirostris*)	ENA	11,760	0.0027	NL
Harbor porpoise (*Phocoena phocoena*)	ENA	341,366	0.2299	NL
Harbor seal (*Phoca vitulina*)	Ireland/Scotland	23,500	0.0230	NL
Gray seal (*Halichoerus grypus*)	ENA	113,300	0.027	NL

[1] ENA = eastern north Atlantic.
[2] Refer to Table 5 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 5 of the Navy's application for literature references associated with density estimates presented in this table.
[4] ESA Status: EN = Endangered; T = Threatened; NL = Not Listed.

TABLE 17—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH THE OPERATIONAL AREA IN THE WESTERN MEDITERRANEAN SEA AND THE LIGURIAN SEA

Species	Stock name [1]	Abundance [2]	Density (Animals/ Km²) [3]	ESA Status [4]
Fin whale	MED	3,583	0.004	EN
Sperm whale	WMED	6,375	0.0049	EN
Cuvier's beaked whale	ENA	3,513	0.0013	NL
Long-finned pilot whale	ENA	778,000	0.0121	NL
Risso's dolphin	WMED	5,320	0.0075	NL
Common dolphin	WMED	19,428	0.0144	NL
Bottlenose dolphin	WMED	23,304	0.041	NL
Striped dolphin	WMED	117,880	0.24	NL

[1] ENA = eastern north Atlantic; MED = Mediterranean; WMED = western Mediterranean.
[2] Refer to Table 5 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 5 of the Navy's application for literature references associated with density estimates presented in this table.
[4] ESA Status: EN = Endangered; T = Threatened; NL = Not Listed.

TABLE 18—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH THE OPERATIONAL AREA IN THE NORTHERN ARABIAN SEA

Species	Stock name [1]	Abundance [2]	Density (animals/ Km²) [3]	ESA Status [4]
Bryde's whale	IND	9,176	0.0001	NL
Humpback whale	XAR	200	0.0004	EN
Sperm whale	IND	24,446	0.0125	EN
Dwarf sperm whale	IND	10,541	0.0145	NL
Cuvier's beaked whale	IND	27,272	0.0001	NL
Blainville's beaked whale	IND	16,867	0.0016	NL
Ginkgo-toothed beaked whale	IND	16,867	0.0016	NL
Longman's beaked whale	IND	16,867	0.0016	NL
False killer whale (pelagic)	IND	144,188	0.0003	NL
Pygmy killer whale	IND	22,029	0.0026	NL
Melon-headed whale	IND	64,600	0.0661	NL
Short-finned pilot whale	IND	268,751	0.0034	NL
Risso's dolphin	IND	452,125	0.0125	NL
Common dolphin	IND	1,819,882	0.0265	NL
Bottlenose dolphin	IND	785,585	0.0164	NL
Pantropical spotted dolphin	IND	736,575	0.0127	NL
Striped dolphin	IND	674,578	0.0706	NL
Spinner dolphin	IND	634,108	0.01	NL
Rough-toothed dolphin	IND	156,690	0.0081	NL

[1] IND = Indian Ocean; XAR = Stock X Arabian Sea.
[2] Refer to Table 5 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 5 of the Navy's application for literature references associated with density estimates presented in this table.
[4] ESA Status: EN = Endangered; T = Threatened; NL = Not Listed.

TABLE 19—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH THE OPERATIONAL AREA IN THE ANDAMAN SEA OFF MYANMAR

Species	Stock name [1]	Abundance [2]	Density (animals/ Km²) [3]	ESA Status [4]
Bryde's whale	IND	9,176	0.0001	NL
Sperm whale	IND	24,446	0.0125	EN
Dwarf sperm whale	IND	10,541	0.0145	NL
Cuvier's beaked whale	IND	27,272	0.0001	NL
Blainville's beaked whale	IND	16,867	0.0016	NL
Ginkgo-toothed beaked whale	IND	16,867	0.0016	NL
Longman's beaked whale	IND	16,867	0.0016	NL
Killer whale	IND	12,593	0.0001	NL
False killer whale (pelagic)	IND	144,188	0.0003	NL
Pygmy killer whale	IND	22,029	0.0026	NL
Melon-headed whale	IND	64,600	0.0661	NL
Short-finned pilot whale	IND	268,751	0.0034	NL
Risso's dolphin	IND	452,125	0.0125	NL
Common dolphin	IND	1,819,882	0.0265	NL
Bottlenose dolphin	IND	785,585	0.0164	NL
Pantropical spotted dolphin	IND	736,575	0.0127	NL
Striped dolphin	IND	674,578	0.0706	NL

TABLE 19—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH THE OPERATIONAL AREA IN THE ANDAMAN SEA OFF MYANMAR—Continued

Species	Stock name [1]	Abundance [2]	Density (animals/ Km^2) [3]	ESA Status [4]
Spinner dolphin	IND	634,108	0.01	NL
Rough-toothed dolphin	IND	156,690	0.0081	NL

[1] IND = Indian Ocean.
[2] Refer to Table 5 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 5 of the Navy's application for literature references associated with density estimates presented in this table.
[4] ESA Status: EN = Endangered; T = Threatened; NL = Not Listed.

TABLE 20—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH THE PANAMA CANAL OPERATIONAL AREA (WEST APPROACH)

Species	Stock name [1]	Abundance [2]	Density (animals/ Km^2) [3]	ESA Status [4]
Blue whale	ENP	2,842	0.0001	EN
Bryde's whale	ETP	13,000	0.0003	NL
Humpback whale	ENP	1,391	0.0004	EN
Sperm whale	ETP	22,700	0.0047	EN
Dwarf sperm whale	ETP	11,200	0.0145	NL
Cuvier's beaked whale	ETP	20,000	0.0025	NL
Blainville's beaked whale	ETP	25,300	0.0013	NL
Ginkgo-toothed beaked whale	ETP	25,300	0.0016	NL
Longman's beaked whale	ETP	25,300	0.0003	NL
Pygmy beaked whale (*Mesoplodon peruvianus*)	ETP	25,300	0.0016	NL
Killer whale	ETP	8,500	0.0002	NL
False killer whale (pelagic)	ETP	39,800	0.0004	NL
Pygmy killer whale	ETP	38,900	0.0014	NL
Melon-headed whale	ETP	45,400	0.0174	NL
Short-finned pilot whale	ETP	160,200	0.0058	NL
Risso's dolphin	ETP	110,457	0.0161	NL
Common dolphin	ETP	3,127,203	0.049	NL
Fraser's dolphin	ETP	289,300	0.001	NL
Bottlenose dolphin	ETP	335,834	0.0157	NL
Pantropical spotted dolphin	NEOP	640,000	0.0669	NL
Striped dolphin	ETP	964,362	0.1199	NL
Spinner dolphin	Eastern	450,000	0.007	NL
Rough-toothed dolphin	ETP	107,633	0.0146	NL

[1] ETP = eastern tropical Pacific; NEOP = northeastern offshore Pacific.
[2] Refer to Table 5 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 5 of the Navy's application for literature references associated with density estimates presented in this table.
[4] ESA Status: EN = Endangered; T = Threatened; NL = Not Listed.

TABLE 21—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH THE OPERATIONAL AREA OFF THE NORTHEASTERN AUSTRALIAN COAST

Species	Stock name [1]	Abundance [2]	Density (animals/ Km^2) [3]	ESA Status [4]
Blue whale	WSP	9,250	0.0002	EN
Fin whale	WSP	9,250	0.0002	EN
Bryde's whale	WSP	22,000	0.0006	NL
Northern minke whale	WSP	25,000	0.0044	EN
Humpback whale	GVEA	3,500	0.0143	EN
Sperm whale	WSP	102,112	0.0029	EN
Pygmy sperm and Dwarf sperm whale	WSP	350,553	0.0031	NL
Cuvier's beaked whale	WSP	90,725	0.0054	NL
Blainville's beaked whale	WSP	8,032	0.0005	NL
Arnoux's beaked whale (*Berardius arnuxii*)	WSP	22,799	0.0005	NL
Ginkgo-toothed beaked whale	WSP	22,799	0.0005	NL
Longman's beaked whale	WSP	22,799	0.0005	NL
Southern bottlenose whale (*Hyperodon planifrons*)	WSP	22,799	0.0005	NL
Killer whale	WSP	12,256	0.0004	NL
False killer whale (pelagic)	WSP	16,668	0.0029	NL
Pygmy killer whale	WSP	30,214	0.0021	NL
Melon-headed whale	WSP	36,770	0.0012	NL
Globicephala spp.	WSP	53,608	0.0153	NL
Risso's dolphin	WSP	83,289	0.0106	NL

TABLE 21—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH THE OPERATIONAL AREA OFF THE NORTHEASTERN AUSTRALIAN COAST—Continued

Species	Stock name [1]	Abundance [2]	Density (animals/Km²) [3]	ESA Status [4]
Common dolphin	WSP	3,286,163	0.0562	NL
Fraser's dolphin	WSP	220,789	0.004	NL
Bottlenose dolphin	WSP	168,791	0.0146	NL
Pantropical spotted dolphin	WSP	438,064	0.0137	NL
Striped dolphin	WSP	570,038	0.0329	NL
Spinner dolphin	WSP	1,015,059	0.0005	NL
Dusky dolphin (*Lagenorhynchus obscurus*)	WSP	12,626	0.0002	NL
Rough-toothed dolphin	WSP	145,729	0.0059	NL

[1] GVEA = group V east Australia; WSP = western south Pacific.
[2] Refer to Table 5 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 5 of the Navy's application for literature references associated with density estimates presented in this table.
[4] ESA Status: EN = Endangered; T = Threatened; NL = Not Listed.

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 operational areas in section 4 (pages 38–97) of the application, which is available online at *http://www.nmfs.noaa.gov/pr/permits/incidental.htm#applications*).

Although not repeated in this document, NMFS has reviewed these data, determined them to be the best available scientific information for the purposes of 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 *http://www.nmfs.noaa.gov/pr/sars/species.htm*. Also, NMFS refers the public to Table 5 (page 37) 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

Acoustic Source Specifications

Metrics Used in This Document

This section includes a brief explanation of the sound measurements frequently used in the discussions of acoustic effects in this document. Sound pressure is the sound force per unit area and is usually measured in micropascals (μPa), where 1 Pascal (Pa) is the pressure resulting from a force of one newton exerted over an area of one square meter. 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 at 1 m, and the units for SPLs are decibels (dB) re: 1 μPa at 1 m. SPL (in dB) = 20 log (pressure/reference pressure). SPL is an instantaneous measurement and can be expressed as the peak, the peak-peak (p-p), or the root mean square (rms). Root mean square, which is the square root of the arithmetic average of the squared instantaneous pressure values, is typically used in discussions of the effects of sounds on vertebrates and all references to SPL in this document refer to the root mean square unless otherwise noted. SPL does not take the duration of a sound into account.

SPL and the Single Ping Equivalent (SPE)

To model potential 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) in 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. 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 (also called animats) within the location, records the exposure history of each animat, and generates a single ping equivalent (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.

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 C of the Navy's 2011 DSEIS/SOEIS.

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

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

Figure 2 Equation for SPE as a function for SPL

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 is a wave of pressure variations propagating through a medium (for the sonar considered in this proposed rulemaking, the medium is seawater). Pressure variations are created by compressing and relaxing the medium. Sound measurements can be expressed in two forms: Intensity and pressure. Acoustic intensity is the average rate of energy transmitted through a unit area in a specified direction and is expressed in watts per square meter (W/m^2). Acoustic intensity is rarely measured directly, it is derived from ratios of pressures; the standard reference pressure for underwater sound is 1 μPa at 1 m (Richardson *et al.,* 1995).

Acousticians have adopted a logarithmic scale for sound intensities, which is denoted in dB. The logarithmic nature of the scale means that each 10 dB increase is a ten-fold increase in power (e.g., 20 dB is a 100-fold increase, 30 dB is a 1,000-fold increase). Humans perceive a 10-dB increase in noise as a doubling of sound level, or a 10-dB decrease in noise as a halving of sound level. Sound pressure level or SPL implies a decibel measure and a reference pressure that is used as the denominator of the ratio.

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. Natural sounds in the ocean span a huge 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) and ultrasonic (typically above 20,000 Hz) sounds, respectively. A single sound may be made up of many different frequencies together. 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 sonars are an example of a narrowband sound source.

Marine Mammal Hearing

Cetaceans have an auditory anatomy that follows the basic mammalian pattern, with some changes to adapt to the demands of hearing in the sea. The typical mammalian ear is divided into an outer ear, middle ear, and inner ear. The outer ear is separated from the inner ear by a tympanic membrane, or eardrum. In terrestrial mammals, the outer ear, eardrum, and middle ear transmit airborne sound to the inner ear, where the sound waves are propagated through the cochlear fluid. Since the impedance of water (i.e., the product of density and sound speed) is close to that of the tissues of a cetacean, the outer ear is not required to transduce sound energy as it does when sound waves travel from air to fluid (inner ear). Sound waves traveling through the inner ear cause the basilar membrane to vibrate. Specialized cells, called hair cells, respond to the vibration and produce nerve pulses that are transmitted to the central nervous system. Acoustic energy causes the basilar membrane in the cochlea to vibrate. Sensory cells at different positions along the basilar membrane are excited by different frequencies of sound (Pickles, 1998).

When considering the influence of various kinds of sound on the marine environment, it is necessary to understand that different kinds of marine life are sensitive to different frequencies of sound. Based on available behavioral data, audiograms derived using auditory evoked potential (AEP) techniques, anatomical modeling, and other data, Southall *et al.* (2007) designated ''functional hearing groups'' for marine mammals and estimated the lower and upper frequencies of functional hearing (i.e., the frequencies that the species can actually hear) of these groups. The functional groups and the associated frequencies are described here (though animals are less sensitive to sounds at the outer edge of their functional range and most sensitive to sounds of frequencies within a smaller range somewhere in the middle of their functional hearing range):

- Low frequency (LF) cetaceans (13 species of mysticetes): Southall *et al.* (2007) estimates that functional hearing occurs between approximately seven Hz and 22 kHz;
- Mid-frequency (MF) cetaceans (32 species of dolphins, six species of larger toothed whales, and 19 species of beaked and bottlenose whales): Southall *et al.* (2007) estimates that functional hearing occurs between approximately 150 Hz and 160 kHz;
- High frequency (HF) cetaceans (eight species of true porpoises, six species of river dolphins, *Kogia,* the franciscana, and four species of cephalorhynchids): Southall *et al.* (2007) estimates that functional hearing occurs between approximately 200 Hz and 180 kHz.
- Pinnipeds in Water: Southall *et al.* (2007) estimates that functional hearing occurs between approximately 75 Hz and 75 kHz, with the greatest sensitivity between approximately 700 Hz and 20 kHz.

Marine Mammal Functional Hearing Groups and LFA Sonar

Baleen (mysticete) whales (members of the LF functional hearing group) have inner ears that appear to be specialized for low-frequency hearing. Conversely, most odontocetes (i.e., sperm whales, 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). Based on an extensive suite of reported laboratory measurements (DoN, 2001, Ketten, 1997, Southall *et al.,* 2007), the LFA sound source is below the range of best hearing sensitivity for MF and HF odontocete and pinnipeds in water hearing specialists (Clark and Southall, 2009).

Marine Mammal Vocalization

Marine mammal vocalizations often extend both above (higher than 20 kHz) and below (lower than 20 Hz) the range of human hearing (National Research Council, 2003; Figure 4–1). Measured data on the hearing abilities of cetaceans are sparse, particularly for the larger cetaceans such as the baleen whales. 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. 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; 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 extremely lacking. 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 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).

Brief Background on the Navy's Assessment of the Potential Impacts on Marine Mammals

Acoustic Modeling Scenarios. The Navy based their analysis of potential impacts on marine mammals from SURTASS LFA sonar on literature review, the Navy's Low Frequency Sound Scientific Research Program (LFS SRP), and a comprehensive program of underwater acoustical modeling.

To assess the potential impacts on marine mammals by the SURTASS LFA sonar source operating at a given site, the Navy must predict the sound field that a given marine mammal species could be exposed to over time. 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 Integration Model (AIM) to estimate the total acoustic exposure for each animal in the modeled population; and (4) Converting the resultant cumulative exposures (within the post-AIM analysis) for a modeled population into an estimate of the risk of a significant disturbance of a biologically important behavior (i.e., a take estimate for Level B harassment of marine mammals based upon an estimated percentage of each stock affected by SURTASS LFA sonar operations) or an assessment of risk in terms of injury of marine mammals (i.e., a take estimate for Level A harassment of marine mammals based on a cumulative exposure of greater than or equal to 180-dB SPE). In the post-AIM analysis, as mentioned in number (4), the Navy developed a relationship for converting the resultant cumulative exposures for a modeled population into an estimate of the risk to the entire population of a significant disruption of a biologically important behavior and of injury. This process assessed risk in relation to received level (RL) and repeated exposure. The Navy's risk continuum is based on the assumption that the threshold of risk is variable and occurs over a range of conditions rather than at a single threshold. Taken together, the LFS SRP results, the acoustic propagation modeling, and the Navy's risk assessment model provide an estimate of takes of marine mammals.

The Navy modeled acoustic propagation using its standard acoustical performance prediction transmission loss model-PE version 3.4. The results of this model are the primary input to the AIM, which the Navy used to estimate marine mammal sound exposures. AIM integrates simulated movements (including dive patterns) of marine mammals, a schedule of SURTASS LFA sonar transmissions, and the predicted sound field for each transmission to estimate acoustic exposure during a hypothetical SURTASS LFA sonar operation. Description of the PE and AIM models, including AIM input parameters for animal movement, diving behavior, and marine mammal distribution, abundance, and density, are described in detail in the Navy's application and in the DSEIS/SOEIS (see Subchapter 4.4 and Appendix C) and are not discussed further in this document.

For this application for rulemaking, the Navy has used the same analytical methodology utilized in the first and second five-year rules and LOAs to provide reasonable and realistic estimates of the potential effects to marine mammals specific to the potential mission areas as presented in the application. Although this proposed rule uses the same analytical methodology the Navy used for the 2002–2007 rule, the Navy continuously updates the analysis with new marine mammal biological data (behavior, distribution, abundance and density) whenever new information becomes available.

The Navy initially developed 31 acoustic modeling scenarios for the major ocean regions in the SURTASS LFA sonar FOEIS/EIS (DoN, 2001); 11 acoustic modeling scenarios for the 2007 FSEIS and the 2007 rulemaking and LOAs; and eight additional sites for the 2011 DSEIS/SOEIS.

In the initial modeling effort for the 2001 FOEIS/EIS, the Navy selected locations to represent the greatest potential effects for each of the three major ocean acoustic regimes where SURTASS LFA sonar could potentially be used. These acoustic regimes were: (1) Deep-water convergence zone propagation, (2) near surface duct propagation, and (3) shallow water bottom interaction propagation. The Navy selected these sites to model the greatest potential for effects from the use of SURTASS LFA sonar incorporating the following factors: (1) closest plausible proximity to land (from a SURTASS LFA sonar operations standpoint), and/or OBIAs for marine mammals most likely to be affected; (2) acoustic propagation conditions that allow minimum propagation loss, or transmission loss (TL) (i.e., longest acoustic transmission ranges); and (3) time of year selected for maximum animal abundance. These 31 sites presented in the Navy's 2001 FOEIS/EIS represented the upper bound of impacts (in terms of both possible acoustic propagation conditions and marine mammal population and density) that could be expected from operation of the SURTASS LFA sonar system.

In the 2007 FSEIS, the Navy provided a risk assessment case study that included nine additional sites based on reasonable and realistic choices for potential SURTASS LFA sonar testing, training, and operations during the proposed period of the rulemaking and LOA application. Subsequent to the publication of the 2007 FSEIS, the Navy added two additional sites in the waters north and south of the Hawaiian Islands. The most recent risk assessment analyses provided in the Navy's application and 2011 DSEIS/SOEIS proves updated modeling for the 11 sites under the 2007 rulemaking and eight additional sites using the most up-to-date marine mammal abundance, density, and behavioral information available. These 19 operating sites are in areas of potential strategic importance and/or areas of possible naval fleet exercises.

Overall, the Navy's total effort for underwater acoustic modeling includes all 50 potential operational sites for SURTASS LFA sonar. The analysis of the 50 potential sites provides the foundation for the analysis of potential effects of SURTASS LFA sonar operations on the overall marine environment.

If the Navy conducts SURTASS LFA sonar operations in an area that was not acoustically modeled in the 2001 FOEIS/EIS (DoN, 2001), the 2007 FSEIS (DoN, 2007) or the 2011 DSEIS/SOEIS (DoN, 2011), the Navy states that the potential effects would most likely be less than those analyzed for the most similar site in the analyses because the modeled sites represent the upper bound of effects. NMFS concurs with this approach, as any site not modeled in the Navy's analyses should fall within or under the modeled bounds of impacts of possible acoustic propagation conditions and marine mammal densities. The assumptions of the 2001 FOEIS/EIS (DoN, 2001) and the 2007 FSEIS (DoN, 2007) are still valid and there are no new data to contradict the conclusions made in the Navy's documents.

Risk Analysis. To determine the potential impacts that exposure to LF sound from SURTASS LFA sonar operations could have on marine mammals, the Navy defined biological risk standards with associated measurement parameters. The Navy's measurement parameters for determining exposure were RLs in dB, the pulse repetition interval (time between pings), and the number of pings received. To address the potential for accumulation of effects on marine mammals over a seven to 20-day period (i.e., the estimated maximum SURTASS LFA sonar mission period, allowing for varying RLs and a duty cycle of 20 percent or less), the Navy developed a function that translates the modeled history of repeated exposures (as calculated in the AIM) into an equivalent RL for a single exposure with a comparable risk (as previously discussed in the SPL and the Single Ping Equivalent (SPE) section). Based upon the best available information, NMFS believes that the Navy's assumptions are still valid and there are no new data to contradict the conclusions made by the Navy's risk analysis. NMFS refers the reader to Section 6.4.3 of the Navy's application and Appendix C of the 2011 DSEIS/SOEIS for more detailed information on the Navy's risk assessment approach.

Potential Effects of the Specified Activity on Marine Mammals

The Navy has requested authorization for the incidental take of marine mammals that may result from upcoming training, testing, and military operations using SURTASS LFA sonar on a maximum of four U.S. Naval ships in certain areas of the Pacific, Atlantic, and Indian Oceans and the Mediterranean Sea. 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 operations, and, in consultation with NMFS as a cooperating agency for the SURTASS LFA sonar 2011 DSEIS/SOEIS, has determined that take of marine mammals incidental to this non-acoustic component of the Navy's operations is unlikely and, therefore, 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.

For the purpose of MMPA authorizations, NMFS' effects assessments serve four primary purposes: (1) Identification of the permissible methods of taking, meaning: The nature of the take (e.g., resulting from anthropogenic noise versus from ship strike, etc.); the regulatory level of take (i.e., mortality versus Level A or Level B harassment) and the estimated amount of take; (2) Informing the prescription of means of effecting the least practicable adverse impact on such species or stock and its habitat (i.e., mitigation); (3) Supporting the determination of whether the specified activity will have a negligible impact on the affected species or stocks of marine mammals (based on the likelihood that the activity will adversely affect the species or stock through effects on annual rates of recruitment or survival); and (4) Determining whether the specified activity will have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses.

NMFS' analysis of potential impacts from SURTASS LFA operations including lethal responses, physical trauma, sensory impairment (permanent and temporary threshold shifts and acoustic masking), physiological responses (particularly stress responses), and behavioral disturbance is outlined below this section. NMFS will focus qualitatively on the different ways that SURTASS LFA sonar operations may affect marine mammals (some of which may not classify as take). Then, in the Estimated Take of Marine Mammals Section, NMFS will relate the potential effects to marine mammals from SURTASS LFA sonar operations to the MMPA definitions of take, including Level A and Level B Harassment, and attempt to quantify those effects.

The potential effects to marine mammals described in the following sections do not take into consideration the proposed monitoring and mitigation measures described later in this document (see the Proposed Mitigation section which, as noted, are designed to effect the least practicable adverse impact on affected marine mammals species and stocks.

Potential Effects of Exposure to SURTASS LFA Sonar Operations

Based on the literature, the potential effects of sound from the proposed activities associated with SURTASS LFA sonar might include one or more of the following: Behavioral changes, masking, non-auditory injury, and noise-induced loss of hearing sensitivity (more commonly called ''threshold shift''). Separately, an animal's behavioral reaction to an acoustic exposure might lead to physiological effects that might ultimately lead to injury or death. NMFS discusses this potential effect later in the Stranding section.

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 variable 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;

(4) Upon repeated exposure, a marine mammal may exhibit diminishing responsiveness (habituation), or disturbance effects may persist; the latter is most 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;

(5) Any anthropogenic (human-made) noise that is strong enough to be heard has the potential to reduce (mask) the ability of a marine mammal to hear natural sounds at similar frequencies, including calls from conspecifics (i.e., an organism of the same species), 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 risk of permanent hearing impairment. In addition, intense acoustic or explosive events (not relevant for this proposed activity) 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

Threshold Shift (Noise-Induced Loss of Hearing)

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 temporary threshold shift (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 TSs: 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 (at least in terrestrial mammals), displacement of certain inner ear membranes, increased blood flow, and post-stimulatory reduction in both efferent and sensory neural output (Southall *et al.,* 2007). As amplitude and duration of sound exposure increase, so, generally, does the amount of TS, along with the recovery time. Human non-impulsive noise exposure guidelines are based on the assumption that exposures of equal energy (the same Sound Exposure Level (SEL)) producing equal amounts of hearing impairment regardless of how the sound energy is distributed in time (NIOSH, 1998). Until recently, previous marine mammal TTS studies have also generally supported this equal energy relationship (Southall *et al.,* 2007). The amplitude, duration, frequency, temporal pattern, and energy distribution of sound exposure all affect the amount of associated TS and the frequency range in which it occurs. Three studies, two by Mooney *et al.* (2009a, 2009b) on a single bottlenose dolphin either exposed to playbacks of Navy MF active sonar or octave-band noise (4–8 kHz) and one by Kastak *et al.* (2007) on a single California sea lion exposed to airborne octave-band noise (centered at 2.5 kHz), concluded that for all noise exposure situations the equal energy relationship may not be the best indicator to predict TTS onset levels. All three of 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. For intermittent sounds, less TS will occur 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) (although in the case of SURTASS LFA, animals are not expected to be exposed to levels high enough or durations long enough to result in PTS).

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. For cetaceans, published data on the onset of TTS are limited to the captive bottlenose dolphin, beluga, harbor porpoise, and Yangtze finless porpoise (Finneran *et al.,* 2000, 2002b, 2005a, 2007, 2010a, 2010b; Schlundt *et al.,* 2000; Nachtigall *et al.,* 2003, 2004; Mooney *et al.,* 2009a, 2009b; Lucke *et al.,* 2009; Finneran and Schlundt, 2010; Popov *et al.,* 2011). For pinnipeds in water, data are limited to Kastak *et al.*'s (1999, 2005) measurement of TTS in one captive harbor seal, one captive elephant seal, and one captive California sea lion (Finneran *et al.,* 2003 tried to induce TTS in two California sea lions but could not).

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). For example, 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 levels and durations 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.

Also, depending on the degree and frequency range, the effects of PTS on an animal could range in severity, although it 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 cost. There is no empirical evidence that exposure to SURTASS LFA sonar can cause PTS in any marine mammals; instead the possibility of PTS has been inferred from studies of TTS on captive marine mammals (see Richardson *et al.,* 1995).

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), although recent preliminary empirical data suggests that there is no increase in blood nitrogen levels or formation of bubbles in diving bottlenose dolphins (Houser, 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 of a problematic size.

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). 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). More recent 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. To date, energy levels predicted to cause in vivo bubble formations within diving cetaceans have not been evaluated (NOAA, 2002b). Although it has been argued that traumas from some recent 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) 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/HF active sonar exposures.

In 2009, Hooker *et al.* (2009) 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, and resulted in higher predicted tissue and blood N2 levels (Hooker *et al.,* 2009) and suggested that the prevalence of Cuvier's beaked whales stranding 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).

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). Because SURTASS LFA sonar transmissions are lower in frequency (less than 500 Hz) and dissimilar in characteristics from those of marine mammal predators, or MF active sonars the SURTASS LFA sonar transmissions are not expected to cause gas bubble formation or beaked whale strandings. Further investigation is needed to further assess the potential validity of these hypotheses.

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 sounds in the environment are louder than, and of a similar frequency as, auditory signals an animal is trying to receive. Masking is a phenomenon that affects animals that are 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 disturb the behavior of individual animals, groups of animals, or 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 is most likely to affect some species' ability to detect communication calls and natural sounds (i.e., surf noise, prey noise, etc.) (Richardson *et al.,* 1995).

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, 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.

As mentioned previously, the functional hearing ranges of mysticetes overlap with the frequencies of the SURTASS LFA sonar sources used in the Navy's training and testing, as well as during military operations. The closer the characteristics of the masking signal to the signal of interest, the more likely masking is to occur. 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 LFA sonar operational parameters (2003 to 2012), is nominally 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. The Navy provided an analysis of marine mammal hearing and masking in Subchapter 4.6.1.2 of the 2007 FSEIS and 4.2.5 in the 2011 DSEIS/SOEIS. 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 would 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 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 animals that vocalize have evolved with an ability to make adjustments to 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 which 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 impair 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 remain unknown, like most other trade-offs animals must make, some of these strategies probably come at a cost (Patricelli *et al.,* 2006). For example, 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). Shifting songs and calls to higher frequencies may also impose energetic costs (Lambrechts, 1996).

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 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.

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, 1995), altered metabolism (Elasser *et al.,* 2000), reduced immune competence (Blecha, 2000), and behavioral disturbance. 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 that experience the diversion. For example, when mounting a stress response diverts energy away from growth in young animals, those animals may experience stunted growth. When mounting 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'' (sensu Seyle, 1950) or ''allostatic loading'' (sensu 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; Reneerkens *et al.,* 2002; 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. Despite the dearth of information on stress responses for marine mammals exposed to anthropogenic sounds, studies of other marine animals 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) on marine mammals remains limited, it seems reasonable to assume that reducing an animal's ability to gather information about its environment and to communicate with other members of its species would be stressful for animals that use hearing as their primary sensory mechanism. Therefore, we assume that acoustic exposures sufficient to trigger onset PTS or TTS would be accompanied by physiological stress responses because terrestrial animals exhibit those responses under similar conditions (NRC, 2003). More importantly, marine mammals might experience stress responses at received levels lower than those necessary to trigger onset 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 to TTS.

Behavioral Disturbance

Behavioral responses to sound are highly variable and context-specific. Many different variables can influence an animal's perception of and response to (in both nature and magnitude) 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 pre-disposed 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). 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.

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). A more recent review (Nowacek *et al.,* 2007) addresses studies conducted since 1995 and focuses on observations where the received sound level of the exposed marine mammal(s) was known or could be estimated. 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. Estimates of 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.

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, a reaction, they noted, that 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 Acoustic Thermometry of Ocean Climate (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). They did, however, 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.

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. A determination of whether foraging disruptions incur fitness consequences will require information on or 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.

Brownell (2004) reported the behavioral responses of western gray whales off the northeast coast of Sakhalin Island to sounds produced by local seismic activities. In 1997, the gray whales responded to seismic activities by changing their swimming speed and orientation, respiration rates, and distribution in waters around the seismic surveys. In 2001, seismic activities were conducted in a known foraging ground and the whales left the area and moved farther south to the Sea of Okhotsk. They only returned to the foraging ground several days after the seismic activities stopped. The potential fitness consequences of displacing these whales, especially mother-calf pairs and ''skinny whales,'' outside of their normal feeding area are not known; however, because gray whales, like other large whales, must gain enough energy during the summer foraging season to last them the entire year, sounds or other stimuli that cause them to abandon a foraging area for several days could disrupt their energetics (i.e., the measurement of energy flow through an animal, from what goes into an animal as food (prey) to how the animal converts that energy for growth, reproduction, maintenance, and metabolism) and force them to make trade-offs like delaying their migration south, delaying reproduction, reducing growth, or migrating with reduced energy reserves.

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). Social disruptions must be considered, however, in context of the relationships that are affected. While some disruptions may not have deleterious effects, 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.

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, but 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) to investigate avoidance behavior of gray whales to low frequency sound signals. The objective was to determine whether 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 up to 200 dB. The Navy reported that the whales showed some avoidance responses when the source was moored one mile (1.8 km) offshore, in the migration path, but returned to their migration path when they were a few kilometers from the source. When the source was moored two miles (3.7 km) offshore, responses were much less, even when the source level was increased to 200 dB re: 1 μPa, to achieve the same RL for most whales in the middle of the migration corridor. Also, 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 signals at received levels similar to those that produced only minor but short-term behavioral responses in the baleen whales (i.e., LF hearing specialists) (Clark and Southall, 2009). 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 to 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 tailslaps 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 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 conducted by NMFS and other scientists showed one beaked whale (*Mesoplodon densirostris*) responding to an MF active sonar playback. The BRS–07 cruise report 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 BRS–07 cruise report notes that the results are from a single experiment and that a greater sample size is needed before robust and definitive conclusions can be drawn (NMFS, 2008a).

In the 2008 BRS study, researchers identified an emerging pattern of responses of deep-diving beaked whales to MF active sonar playbacks. For example, 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 expected TTS (approximately 160 dB re: 1μPa at 1 m). This sensitivity is manifest by an adaptive movement away from a sound source. This response was observed irrespective of whether the signal transmitted was within the band width 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 (NMFS, 2008b).

In the 2010 BRS study, researchers again used controlled exposure experiments (CEE) to carefully measure behavioral responses of individual animals to sound exposures of 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). However, 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). The results of this study 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 presences 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 for terrestrial species. For instance, the probability of flight responses in Dall's sheep *Ovis dalli dalli* (Frid, 2001a, 2001b), 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 broad-band 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).

Aicken *et al.,* (2005) monitored the behavioral responses of marine mammals to a new low-frequency active sonar system that was being developed for use by the British Navy. During those trials, fin whales, sperm whales, Sowerby's beaked whales, long-finned pilot whales (*Globicephala melas*), 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.

Behavioral Responses. 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 at 1 m range and an increasing likelihood of avoidance and other behavioral effects in the 120 to 160 dB re: 1 μPa at 1 m range. As mentioned earlier, though, contextual variables play a very important role in the reported responses, and the severity of effects are not 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 at 1 m, while in other cases these responses were not seen in the 120 to 150 dB re: 1 μPa at 1 m 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 1 m), at least for initial exposures. All recorded exposures above 140 dB re: 1 μPa at 1 m 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 the analysis. The limited data suggest that exposure to non-pulse sounds between 90 and 140 dB re: 1 μPa at 1 m generally do not result in strong behavioral responses of pinnipeds in water, but no data exist at higher received levels.

In addition to summarizing the available data, Southall *et al.* (2007) developed a behavioral response severity scaling system with the intent of ultimately being able to assign some level of biological significance to a response. Following is a summary of their scoring system (a comprehensive list of the behaviors associated with each score is in the report):

- 0–3 (Minor and/or brief behaviors) includes, but is not limited to: No response; minor changes in speed or locomotion (but with no avoidance); individual alert behavior; minor cessation in vocal behavior; minor changes in response to trained behaviors (in laboratory)
- 4–6 (Behaviors with higher potential to affect foraging, reproduction, or survival) includes, but is not limited to: Moderate changes in speed, direction, or dive profile; brief shift in group distribution; prolonged cessation or modification of vocal behavior (duration greater than the duration of sound); minor or moderate individual and/or group avoidance of sound; brief cessation of reproductive behavior; or refusal to initiate trained tasks (in laboratory)
- 7–9 (Behaviors considered likely to affect vital rates) includes, but is not limited to: Extensive or prolonged aggressive behavior; moderate, prolonged, or significant separation of females and dependent offspring with disruption of acoustic reunion mechanisms; long-term avoidance of an area; outright panic, stampede, stranding; threatening or attacking sound source (in laboratory).

In Table 22, NMFS has summarized the scores that Southall *et al.* (2007) assigned to the papers that reported behavioral responses of low-frequency cetaceans, mid-frequency cetaceans, and pinnipeds in water to non-pulse sounds. This table is included simply to summarize the findings of the studies and opportunistic observations (all of which were capable of estimating received level) that Southall *et al.* (2007) compiled in an effort to develop acoustic criteria.

Table 22 Summary of reported behavioral responses of low-frequency cetaceans, mid-frequency cetaceans, and pinnipeds in water to non-pulse sounds.

	Received RMS Sound Pressure Level (dB re: 1 μPa at 1 m)											
Response Score	80 to < 90	90 to < 100	100 to < 110	110 to < 120	120 to < 130	130 to < 140	140 to < 150	150 to < 160	160 to < 170	170 to < 180	180 to < 190	190 to < 200
9												
8		M	M		M		M				M	M
7						L	L					
6	H	L/H	L/H/P	L/M/H	L/M/H	L	L/H	H	M/H	M		
5			H	H	M							
4				L/M	L/M/P	P	L					
3		M	L/M	L/M	M/P	P						
2			L	L/M	L	L	L					
1			M	M	M							
0	L/H/P	L/H/P	L/M/H	L/M/H/P	L/M/H/P	L	M				M	M

Data compiled from three tables from Southall et al. (2007) indicating when marine mammals (low-frequency cetaceans = L, mid-frequency cetaceans = M, high frequency cetaceans = H, and pinnipeds = P) were reported as having a behavioral response of the indicated severity to a non-pulse sound of the indicated received level. As discussed in the text, responses are highly variable and context specific.

Potential Effects of Behavioral Disturbance

The different ways that marine mammals respond to sound are sometimes indicators of the ultimate effect that exposure to a given stimulus will have on the well-being (survival, reproduction, etc.) of an animal. 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; Giese, 1996; Mullner *et al.,* 2004; Waunters *et al.,* 1997), 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 from the changes in energetics of marine mammals because of the energy required to 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 (Hartman, 1979; Miksis-Olds, 2006).

Those 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 behavioral states 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 only engaged in resting behavior five percent of the time when vessels were within 300 m compared with 83 percent of the time when vessels were not present. 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, however, vigilance has a cost of time; 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, however, 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 less time resting or foraging, when aircraft made direct approaches over them (Frid, 2001; Stockwell *et al.,* 1991).

Several authors have established that long-term and intense disturbance stimuli can cause population declines 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, 1983). 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 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). An example of this concept with terrestrial species involved, a study of grizzly bears (*Ursus horribilis*) which 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 bottlenose dolphins exposed to sound over a five-day period 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 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 severe unless it could directly affect reproduction or survival (Southall *et al.,* 2007).

Stranding and Mortality

When a live or dead marine mammal swims or floats onto shore and becomes ''beached'' or incapable of returning to sea, the event is termed a ''stranding'' (Geraci *et al.,* 1999; Perrin and Geraci, 2002; Geraci and Lounsbury, 2005; NMFS, 2007). The legal 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 pre-dispose 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; DeVries *et al.,* 2003; Fair and Becker, 2000; Foley *et al.,* 2001; Moberg, 2000; Relyea, 2005a; 2005b, Romero, 2004; Sih *et al.,* 2004).

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) identified ten mass stranding events and concluded that, out of eight stranding events reported from the mid-1980s to the summer of 2003, seven had been coincident with the use of MF active sonar and most involved beaked whales.

Over the past 12 years, there have been five stranding events coincident with military MF active sonar use in which exposure to sonar is believed by NMFS and the Navy to have been a contributing factor to strandings: Greece (1996); the Bahamas (2000); Madeira (2000); Canary Islands (2002); and Spain (2006). NMFS refers the reader to 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 the Hanalei Bay, Kaua'i, Hawaii for over 28 hours. NMFS determined that the mid-frequency sonar 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 MF active sonar 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 exercises was conducted by the U. S. Navy.

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, the system acoustic characteristics differ between LF and MF sonars: 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.

As discussed previously, Cox *et al.* (2006) provided a summary of common features shared by the strandings events 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 do not relate to LFA sonar operations. First, the SURTASS LFA sonar vessel operates with a horizontal line array of 4,921ft (1,500 m) length at depths below 492 ft (150 m) and a vertical line array (LFA sonar source) at depths greater than 328 ft (100 m). Second, the Navy will not operate SURTASS LFA sonar within 22 km (13. mi; 11.8 nm) of any coastline. For these reasons, SURTASS LFA sonar cannot be operated in deep water that is close to land. 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 2000, and Canaries 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.

Concurrent Use of LF and MF Active Sonar

The environmental impacts of the SURTASS LFA sonar system, including the potential for synergistic and cumulative effects with MF active sonar operation, has been addressed in detail in the Navy's application and the SURTASS LFA sonar 2011 DSEIS/SOEIS. NMFS will not consider the authorization of take of marine mammals incidental to the operation of MF active sonar in this document because NMFS has already separately authorized the incidental take associated with these activities. NMFS has considered more specifically the manner in which LFA sonar and MFAS may interact in a multi-strike group exercise with respect to the potential to impact marine mammals in a manner not previously considered.

Tactical and technical considerations dictate that the LFA sonar ship would typically be tens of miles from the MF active sonar ship when using active sonar. It is unlikely, but remotely possible, that both LF and MF active sonar would be active at exactly the same time during a major exercise. Based on the differing operating characteristics of each sonar (pulse length, duty cycle, etc.), the percentage of overlap during concurrent MF and LF active sonar operations is approximately 0.017 percent. In the unlikely event that both systems were transmitting simultaneously, the likelihood of more than a relatively small number of individual marine mammals being physically present at a time, location, and depth to be able to receive both LF and MF active sonar signals at levels of concern at the same time is even smaller as the sound from both signals would have attenuated when they reached the marine mammal in question, so even a simultaneous exposure would not be at the full signal of either system. Additionally, only a few species have maximum sensitivity to both the low and middle frequencies.

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 Vessel Movement

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. In those cases where there is a busy shipping lane or where there is 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 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; Williams *et al.*, 2002; 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). 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: ''In summary, toothed whales sometimes show no avoidance reaction to vessels, or even approach them. However, avoidance can occur, especially in response to vessels of types used to chase or hunt the animals. This may cause temporary displacement, but we know of no clear evidence that toothed whales have abandoned significant parts of their range because of vessel traffic.''

Baleen whales: ''When baleen whales receive low-level sounds from distant or stationary vessels, the sounds often seem to be ignored. Some whales approach the sources of these sounds. When vessels approach whales slowly and non-aggressively, whales often exhibit slow and inconspicuous avoidance maneuvers. In response to strong or rapidly changing vessel noise, baleen whales often interrupt their normal behavior and swim rapidly away. 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, even in regions with low vessel traffic, generally have become less wary of boats and their noises, and they have appeared to be less easily disturbed than previously. In particular locations with intense shipping and repeated approaches by boats (such as the whale-watching areas of Stellwagen Bank), more and 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 MMPA harassment) to low-level distant shipping noise as the animals in the area are likely to be habituated to such noises (Nowacek *et al.*, 2004). In light of these facts, NMFS does not expect the Navy's vessel movements to result in Level B harassment.

Vessel Strike

Commercial and Navy ship strikes of cetaceans can cause major wounds, which may 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 in order to restore oxygen levels within their tissues after deep dives (e.g., the sperm whale). In addition, some 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). These species are primarily large, slow moving whales. Smaller marine mammals (e.g., bottlenose dolphin) move quickly through the water column and are often seen riding the bow wave of large ships. Marine mammal responses to vessels may include avoidance and changes in dive pattern (NRC, 2003).

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. The authors concluded that most deaths occurred when a vessel was traveling in excess of 14.9 mph (24.1 km/hr; 13 kts).

Jensen and Silber (2003) 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. The majority (79 percent) of these strikes occurred 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. Computer simulation modeling showed that hydrodynamic forces pulling whales toward the vessel hull increase with increasing speed (Clyne, 1999; Knowlton *et al.*, 1995).

The Jensen and Silber (2003) report notes that the database represents a minimum number of collisions, because the vast majority probably goes undetected or unreported. In contrast, Navy vessels are likely to detect any strike that does occur, and they are required to report all ship strikes involving marine mammals.

The Navy's proposed operation of up to four SURTASS LFA sonar vessels world-wide is relatively 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 operations 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 operations, each vessel's cruising speed would be 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). Second, the Navy would restrict the operation of SURTASS LFA vessels at a distance of 1 km (0.62 mi; 0.54 nmi) seaward of the outer perimeter of any OBIA designated for marine mammals during a specified period, further minimizing the potential for marine mammal interactions. Also, the Navy would not operate SURTASS

LFA vessels a distance of 22 km (13. mi; 11.8 nmi) or less of any coastline, including islands, thus operating in offshore coastal areas with lower densities of marine mammals would minimize adverse impacts.

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 T–AGOS ships have their bridges 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 operations scan the ocean for marine mammals and must report visual alerts of marine mammal presence to the Deck Officer; Navy 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 3–4 kts (approximately 3.4 mph; 5.6 km/hr) with deployed arrays. For a thorough discussion of mitigation measures, please see the Mitigation section later in this document.

Anticipated Effects on Marine Mammal Habitat

The Navy's proposed routine testing and training, as well as military operations using SURTASS LFA sonar, 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.

Based on the following information and the supporting information included in the Navy's application, the 2001 FOEIS/EIS, the 2007 FSEIS, and the 2011 DSEIS/SOEIS, NMFS has preliminarily determined that SURTASS LFA sonar operations will not have significant or long-term impacts on marine mammal habitat. 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 the physical alteration of the habitat. Marine mammals may be temporarily displaced from areas where SURTASS LFA operations are occurring, but the area will likely be utilized again after the activities have ceased. A summary of the conclusions are included in subsequent sections.

Compliance With Maritime Law

Use of SURTASS LFA sonar entails the periodic deployment of acoustic transducers and receivers into the water column from ocean-going ships. The Navy deploys SURTASS LFA sonar from ocean surveillance ships that are U.S. Coast Guard-certified for operations and operate in accordance with all applicable federal, international, and U.S. Navy rules and regulations related to environmental compliance, especially for discharge of potentially hazardous materials. SURTASS LFA sonar ships comply with all requirements of the Clean Water Act of 1972 (CWA; 33 U.S.C. section 1251 *et seq.*) and Act to Prevent Pollution from Ships (APPS; 33 U.S.C. subsections 1905–1915). SURTASS LFA vessel movements are not unusual or extraordinary and are part of routine operations of seagoing vessels. Therefore, no discharges of pollutants regulated under the APPS or CWA will result from the operation of the sonar systems nor will any unregulated environmental impacts from the operation of the SURTASS LFA sonar vessels occur.

Geographic Restrictions

The Navy has proposed that the sound field does not exceed 180 dB re: 1 μPa at 1 m (i.e., a mitigation zone) within 22 km (13. mi; 11.8 nmi) of any coastline, including islands, or within proposed OBIAs during biologically important seasons, during the conduct of SURTASS LFA operations.

Critical Habitat

Of the designated critical habitat for marine mammals, four areas are at a distance sufficient from shore to potentially be affected by SURTASS LFA sonar. They are the critical habitat for the north Atlantic right whale (NARW), north Pacific right whale (NPRW), Hawaiian monk seal, and Steller sea lion. The Navy proposes that the sound field would not exceed 180 dB re: 1 μPa at 1 m in the areas designated as critical habitat for the north Atlantic right whale, north Pacific right whale, and the Hawaiian monk seal.

For NARW critical habitat, the Navy has proposed an OBIA that encompasses the critical habitats of the North Atlantic right whale in Georges Bank (OBIA #1); Roseway Basin right whale Conservation Area (OBIA #2); in portions of the Gulf of Maine including Stellwagen Bank National Marine Sanctuary, that are located outside of 22 km (13. mi; 11.8 nmi) (OBIA #3); and the southeastern U.S. Right whale Seasonal critical habitat (OBIA #4). In 2008, NMFS designated two areas of critical habitat for the NPRW, one in the Bering Sea where the Navy proposes to not conduct SURTASS LFA sonar operations. For the other designated area for critical habitat in the Gulf of Alaska, the Navy has proposed an OBIA (#5) that bounds the designated critical habitat for the species.

Much of the proposed critical habitat for Hawaiian monk seals is within 22 km (13. mi; 11.8 nmi) of any shoreline and there is no proposed OBIA that encompasses the entirety of Hawaiian monk seal critical habitat. However, the Navy has proposed an OBIA (#16) that encompasses the Penguin Bank portion of the Hawaiian Islands Humpback Whale National Marine Sanctuary.

There is no proposed OBIA that encompasses designated critical habitat for Steller sea lions. Much of the critical habitat for the Steller sea lion is located in the Bering Sea, where SURTASS LFA sonar will not operate. Although it is possible that the sonar will be operated in the western Gulf of Alaska where the eastern critical habitat for the Steller sea lion is located and some of that habitat lies outside of 22 km (13. mi; 11.8 nmi) from shore, the water depth in which the habitat is found is sufficiently shallow that it is unlikely that the Navy would operate sonar in the vicinity of that critical habitat.

Both the Navy and NMFS will consult with NMFS on effects on critical habitat pursuant to section 7 of the ESA.

Marine Protected Areas (MPA)

Within the National System of MPAs, seven formally recognized areas are in potential SURTASS LFA sonar operating areas because a portion of the area or its seaward boundary is located beyond 22 km (13. mi; 11.8 nmi) from the coastline. These MPAs are: Stellwagen Bank National Marine Sanctuary (NMS); Olympic Coast NMS; Gulf of the Farallones NMS; Monterey Bay NMS; Cordell Bank NMS; Hawaiian Islands Humpback Whale NMS; and Papahanaumokuakea Marine National Monument. The Navy has proposed not to operate SURTASS LFA sonar in specified areas of National Marine Sanctuaries during biologically important seasons (see OBIA section discussed later in this document).

The proposed SURTASS LFA operations are not anticipated to have any permanent impact on habitats used by the marine mammals in the proposed operational areas, including the food sources they use (i.e., fish and invertebrates). Additionally, no physical damage to any habitat is anticipated as a result of conducting the proposed SURTASS LFA operations. While it is anticipated that the specified activity may result in marine mammals avoiding certain areas due to temporary ensonification, this impact to habitat is temporary and reversible and was considered in further detail earlier in this document, as behavioral modification. The main impact associated with the proposed activity will be temporarily elevated noise levels and the associated direct effects on marine mammals, previously discussed in this notice.

Anticipated Impacts on Fish

The Navy's 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.,* 2005a, 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.

Anticipated Impacts on Invertebrates

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*) (Herberholtz 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, suggesting that cephalopods are particularly sensitive to low-frequency sound. However, the Navy notes in the DSEIS/SOEIS (Chapter 3–6) that the authors failed to elaborate that there were no anthropogenic sources to which animals might be exposed with characteristics similar to those used in their study. 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. Therefore, the study's sound exposures were longer in duration and higher in energy than any exposure a marine mammal would likely ever receive and acoustically very different than a free field sound to which animals would be exposed in the real world. Given the lack of data on hearing thresholds of cephalopods, SURTASS LFA sonar operations could only have a lasting impact on these animals if they are within a few tens of meters from the source. In conclusion, NMFS does not expect any short- or long-term effects to marine mammal food resources from SURTASS LFA sonar activities.

Proposed Mitigation

In order to issue an incidental take authorization (ITA) 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.'' The NDAA of 2004 amended section 101(a)(5)(A) of the MMPA 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.'' The training activities described in the SURTASS LFA sonar application are considered military readiness activities.

NMFS reviewed the proposed SURTASS LFA sonar activities and the proposed mitigation measures as described in the Navy's application to determine if they would result in the least practicable adverse effect on marine mammals, which includes a careful balancing of the likely benefit of any particular measure to the marine mammals with the likely effect of that measure on personnel safety, practicality of implementation, and impact on the effectiveness of the ''military readiness activity.''

To reduce the potential for impacts from acoustic stimuli associated with the Navy's SURTASS LFA sonar activities, the Navy has proposed to implement the following mitigation measures for marine mammals:

(1) LFA sonar mitigation zone—LF sources transmissions are suspended if the Navy detects marine mammals within the mitigation zones by any of the following detection methods:

(a) Visual monitoring;

(b) Passive acoustic monitoring;

(c) Active acoustic monitoring;

(2) Geographic restrictions in the following areas:

(a) Offshore Biologically Important Areas (OBIAs);

(b) Coastal Standoff Zone.

Additionally, as with the previous rulemaking, NMFS proposes to include additional operational restrictions for SURTASS LFA sonar operations:

(1) Additional 1-km buffer around the LFA sonar mitigation zone; and

(2) Additional 1-km buffer around an OBIA perimeter.

Both the Navy's proposed mitigation and NMFS' additional proposed mitigation are discussed below this section.

LFA Sonar Mitigation Zone

The Navy has proposed in its application to establish a 180-dB (RL) isopleth LFA sonar mitigation zone around the surveillance vessel. If a marine mammal approaches or enters the LFA sonar mitigation zone, the Navy would implement a suspension of SURTASS LFA sonar transmissions.

Prior to commencing and during SURTASS LFA transmissions, the Navy will determine 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). The 180-dB isopleth will define the LFA sonar mitigation zone for marine mammals around the surveillance vessel.

The Navy modeling of the sound field in near-real time conditions provides the information necessary to modify SURTASS LFA operations, including the delay or suspension of LFA transmissions. Acoustic model updates are nominally made every 12 hr, or more frequently when meteorological or oceanographic conditions change. If the sound field criteria were exceeded, the sonar operator would notify the Officer in Charge (OIC), who would order the delay or suspension of transmissions. If it were predicted that the SPLs would exceed the criteria within the next 12 hr period, the OIC would also be notified in order to take the necessary action to ensure that the sound field criteria would not be exceeded.

NMFS' Additional 1-km Buffer Zone Around the LFA Sonar Mitigation Zone

As an added measure, NMFS again proposes to require a ''buffer zone'' that extends an additional 1 km (0.62 mi; 0.54 nm) beyond the 180-dB isopleth LFA sonar mitigation zone. This buffer 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, the 180-dB isopleth for the LFA sonar mitigation zone, plus NMFS' 1-km (0.54 nm) buffer zone would comprise the entire mitigation zone for SURTASS LFA sonar operations, wherein suspension of transmissions would occur if a marine mammal approaches or enters either zone. The Navy notes in its application that this additional mitigation is practicable and it would adhere to this additional measure if required in the proposed rule.

In addition to establishing a 180-dB (RL) isopleth LFA sonar mitigation zone around the surveillance vessel the Navy has also proposed to 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 LF sound levels received by marine mammals located in the vicinity of known dive sites.

Visual Mitigation Monitoring

The use of shipboard lookouts is a critical component of all Navy mitigation measures. Navy shipboard lookouts are highly qualified and experienced observers of the marine environment. Their duties require that they report all objects sighted in the water to the Deck Officer (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. There are personnel serving as lookouts on station at all times (day and night) when a ship or surfaced submarine is moving through the water.

Visual monitoring consists of daytime observations by lookouts (personnel trained in detecting and identifying marine mammals) for marine mammals from the vessel. The objective of these observations is to maintain a bearing of marine mammals observed and to ensure that none approach the source close enough to enter the LFA mitigation zone or the 1-km buffer zone proposed by NMFS (see Additional Mitigation Measure Proposed by NMFS section).

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 would maintain a topside watch and marine mammal observation log during operations 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, as well as any unusual behavior, into the log. 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 LFA mitigation or buffer zone, the lookout will notify the OIC. The OIC shall then notify the HF/M3 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 LFA mitigation or buffer zones, the OIC shall order the delay or suspension of SURTASS LFA sonar transmissions when the animal enters the LFA mitigation or buffer zone to prevent Level A harassment. The lookout will enter his/her observations into the log. This would include tabular information that includes: Date/time; vessel name; LOA area; marine mammals affected (number and type); assessment basis (observed injury, behavioral response, or model calculation); LFA mitigation or buffer zone radius; bearing from vessel; whether operations were delayed, suspended or terminated; and a narrative.

If a lookout observes a marine mammal anywhere within the LFA mitigation or 1-km buffer zone (as proposed by NMFS), the lookout shall notify the OIC who will promptly order the immediate delay or suspension of SURTASS LFA sonar transmissions. The lookout will enter his/her observations into the log.

Marine mammal biologists, who are qualified in conducting at-sea marine mammal visual monitoring from surface vessels, shall train and qualify designated ship personnel to conduct at-sea visual monitoring. The Navy will hire one or more marine mammal biologists qualified in conducting at-sea marine mammal visual monitoring from surface vessels to train and qualify designated ship personnel to conduct at-sea visual monitoring.

Passive Acoustic Mitigation Monitoring

For the second of the three-part mitigation monitoring measures, the Navy proposes to conduct passive acoustic monitoring using the SURTASS towed horizontal line array to listen for vocalizing marine mammals as an indicator of their presence. This system serves to augment the visual and active sonar detection systems. 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 OIC who will immediately alert the HF/M3 active sonar operators and the lookouts. The OIC will order the delay or suspension of SURTASS LFA sonar transmissions when the animal enters the LFA mitigation or 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 the log.

Active Acoustic Mitigation Monitoring

HF active acoustic monitoring uses the HF/M3 sonar to detect, locate, and track marine mammals that could pass close enough to the SURTASS LFA sonar array to enter the LFA sonar mitigation or buffer zones. HF/M3 acoustic monitoring begins 30 min before the first SURTASS LFA sonar transmission of a given mission is scheduled to commence and continues until the Navy terminates the transmissions.

If the HF/M3 sonar operator detects a marine mammal contact outside the LFA sonar mitigation zone or buffer zones, 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 LFA sonar mitigation or buffer zones, he/she shall notify the OIC. The OIC then immediately orders the delay or suspension of transmissions when the animal is predicted to enter the LFA sonar mitigation or buffer zones.

If the HF/M3 sonar operator detects a marine mammal within the LFA mitigation or buffer zones, he/she shall notify the OIC who will immediately order the delay or suspension of 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, 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 (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 programs detect a marine mammal during ramp-up. Ramp-up may continue once marine mammals are no longer detected by any of the three monitoring programs.

Prior to any SURTASS LFA sonar calibrations or testing that are not part of regular SURTASS LFA sonar transmissions, 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. The Navy will not increase the HF/M3 source level if any of the three monitoring programs detect a marine mammal during ramp-up. Ramp-up may continue once marine mammals are no longer detected by any of the three monitoring programs.

In situations where the HF/M3 sonar system has been powered down for more than 2 min, 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.

Past Mitigation Monitoring Under the Previous Rules

For the first four LOA periods under the 2007 rule, the Navy has reported a total of eight visual sightings, four passive acoustic detections, and 29 HF/M3 active sonar detections (DoN, 2008; 2009a; 2010; 2011) leading to mitigation protocols of suspensions/delays of transmissions in a total of 70 missions.

During the 2002–2007 rule period, the Navy reported a total of four visual sightings, no passive acoustic detections, and 101 active HF/M3 active sonar detections leading to mitigation protocols of suspensions/delays of transmissions (DoN, 2007a; 2007b) in a total of 58 missions. However, these data sets involving marine species are too small to support any meaningful analyses, such as determining if there are any differences in detection during the time when LFA sonar is active versus when it is inactive.

Geographic Restrictions

As noted above, the Navy has proposed two types of geographic restrictions for SURTASS LFA operations in the LOA application: (1) establishing OBIAs for marine mammal protection and restricting SURTASS LFA sonar operations within these designated areas such that the SURTASS LFA sonar-generated sound field will not exceed 180 dB re: 1 μPa (RL); and (2) restricting SURTASS LFA sonar operations within 22 km (13. mi; 11.8 nmi) of any coastline, including islands.

Offshore Biologically Important Areas

As with the previous SURTASS LFA sonar rulemakings, the Navy's application again proposed establishing offshore biologically important areas OBIAs for marine mammal protection. In preparation for this rule making, NMFS developed a more systematic process for selecting, assessing, and designating OBIAs for SURTASS LFA sonar.

First, NMFS developed screening criteria to help initially select potential areas and then determine an area's eligibility for consideration as an OBIA nominee. These OBIA screening criteria included:

(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).

NMFS used the screening criteria to review 403 existing and potential marine protected areas based on the World Database on Protected Areas (WDPA) (IUCN and UNEP, 2009), Holt (2005), and prior SURTASS LFA sonar OBIAs to produce a preliminary list of 27 OBIA nominees.

NMFS next convened an expert review panel of biologists knowledgeable about potentially affected marine mammal biologically important areas. This panel consisted of subject matter experts (SME), each with expertise in geographic regions including the Atlantic Ocean, Pacific Ocean, Mediterranean Sea, Indian Ocean/Southeast Asia, and East Africa. The SMEs provided their individual analyses of NMFS' preliminary candidates as potential marine mammal OBIAs in waters where the Navy potentially could use the SURTASS LFA sonar systems and provided additional recommendations for other OBIAs. This resulted in a total number of 73 potential OBIAs. These areas were further screened for sufficient scientific support, resulting in 45 potential OBIAs.

Although not part of its initial screening criteria, 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. The LFA sound source is well below the range of best hearing sensitivity for most MF and HF odontocete hearing specialists. This means, for example, for harbor porpoises, that a sound with a frequency less than 1 kHz needs to be significantly louder (more than 40 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 believes that MF and HF odontocete hearing specialists have such reduced sensitivity to the LFA 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 and buffer zones. Consideration of this additional information resulted in a list of 22 final OBIA nominees for the Navy's consideration.

The 22 areas are: (1) Georges Bank, year round; (2) Roseway Basin Right Whale Conservation Area, June through December; (3) the Great South Channel, U.S. Gulf of Maine, and Stellwagen Bank NMS, January 1 to November 14; (4) the Southeastern U.S. Right Whale Seasonal Habitat, November 15 to January 15; (5) the North Pacific Right Whale Critical Habitat, March through August; (6) Silver Bank and Navidad Bank, December through April; (7) the coastal waters of Gabon, Congo and

Equatorial Guinea, June through October; (8) the Patagonian Shelf Break, year round; (9) Southern Right Whale Seasonal Habitat, May through December; (10) the central California National Marine Sanctuaries, June through November; (11) the Antarctic Convergence Zone, October through March; (12) Piltun and Chayvo offshore feeding grounds in the Sea of Okhotsk, June through November; (13) the coastal waters off Madagascar, July through September for humpback whale breeding and November through December for migrating blue whales; (14) Madagascar Plateau, Madagascar Ridge, and Walters Shoal, November through December; (15) the Ligurian-Corsican-Provencal Basin and Western Pelagos Sanctuary in the Mediterranean Sea, July to August; (16) Hawaiian Islands Humpback Whale NMS and Penguin Bank, November through April; (17) the Costa Rica Dome, year round; (18) the Great Barrier Reef Between 16° S and 21° S, May through September; (19) the Bonney Upwelling on the west coast of Australia, December through May; (20) the Northern Bay of Bengal and Head of Swatch-of-No-Ground, year round; (21) the Olympic Coast NMS (within 23 nmi (26.5 m; 42.6 km) of the coast from 47°07′ N to 48°30′ N latitude), December, January, March, and May and the Prairie, Barkley Canyon, and Nitnat Canyon, June through September; and (22) an area within the Southern California Bight, June through November for blue whales, December through May for gray whales, year-round for all other species.

The Navy agreed that these areas met NMFS' criteria and based on its practicability assessment pursuant to the MMPA, the Navy proposed 21 of the 22 sites in its application. An area within the Southern California Bight, specifically an area including Tanner and Cortes Banks (see section 4.5.2.3 for boundary information) from June through November, met the criteria as a concentrated area for blue whales based on predictive modeling (Barlow *et al.,* 2009) or as a foraging area based on a 2000–2004 study of blue whale calls (Oleson, Calambokidis, Barlow, & Hildebrand, 2007). However, the Navy concluded that the underlying data cover a short time period and the dynamic nature of blue whale distribution and the variability of prey abundance make it difficult to assign any permanence to this area as one of blue whale concentration. The Navy determined that avoiding this area was operationally impracticable as much of the OBIA is within the existing Southern California (SOCAL) Range Complex which plays a vital part in ensuring military readiness. The training that occurs in the SOCAL Range Complex includes antisubmarine warfare (ASW) training and the SOCAL Range Complex provides the uneven, mountainous underwater topography that is essential to such training, because it is similar to the kind of underwater topography that submarines use to hide or mask their presence. NMFS preliminarily concurs with the Navy's practicability assessment.

Based on the Navy's practicability evaluation, NMFS proposes to designate these 21 sites as OBIAs for LFA sonar. NMFS refers the readers to Table 2 in the Navy's application and Chapter 4 and Appendix D–8 of the Navy's 2011 DSEIS/SOEIS for more detailed information on the specific justification for each OBIA, the locations, and geographic boundaries of the proposed OBIAS.

NMFS' Additional 1-km Buffer Zone Around an OBIA Perimeter

NMFS also proposes an OBIA ''buffer'' requirement for the Navy that would restrict the operation of SURTASS LFA sonar so that the SURTASS LFA sonar sound field does not exceed 180 dB re: 1 μPa at a distance of 1 km (0.62 mi; 0.54 nmi) seaward of the outer perimeter of any OBIA designated for marine mammals during the specified period. The Navy notes in its application that this additional mitigation is practicable and it would adhere to this additional measure if required in the proposed rule.

OBIAs are mitigation measures for SURTASS LFA sonar and are based on the system's unique operating and physical characteristics and should not be assumed to be appropriate for other activities.

Coastal Standoff Zone

The Navy has proposed to restrict SURTASS LFA sonar operations within 22 km (13. mi; 11.8 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 distance.

Operational Exception

It may be necessary for SURTASS LFA transmissions to be at or above 180 dB re 1 μPa (rms) within the boundaries of the designated SURTASS LFA sonar OBIAs, including operating within an OBIA, when: (1) Operationally necessary to continue tracking an existing underwater contact; or (2) operationally necessary to detect a new underwater contact within the OBIA. This exception will not apply to routine training and testing with the SURTASS LFA sonar systems.

Mitigation Conclusions

NMFS has carefully evaluated the Navy's proposed mitigation measures and considered a broad range of other measures in the context of ensuring that NMFS prescribes the means of effecting the least practicable adverse impact on the affected marine mammal species and stocks and their habitat. Our evaluation of potential measures included consideration of the following factors in relation to one another:

- The manner in which, and the degree to which, the successful implementation of the measure is expected to minimize adverse impacts to marine mammals;
- The proven or likely efficacy of the specific measure to minimize adverse impacts as planned; and
- The practicability of the measure for applicant implementation, including consideration of personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity.

In some cases, additional mitigation measures are proposed beyond those that the applicant proposed. Any mitigation measure(s) prescribed by NMFS should be able to accomplish, have a reasonable likelihood of accomplishing (based on current science), or contribute to the accomplishment of one or more of the general goals listed below:

(a) Avoidance or minimization of injury or death of marine mammals wherever possible (goals b, c, and d may contribute to this goal).

(b) A reduction in the numbers of marine mammals (total number or number at biologically important time or location) exposed to received levels of LFA sonar or other activities expected to result in the take of marine mammals (this goal may contribute to goal a, above, or to reducing harassment takes only).

(c) A reduction in the number of times (total number or number at biologically important time or location) individuals would be exposed to received levels of LFA sonar or other activities expected to result in the take of marine mammals (this goal may contribute to goal a, above, or to reducing harassment takes only).

(d) A reduction in the intensity of exposures (either total number or number at biologically important time or location) to received levels of LFA sonar or other activities expected to result in the take of marine mammals (this goal may contribute to goal a, above, or to reducing the severity of harassment takes only).

(e) Avoidance or minimization of adverse effects to marine mammal habitat, paying special attention to the food base, activities that block or limit passage to or from biologically important areas, permanent destruction of habitat, or temporary destruction/disturbance of habitat during a biologically important time.

(f) For monitoring directly related to mitigation—an increase in the probability of detecting marine mammals, thus allowing for more effective implementation of the mitigation (i.e., shutdown in the LFA mitigation and buffer zones).

Based on our evaluation of the Navy's proposed measures, as well as other measures considered by NMFS or recommended by the public, NMFS has determined preliminarily that the Navy's proposed mitigation measures together with the additional mitigation measures proposed by NMFS provide the means of effecting the least practicable adverse impacts on marine mammals species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, while also considering personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity. NMFS provides further details in the following section.

NMFS believes that the shutdown in the LFA sonar mitigation and buffer zones, visual monitoring, passive acoustic monitoring, active acoustic monitoring using HF/M3 sonar with ramp-up procedures, and geographic restriction measures proposed will enable the Navy to: (1) Avoid Level A harassment of marine mammals; (2) Minimize the numbers of marine mammals exposed to SURTASS LFA sonar sound associated with TTS; and (3) Minimize the numbers taken specifically during times of important behaviors, such as feeding, migrating, calving, or breeding.

TTS: The LFA sonar signal is not expected to cause TTS at received levels below 180 dB re: 1 μPa. In other words, the received level of the LFA sonar signal at approximately 1 km (0.62 mi; 0.54 nmi) from the vessel is 180 dB re: 1 μPa. Implementing an additional 1-km buffer zone increases the shutdown zone to approximately 2 km (1.2 mi; 1.1 nmi) around the LFA sonar array and vessel will ensure that no marine mammals are exposed to an SPL greater than about 174 dB re: 1 μPa.

The best information available indicates that effects from SPLs less than 180 dB re: 1 μPa will be limited to short-term, Level B behavioral Harassment affecting less than an average of 12 percent of the stocks present in an operational area annually for most affected species.

PTS/Injury: In the case of SURTASS LFA sonar operations, NMFS does not expect marine mammals to be exposed to received sound levels that are high enough or long enough in duration to result in PTS. The Navy's standard protective measures indicate that they would ensure delay or suspension of SURTASS LFA sonar transmissions if any of the three monitoring programs detect a marine mammal entering the LFA mitigation and/or buffer zones i.e., within approximately two km (1.2 mi; 1.1 nmi) of the vessel. The proposed mitigation monitoring measures would allow the Navy to avoid exposing marine mammals to received levels of SURTASS LFA sonar or HF/M3 sonar sound that could result in injury (Level A harassment).

Southall *et al.* (2007) proposed injury criteria for individual marine mammals exposed to non-pulsed sound types, which included discrete acoustic exposures from SURTASS LFA sonar. The proposed injury criteria for cetaceans are sound pressure levels (SPL) of 230 dB re: 1 μPa and sound exposure levels (SEL) of 215 dB re: 1 μPa^2-sec. Taking into account an 18-dB adjustment for the longer LFA signal in SEL units, the proposed injury criteria for cetaceans exposed to SURTASS LFA sonar signals would result in an SEL of 197 dB re: 1 μPa^2-sec (i.e., $215 - 18 = 197$) (which converts to an SPL of approximately 182 dB re: 1 μPa). The Navy's criterion for estimating injury marine mammals is an SPL of 180 dB re: 1 μPa is lower than the injury criteria proposed by Southall *et al.* (2007). Thus, the probability of SURTASS LFA sonar transmissions (with mitigation) causing PTS in marine mammals is considered unlikely.

The SPLs capable of potentially causing injury to an animal are well within approximately 1 km (0.62 mi; 0.54 nm) of the ship. Implementing a shutdown zone of approximately 2 km (1.2 mi; 1.1 nmi) around the LFA sonar array and vessel will ensure that no marine mammals are exposed to an SPL greater than about 174 dB re: 1 μPa. This is significantly lower than the 180-dB re: 1 μPa used for other acoustic projects for protecting marine mammals from injury.

Serious injury is unlikely to occur unless a marine mammal is well within the 180-dB re: 1 μPa LFA sonar mitigation zone and close to the source. The closer a mammal is to the vessel, the more likely the Navy personnel will detect it by the three-part monitoring program leading to the immediate suspension of SURTASS LFA sonar operations.

The Navy has operated SURTASS LFA sonar under NMFS regulations for the last nine years without any reports of injury or death. The evidence to date, including recent scientific reports and annual monitoring reports, and nine-year's worth of conducting SURTASS LFA operations further supports the conclusion that the potential for serious injury to occur is minimal.

Proposed Research

The Navy sponsors significant research and monitoring projects for marine living resources to study the potential effects of its activities on marine mammals. These funding levels have increased in recent years to $31 million in FY 2009 and $32 million in FY 2010 for marine mammal research and monitoring activities at universities, research institutions, federal laboratories, and private companies. Navy-funded research has produced many peer-reviewed articles in professional journals. This ongoing marine mammal research relates to hearing and hearing sensitivity, auditory effects, dive and behavioral response models, noise impacts, beaked whale global distribution, modeling of beaked whale hearing and response, tagging of free-ranging marine animals at-sea, and radar-based detection of marine mammals from ships. The Navy sponsors 70 percent of all U.S. research on the effects of human-generated underwater sound on marine mammals and 50 percent of such research conducted worldwide. These research projects may not be specifically related to SURTASS LFA sonar operations; 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 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 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:

(a) 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 behavioral harassment, TTS, or PTS.

(b) 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.

(c) 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).

(d) An increase in knowledge of the affected species.

(e) An increase in our understanding of the effectiveness of certain mitigation and monitoring measures.

(f) A better understanding and record of the manner in which the authorized entity complies with the incidental take authorization.

(g) 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.

Marine Mammal Monitoring (M3) Program

The Marine Mammal Monitoring (M3) Program uses the Navy's permanent seafloor sensor arrays in areas of the Atlantic Ocean to passively monitor the movements of some large cetaceans, including their migration and feeding patterns, by tracking them through their vocalizations. Analysts can not only count numbers of whales, but in some cases also note the interaction and influence of underwater noise sources on the animals. Some whales are vocal enough to allow long-term tracking; e.g., in 2010 a blue whale was tracked for 67 days. Recently, upgraded acoustic signal processing systems have allowed for detection of sperm whale clicks—longest holding to date of one sperm whale is 12 hrs, which included 14 dives. As previously noted these data are not real time and thus cannot be relied upon for mitigation purposes. At present, most of the data resulting from the M3 Program are classified. 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.

Passive Acoustic Monitoring With Fleet Exercises

For fleet exercises that SURTASS LFA sonar is involved in, the Navy is exploring the feasibility of coordinating with other fleet assets and/or range monitoring programs to include the use of SURTASS towed horizontal line arrays to augment the collection of marine mammal vocalizations before, during, and after designated exercises. The goal would be to determine the extent, if any, of changes in marine mammal vocalizations that could have been caused by SURTASS LFA sonar operations during the exercise. This applies directly to increased knowledge of marine mammal species. If the collection of such calibrated and validated data can occur, this could be useful information in NMFS' environmental compliance processes for underwater LF sonar systems.

This effort would require detailed pre-planning and a comprehensive data collection and analysis plan, which will necessarily be subject to the fleet operations plan for the exercise itself. Other factors that would need to be addressed include the following: Scheduling of assets; budgetary constraints; potential for qualified, professional marine mammal biologists to ride the SURTASS LFA sonar vessel during the data collection efforts; security measures; de-conflicting any potential behavioral responses of marine mammals in the fleet exercise area from other underwater sound sources (e.g., MF active sonars) with potential behavioral responses from SURTASS LFA sonar transmissions; and accounting for other variables that may cause a change in marine mammals' vocalization output. This would be a task for a scientific team made up of marine biologists, LFA operators, and meteorological/oceanographic experts.

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 include both anthropogenic and natural sources of noise. Ocean noise distributions 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. The Navy is exploring the feasibility of declassifying and archiving the ambient noise data for incorporation into appropriate ocean noise budget efforts. Thus, the SURTASS LFA sonar vessels could serve as ad hoc ships of opportunity for monitoring data that could provide validation of marine mammal-relevant global ocean noise budgets by supplying up-to-date measurements of the underwater noise field in data-poor and/or littoral areas not previously surveyed.

Past Monitoring

The Navy's Low Frequency Sound Scientific Research Program (LFS SRP) in 1997 to 1998 provided insights to baleen whale responses to LFA sonar signals. The Navy designed the three-year study to assess the potential impacts of SURTASS LFA sonar on the behavior of low-frequency hearing specialists specifically addressing three important behavioral contexts for baleen whales: Feeding, migration, and breeding. The results of the LFS SRP 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 (Clark *et al.,* 2001) (see Potential Effects of Behavioral Disturbance).

Adaptive Management

Our understanding of the potential effects of SURTASS LFA sonar on marine mammals is continually evolving. Reflecting this, the Navy proposes to include an adaptive management component within the framework of the scientific underpinning of its 2011 SEIS/OEIS that supports its application. This allows the Navy, in concert with NMFS, to consider, on a case-by-case basis, new/revised peer-reviewed and published scientific data and 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); if new scientific data indicate that such modifications would be appropriate. It also allows for updates to marine mammal stock estimates to be included in annual LOA applications, which, in turn, provides for the use of the best available scientific data for predictive models, including AIM.

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:

General Notification of Injured or Dead Marine Mammals

The Navy will systematically observe SURTASS LFA sonar operations 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 strandings that could potentially be associated with SURTASS LFA sonar operations.

Navy personnel will ensure that NMFS is notified immediately or as soon as clearance procedures allow if an injured, stranded, or dead marine mammal is found during or shortly after, and in the vicinity of, any SURTASS LFA operations. The Navy will provide NMFS with species or description of the animal(s), the condition of the animal(s) (including carcass condition if the animal is dead), location, time of first discovery, observed behaviors (if alive), and photo or video (if available).

In the event that an injured, stranded, or dead marine mammal is found by the Navy that is not in the vicinity of, or found during or shortly after SURTASS LFA sonar operations, the Navy will report the same information as listed above as soon as operationally feasible and clearance procedures allow.

General Notification of a Ship Strike

Because SURTASS LFA vessels move slowly, it is not likely these vessels would strike a marine mammal. In the event of a ship strike by the SURTASS LFA vessel, at any time or place, the Navy shall do the following:

- Immediately report to NMFS the species identification (if known), location (lat/long) of the animal (or the strike if the animal has disappeared), and whether the animal is alive or dead (or unknown);
- Report to NMFS as soon as operationally feasible the size and length of the animal, an estimate of the injury status (*e.g.,* dead, injured but alive, injured and moving, unknown, etc.), vessel class/type and operational status;
- Report to NMFS the vessel length, speed, and heading as soon as feasible; and
- Provide NMFS a photo or video, if equipment is available.

Long-Term Monitoring (LTM) Program Reports

During routine operations of SURTASS LFA sonar, the Navy will collect and record technical and environmental data, which are part of the Navy's LTM Program. These would include data from visual and acoustic monitoring, ocean environmental measurements, and technical operational inputs.

Quarterly Mitigation Monitoring Report

On a quarterly basis, the Navy would provide NMFS with classified and unclassified reports that include all active-mode missions completed 30 days or more prior to the date of the deadline for the report. Specifically, these 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 operations. 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 report would include the Navy's analysis of whether any Level A and/or Level B taking occurred within the SURTASS LFA sonar mitigation zone and, if so, estimates of the percentage of marine mammal stocks affected (both for the quarter and cumulatively (to date) for the year covered by the LOA) by SURTASS LFA sonar operations. This analysis would include estimates for both within and outside the LFA sonar mitigation zone, using predictive modeling based on operating locations, dates/times of operations, system characteristics, oceanographic environmental conditions, and animal demographics. In the event that no SURTASS LFA missions are completed during a quarter, the Navy will provide NMFS with a report of negative activity.

Annual Report

The annual report, which is due no later than 45 days after the expiration date of the LOAs, would provide NMFS with an unclassified summary of the year's quarterly reports and will include the Navy's analysis of whether any Level A and/or Level B taking occurred within the SURTASS LFA sonar mitigation zones and, if so, estimates of the percentage of marine mammal stocks affected by SURTASS LFA sonar operations. This analysis would include estimates for both within and outside the LFA sonar mitigation zones, using predictive modeling based on operating locations, dates/times of operations, system characteristics, oceanographic environmental conditions, and animal demographics.

The annual report would also 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 operations; and (3) any discernible or estimated cumulative impacts from SURTASS LFA sonar operations.

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 on marine mammal species and stocks. This report, which is due at least 240 days prior to expiration of these regulations, would include an in-depth analysis of all monitoring and Navy-funded research pertinent to SURTASS LFA sonar operations conducted during the 5-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 shall respond to NMFS comments and requests for additional information or clarification on quarterly, annual or comprehensive report. 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.*

Estimated Take of Marine Mammals

As mentioned previously, one of the main purposes of NMFS' effects assessments is to identify the permissible methods of taking, meaning: the nature of the take (e.g., resulting from anthropogenic noise vs. from ship strike, etc.); the regulatory level of take (i.e., mortality vs. Level A or Level B harassment) and the amount of take. The Potential Effects section identified the lethal responses, physical trauma, sensory impairment (permanent and temporary threshold shifts and acoustic masking), physiological responses (particular stress responses), and behavioral responses that could potentially result from exposure to SURTASS LFA sonar operations. This section will relate the potential effects to marine mammals from SURTASS LFA sonar operations to the MMPA statutory definitions of Level A and Level B Harassment and attempt to quantify the effects that might occur from the specific training activities that the Navy has proposed.

As mentioned previously, behavioral responses are context-dependent, complex, and influenced to varying degrees by a number of factors other than just received level. 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. At greater distances, though, the nature of vessel movements could also potentially not have any effect on the animal's response to the sound. 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 pertinent factors. So, while sound sources and the received levels are the primary focus of the analysis and those that are laid out quantitatively in the regulatory text, it is with the understanding that other factors related to the training are sometimes contributing to the behavioral responses of marine mammals, although they cannot be quantified.

Definition of Harassment

As mentioned previously, with respect to military readiness activities, section 3(18)(B) of 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 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].

Level B Harassment

Of the potential effects that were described in the previous sections, the following are the types of effects that fall into the Level B Harassment category:

Behavioral Harassment—Behavioral disturbance that rises to the level described in the definition above, when resulting from exposures to SURTASS LFA sonar or HF/M3 sonar (or another stressor), is considered Level B Harassment. Louder sounds (when other factors are not considered) are generally expected to elicit a stronger response than softer sounds. Some of the lower level physiological stress responses discussed in the previous sections will also likely co-occur with the predicted harassments, although these responses are more difficult to detect and fewer data exist relating these responses to specific received levels of sound. When Level B Harassment is predicted based on estimated behavioral responses, those takes may have a stress-related physiological component as well.

In the effects section above, we described the Southall *et al.* (2007) severity scaling system and listed some examples of the three broad categories of behaviors 0–3: (Minor and/or brief behaviors); 4–6: (Behaviors with higher potential to affect foraging, reproduction, or survival); 7–9: (Behaviors considered likely to affect the aforementioned vital rates). Generally speaking, MMPA Level B Harassment, as defined in this document, would include the behaviors described in the 7–9 category and a subset, dependent on context and other considerations, of the behaviors described in the 4–6 category. Behavioral harassment typically would not include behaviors ranked 0–3.

Acoustic Masking and Communication Impairment—The severity or importance of an acoustic masking event can vary based on the length of time that the masking occurs, the frequency of the masking signal (which determines which sounds are masked, which may be of varying importance to the animal), and other factors. Some acoustic masking would be considered Level B Harassment, if it can disrupt natural behavioral patterns by interrupting or limiting the marine mammal's receipt or transmittal of important information or environmental cues.

TTS—As discussed previously, TTS can disrupt behavioral patterns by inhibiting an animal's ability to communicate with conspecifics and interpret other environmental cues important for predator avoidance and prey capture. However, 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). For example, 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 was in the same frequency band as the necessary vocalizations and of a severity that impeded communication.

The following physiological mechanisms are thought to play a role in inducing auditory fatigue: 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. Ward (1997) suggested that when these effects result in TTS rather than PTS, they are within the normal bounds of physiological variability and tolerance and do not represent a physical injury. Additionally, Southall *et al.* (2007) indicates that although PTS is a tissue injury, TTS is not, because the reduced hearing sensitivity following exposure to intense sound results primarily from fatigue, not loss, of cochlear hair cells and supporting structures and is reversible. Accordingly, NMFS classifies TTS (when resulting from exposure to either SURTASS LFA sonar or HF/M3 sonar) as Level B Harassment, not Level A Harassment (injury).

Level A Harassment

Of the potential effects that were described in the previous sections, the following are the types of effects that fall into the Level A Harassment category:

PTS—PTS (resulting from either exposure to SURTASS LFA sonar or HF/M3 sonar) is irreversible and considered an injury. PTS results from exposure to intense sounds that cause a permanent loss of inner or outer cochlear hair cells or exceed the elastic limits of certain tissues and membranes in the middle and inner ears and result in changes in the chemical composition of the inner ear fluids. Although PTS is considered an injury, the effects of PTS on the fitness of an individual can vary based on the degree of TTS and its frequency band.

Tissue Damage due to Acoustically Mediated Bubble Growth—A few theories suggest ways in which gas bubbles become enlarged through exposure to intense sounds (SURTASS LFA sonar or HF/M3 sonar) to the point where tissue damage results. In rectified diffusion, exposure to a sound field would cause bubbles to increase in size. A short duration of active sonar pings (such as that which an animal exposed to SURTASS LFA sonar) would be most likely to encounter) would not likely be long enough to drive bubble growth to any substantial size. Alternately, bubbles could be destabilized by high-level sound exposures such that bubble growth then occurs through static diffusion of gas out of the tissues. The degree of supersaturation and exposure levels observed to cause microbubble destabilization are unlikely to occur, either alone or in concert because of how close an animal would need to be to the sound source to be exposed to high enough levels, especially considering the likely avoidance of the sound source and the required mitigation. Still, possible tissue damage from either of these processes would be considered an injury or, potentially, mortality.

Tissue Damage due to Behaviorally Mediated Bubble Growth—Several authors suggest mechanisms in which marine mammals could behaviorally respond to exposure to SURTASS LFA sonar or HF/M3 sonar by altering their dive patterns in a manner (unusually rapid ascent, unusually long series of surface dives, etc.) that might result in unusual bubble formation or growth ultimately resulting in tissue damage (e.g., emboli). In this scenario, the rate of ascent would need to be sufficiently rapid to compromise behavioral or physiological protections against nitrogen bubble formation. There is considerable disagreement among scientists as to the likelihood of this phenomenon (Piantadosi and Thalmann, 2004; Evans and Miller, 2003). Although it has been argued that the tissue effects observed from recent beaked whale strandings are consistent with gas emboli and bubble-induced tissue separations (Jepson *et al.,* 2003; Fernandez *et al.,* 2005; Tyack *et al.,* 2006), nitrogen bubble formation as the cause of the traumas has not been verified. If tissue damage does occur by this phenomenon, it would be considered an injury or, potentially, mortality.

Estimates of Potential Marine Mammal Exposure

Estimating the take that will result from the proposed activities begins with the CNO and fleet commands proposing mission areas to operate SURTASS LFA sonar. The Navy analyzes the mission areas based on current scientific data to determine the potential sensitivity of marine mammals to SURTASS LFA sonar signals and risks to their stocks. If marine mammal densities prove to be high and/or sensitive animal activities are expected, the Navy changes/refines the mission areas to areas with lower numbers of marine mammals, or lower levels of biologically-sensitive marine mammal activities. Subsequently the process is re-initiated for the modified mission area. Next, the Navy performs standard acoustic modeling and risk analyses, taking into account spatial, temporal, and/or operational restrictions. Then, the Navy applies standard mitigation measures to the analysis to calculate risk estimates for marine mammal stocks in the proposed mission area. Based on these estimates, the Navy decides if the proposed mission area meets the conditions of the MMPA regulations and LOAs, as issued, on marine mammal/animal impacts from SURTASS LFA sonar. If not, the proposed mission area is changed or refined, and the process is re-initiated. If the mission area risk estimates are below the required restrictions, then the Navy has identified and selected the potential mission area with minimal marine mammal/animal activity consistent with its operational readiness requirements and restrictions placed on LFA operations by NMFS in the regulatory and consultation processes. This sensitivity/risk assessment approach allows the Navy to determine where and when SURTASS LFA sonar can operate and meet the MMPA condition for the least practicable adverse impacts on marine mammals.

As described earlier (see Brief Background on the Navy's Assessment of the Potential Impacts on Marine Mammals), the Navy assesses the potential impacts on marine mammals predicting the sound field that a given marine mammal species could be exposed to over time in a potential operating 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 AIM to estimate the total acoustic exposure for each animal in the modeled population; (4) the conversion of the resultant cumulative exposures for a modeled population into an estimate of the risk from a significant disturbance of a biologically important behavior; and (5) the use of a risk continuum to convert these estimates of behavioral risk into an assessment of risk in terms of the level of potential biological removal.

The Navy uses the LFA sonar mitigation zone to calculate estimates for Level A harassment (injury). The area between the LFA sonar mitigation zone and the 1-km (0.62 mi; 0.54 nmi) buffer zone (estimated to extend to about the 174-dB isopleth) is an area where marine mammals could experience Level B harassment. The Navy uses this area to calculate estimates for Level B harassment using a risk continuum from the 120 to 179-dB isopleth for marine mammals. Based on the Navy's AIM modeling results, the primary effects would be the potential for Level B Harassment. In addition, while possible, Level A harassment, if it occurs at all, is expected to be so minimal as to have no effect on rates of reproduction or survival of affected marine mammal species. More information regarding the risk assessment methodology, the models used, the assumptions used in the models, and the process of estimating take is available in section 6.4 of the Navy's application and section 4.4 of the Navy's 2007 Final SEIS and section 4.4 of the Navy's DSEIS/SOEIS.

Because it is infeasible to model enough representative sites to cover all potential LFA operating areas, the Navy's application presents 19 modeled sites as examples to provide estimates of potential operating areas based on the current political climate. The Navy analyzed these 19 operating sites using the most up-to-date marine mammal abundance, density, and behavioral information available. These sites they represent, based on today's political climate, areas where SURTASS LFA sonar could potentially test, train, or operate. Tables 9 through 27 provide the Navy's estimates of the number of marine mammals potentially affected for SURTASS LFA sonar operations and are based on reasonable and realistic estimates of the potential effects to marine mammal stocks specific to the potential mission areas. These data are examples of areas where the Navy could request LOAs under the 5-year rule because they are in areas of potential strategic importance and/or areas of possible naval fleet exercises. As stated previously, this proposed rule does not specify the number of marine mammals that may be taken in the proposed locations because these are determined annually through various inputs such as mission location, mission duration, and season of operation. For the annual application for an LOA, the Navy proposes to present both the estimated percentage of stock incidentally harassed as well as the estimated number of animals that may be potentially harassed by SURTASS LFA sonar.

With the implementation of the three-part monitoring programs (visual, passive acoustic, and HF/M3 monitoring), NMFS and the Navy do not expect that marine mammals would be injured by SURTASS LFA sonar because a marine mammal should be detected and active transmissions suspended or delayed. As mentioned previously, the Navy determines Level A harassments based on actual observations and/or detections within the LFA sonar mitigation zone. The probability of detection of a marine mammal by the HF/M3 system within the LFA sonar mitigation zone approaches 100 percent based on multiple pings (see the 2001 FOEIS/EIS, Subchapters 2.3.2.2 and 4.2.7.1 for the HF/M3 sonar testing results). In the Navy's application, the Navy's acoustic analyses predict that less than 0.0001 percent of the endangered north Pacific right whale stock and 0.00 percent of the stocks of all other marine mammal species may be exposed to levels of sound likely to result in Level A harassment (i.e., exposures at 180 dB re: 1 μPa or greater). Quantitatively, the Navy's request translates into take estimates of zero animals for any species including the endangered north Pacific right whale. However, because the probability of detection by the HF/M3 system within the LFA sonar mitigation zone is not 100 percent, NMFS will include a small number of Level A harassment takes for marine mammals over the course of the five-year regulations based on qualitative analyses.

Reviewing the Navy's historical data on visual alerts that have triggered a suspension of SURTASS LFA sonar transmission outside of the LFA sonar mitigation zone, the data indicate that the largest grouping of mysticetes that has triggered a shutdown outside of the LFA sonar mitigation zone and within the buffer zone is three. Similarly, the largest number of odontocetes that has triggered a shutdown is two. Thus, NMFS analyzes the take of no more than six mysticetes (total), across all species requested in the Navy's application by Level A harassment; no more than 25 odontocetes (across all species) by Level A harassment; and no more than 25 pinnipeds (across all species) by Level A harassment over the course of the 5-year regulations. These are the only quantitative adjustments that NMFS has made to the requested takes from the Navy's modeled exposure results. Again, NMFS notes that over the course of the previous two rulemakings, there have been no reported incidents of Level A harassment of any marine mammal. As with the 2002 and 2007 Rules, the Navy will limit operation of LFA sonar to ensure no marine mammal stock will be subject to more that 12 percent of takes by Level B harassment annually, over the course of the five-year regulations. This annual per-stock cap applies regardless of the number of LFA vessels operating. The Navy will use the 12 percent cap to guide its mission planning and annual LOA applications.

Analysis and Negligible Impact Preliminary Determination

NMFS has defined ''negligible impact'' in 50 CFR 216.103 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.'' In making a negligible impact determination, NMFS considers:

(1) The number of anticipated mortalities;

(2) The number and nature of anticipated injuries;

(3) The number, nature, and intensity, and duration of Level B harassment; and

(4) The context in which the takes occur.

As mentioned previously, NMFS estimates that 94 species of marine mammals could be potentially affected by Level A or Level B harassment over the course of the five-year period.

For reasons stated previously in this document, no mortalities are anticipated to occur as a result of the Navy's proposed SURTASS LFA operations, and none are proposed to be authorized by NMFS.

Pursuant to NMFS' regulations implementing the MMPA, an applicant is required to estimate the number of animals that will be ''taken'' by the specified activities and the type of taking (i.e., takes by harassment only, or takes by harassment, injury, and/or death). This estimate informs the analysis that NMFS must perform to determine whether the activity will have a ''negligible impact'' on the affected species or stock. Level B (behavioral) harassment occurs at the level of the individual(s) and does not assume any resulting population-level consequences (see Potential Effects of Behavioral Disturbance).

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 Level B harassment takes, alone, is not enough information on which to base an impact determination. As mentioned previously, in addition to considering estimates of the number of marine mammals that might be ''taken'' through behavioral harassment, NMFS must consider other factors, such as the likely nature of any responses (their intensity, duration, etc.), the context of any responses (critical reproductive time or location, migration, etc.), as well as the number and nature of estimated Level A harassment takes, the number of estimated mortalities, and effects on habitat. Generally speaking, and especially with other factors being equal, the Navy and NMFS anticipate more severe effects from takes resulting from exposure to higher received levels (though this is in no way a strictly linear relationship throughout species, individuals, or circumstances) and less severe effects from takes resulting from exposure to lower received levels.

The Navy has described its specified activities based on best estimates of the number of hours that the Navy will conduct SURTASS LFA operations. The exact number of transmission hours may vary from year to year, but will not exceed the annual total indicated in Table 1.

Taking the above into account, considering the sections discussed further, and dependent upon the implementation of the proposed mitigation measures, NMFS has preliminarily determined that Navy training, testing, and military operations utilizing SURTASS LFA sonar will have a negligible impact on the marine mammal species and stocks present in operational areas in certain areas of the Pacific, Atlantic, and Indian Oceans and the Mediterranean Sea.

Behavioral Harassment

As discussed in the Potential Effects of Exposure to SURTASS LFA Sonar Operations, marine mammals may respond to SURTASS LFA sonar operations in many different ways, a subset of which qualifies as harassment (see Behavioral Harassment Section). One thing that the take estimates do not take into account is the fact that most marine mammals will likely avoid strong sound sources to one extent or another. Although an animal that avoids the sound source will still be taken in some instances (such as if the avoidance results in a missed opportunity to feed, interruption of reproductive behaviors, etc.) in other cases avoidance may result in fewer instances of take than were estimated or in the takes resulting from exposure to a lower received level than was estimated, which could result in a less severe response.

For SURTASS LFA sonar operations, the Navy provided information (Tables 24–42 of the Navy's application) estimating numbers of total takes that could occur within the proposed operational areas. For reasons stated previously in this document, the specified activities associated with the proposed SURTASS LFA operations will most likely fall within the realm of short-term, Level B behavioral harassment. NMFS bases this assessment on a number of factors:

(1) Geographic Restrictions—With the implementation of geographic restrictions on SURTASS LFA sonar operations, NMFS and the Navy have minimized the likelihood of disruption of marine mammal behavior patterns, such as migration, calving, breeding, feeding, or sheltering. Because the coastal standoff and proposed OBIAs restrict the use of SURTASS LFA sonar in known areas of feeding, calving, and breeding for marine mammals, NMFS does not expect nor does it anticipate that SURTASS LFA sonar operations likely will have adverse effects on annual rates of recruitment or survival (i.e., population-level effects).

Also, the Navy's proposal to not conduct SURTASS LFA sonar operations within 22 km (13. mi; 11.8 nmi) of any coastline, including islands, to ensure that the sound field does not exceed 180 dB (i.e., LFA mitigation and buffer zones) offers protection to areas with higher densities of marine mammals. Because the Navy will operate for the most part in waters that are not areas known for high concentrations of marine mammals, few, if any, marine mammals would be within the SURTASS LFA mitigation and buffer zones.

(2) Low Frequency Sonar Scientific Research Program (LFS SRP)—Based on the past nine years of SURTASS LFA sonar operations and the LFS SRP, NMFS does not expect nor does it anticipate that SURTASS LFA sonar operations will have likely adverse effects on annual rates of recruitment or survival (i.e., population-level effects). The Navy designed the three-year 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. 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. Taken together, the results from the three phases of the LFS SRP do not support the hypothesis that most baleen whales exposed to RLs near 140 dB re: 1 μPa would exhibit disturbance behavior and avoid the area. These experiments, which exposed baleen whales to received levels ranging from 120 to about 155 dB re: 1 μPa, detected only minor, short-term behavioral responses. However, short-term behavioral responses do not necessarily constitute significant changes in biologically important behaviors.

(3) Efficacy of the Navy's Three-Part Mitigation Monitoring Program—From 2003 to 2010, the Navy reported a total of 12 visual sightings, four passive acoustic detections, and 130 HF/M3 active sonar detections of marine mammals, all leading to suspension/delays of transmissions in accordance with mitigation protocols. Because the HF/M3 active sonar is able to monitor large and medium 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. The area between the 180-dB LFA sonar mitigation zone and the 1-km (0.62 mi; 0.54 nm) buffer zone proposed by NMFS (estimated to extend to about the 174-dB isopleth from the vessel) is an area where marine mammals would experience Level B Harassment if exposed to LFA sonar transmissions, in accordance with the Navy's risk analysis and acoustic modeling (2001 FOEIS/EIS, Subchapter 4.2.3). 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, 10 m (32.8 ft) in length or larger, and a probability approaching 100 percent for multiple pings for any sized marine mammal. Further, implementing a shutdown zone of approximately 2 km (1.2 mi; 1.1 nmi) around the vessel will ensure that no marine mammals are exposed to an SPL greater than about 174 dB re: 1 μPa at 1 m.

TTS

Schlundt *et al.* (2000) documented TTS in trained bottlenose dolphins and belugas after exposure to intense 1-second signal duration tones at 400 Hz, and 3, 10, 20, and 75 Hz. NMFS notes the LF-band tones at 400 Hz at which the researchers were unable to induce TTS in any animal at levels up to 193 dB re: 1 μPa at 1 m which was the maximum level achievable with the equipment used in the experiment. The researchers implied that the TTS threshold for a 100-second signal would be approximately 184 dB (Table 1–4, 2001 FOEIS/EIS).

When SURTASS LFA sonar transmits, there is a boundary that encloses a volume of water where received levels equal or exceed 180 dB (the 180-dB isopleth LFA sonar mitigation zone) and a volume of water outside this boundary where received levels are below 180 dB (the 1 km buffer encircling the 180-dB LFA sonar mitigation zone. The level of risk for TTS for marine mammals depends on their location in relation to SURTASS LFA sonar. Because the onset of PTS for marine mammals may be 15–20 dB above TTS levels, one can assume that a marine mammal would have to be within the 1 km buffer around the 180-dB LFA sonar mitigation zone (i.e., modeled SPLs of 120–180 dB re: 1 μPa at 1 m) to induce TTS. However, the Navy's standard protective measures indicate that they would ensure delay or suspension of SURTASS LFA sonar transmissions if any of the three monitoring programs detect a marine mammal within 2 km (1.2 mi; 1.1 nmi) of the vessel. Thus, the proposed mitigation measures would allow the Navy to reduce the number of marine mammals exposed to received levels of SURTASS LFA sonar or HF/M3 sonar sound that could result in TTS. For transient sounds, the sound level necessary to cause TTS is inversely related to the duration of the sound. Again, in the case of SURTASS LFA, animals are not expected to be exposed to levels high enough or durations long enough to result in TTS. In order to receive more than one ''ping'' during a normal vessel leg, an animal would need to match the ship in speed and course direction between pings. Because of the relatively short duty cycle, the water depth of the convergence zone ray path, the movement of marine mammals in relationship to the SURTASS LFA sonar ship, and the effectiveness of the three-part mitigation program, few marine mammals are likely to be affected by TTS (see Direct Physiological Effects—Threshold Shift (Noise-Induced Loss of Hearing).

PTS

In NMFS' 2002 and 2007 rules, NMFS and the Navy based their estimate of take by injury or the significant potential for such take (Level A harassment) on the criterion of 180 dB. NMFS continues to believe this is a scientifically supportable and conservative value for preventing auditory injury or the significant potential for such injury (Level A harassment), as it represents a value less than where the potential onset of a minor TTS in hearing might occur based on Schlundt *et al.'s* (2000) research (see the Navy's 2007 Final Comprehensive Report Tables 5 through 8).

The Navy's standard protective measures indicate that they would ensure delay or suspension of SURTASS LFA sonar transmissions if any of the three monitoring programs detect a marine mammal either entering the LFA sonar mitigation zone or buffer zones; (within approximately two km (1.2 mi; 1.1 nmi)) of the LFA transmit array or vessel. The proposed mitigation measures 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). The sound pressure level (SPL) that is capable of potentially causing injury to an animal is within approximately 1 km (0.62 mi; 0.54 nm) of the ship. Implementing a shutdown zone of approximately 2 km (1.2 mi; 1.1 nmi) around the LFA sonar array and vessel will ensure that no marine mammals are exposed to an SPL greater than about 174 dB re: 1 μPa (RL). This is significantly lower than the 180-dB re: 1 μPa (RL) used for other acoustic projects for protecting marine mammals from injury. Serious injury is unlikely to occur unless a marine mammal is well within the 180-dB LFA sonar mitigation zone and close to the source. The closer the mammal is to the vessel, the more likely it will be detected by the tripartite monitoring program leading to the immediate suspension of SURTASS LFA sonar transmissions.

With three levels of mitigation monitoring for detecting marine mammals, NMFS believes it is unlikely that any marine mammal would be exposed to received levels of 180 dB re: 1 μPa before being detected and the SURTASS LFA sonar shut down. However, because the probability is not zero, the Navy has requested Level A harassment takes incidental to SURTASS LFA sonar operations.

Mortality

There is no empirical evidence of strandings of marine mammals associated with the employment of SURTASS LFA sonar. Moreover, the system acoustic characteristics differ between LF and MF sonars associated with strandings: 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. NMFS has provided a summary of common features shared by the strandings events in Greece (1996), Bahamas (2000), Madeira (2000), Canary Islands (2002), Hanalei Bay (2004), and Spain (2006) earlier in this document. 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 SURTASS LFA sonar operations.

In summary (from the discussion above this section), NMFS has made a preliminary finding that the total taking from SURTASS LFA activities will have a negligible impact on the affected species or stocks based on following: (1) The historical effectiveness of the Navy's three-part monitoring program in detecting marine mammals and triggering shutdowns, which make it unlikely that an animal will be exposed to sound levels above 180 dB (i.e., levels potentially associated with injury); (2) Geographic restrictions such as OBIAs and the coastal standoff zone; (3) The requirement that the SURTASS LFA sonar sound field not exceed 180 dB within 22 km of any shoreline, including islands, or at a distance of one km from the perimeter of an OBIA; (4) The fact that LF signals attenuate greatly in the near-surface zone, where many of the marine mammals congregate for biologically-important behaviors; (5) The small number of SURTASS LFA sonar systems that would be operating world-wide; (6) The relatively low duty cycle, short mission periods and offshore nature of the SURTASS LFA sonar; (7) The fact that marine mammals in unspecified migration corridors and open ocean concentrations would be adequately protected by the three-part monitoring and mitigation protocols; and (8) Previous Endangered Species Act consultation findings that that operation of the SURTASS LFA sonar is not likely to jeopardize the continued existence of any endangered or threatened species under the jurisdiction of NMFS or result in the destruction or adverse modification of critical habitat. Impacts to marine mammals are anticipated to be in the form of Level B behavioral harassment, due to the brief duration and sporadic nature of the SURTASS LFA sonar operations. Certain species may have a behavioral reaction (e.g., increased swim speed, avoidance of the area, etc.) to the sound emitted during the proposed activities. In conclusion, while marine mammals will potentially be affected by the SURTASS LFA sonar sounds, NMFS has preliminarily determined that these impacts will be short-term and are not reasonably likely to adversely affect the species or stock through effects on annual rates of recruitment or survival.

Subsistence Harvest of Marine Mammals

Although the Navy will not operate SURTASS LFA sonar in the vast majority of Arctic waters, the Navy may potentially operate LFA sonar in the Gulf of Alaska, where subsistence uses of marine mammals occur. Subsistence uses of marine mammals in the Gulf of Alaska include the harvest of harbor seals and Steller sea lions along coastal and inshore, including bay, areas of the gulf. As many as six Alaskan Native groups subsistence hunt harbor seals in the Gulf of Alaska, although the Dena'ina only occasionally hunt harbor seals, and four Native groups hunt Steller sea lions, with the Southeastern Alaska Native groups only occasionally harvesting Stellers (Wolfe *et al.,* 2009). Subsistence products that are derived from harbor seals and Steller sea lions by these Alaskan Native groups include oil, meat, and skins. Subsistence hunting of harbor seals and Steller sea lions is a specialized activity among Alaska Native groups, with only 30 percent and 3 percent of the surveyed native households hunting harbor seals and Steller sea lions, respectively (Wolfe *et al.,* 2009).

Should the Navy operate SURTASS LFA sonar in the Gulf of Alaska, sonar operation would adhere to the shutdown in the mitigation and buffer zones, we well as established geographic restrictions, which include the coastal standoff range (which dictates that the sound field produced by the sonar must be below 180 dB re: 1 µPa at 1 m within 22 km (13. mi; 11.8 nmi) of any coastline) and exclusion from OBIAs.

Although there are peaks in harvest activity for both species, both harbor seals and Steller sea lions are harvested year-round in the coastal waters of the gulf. While it is impossible to predict the future timing of the possible employment of SURTASS LFA sonar in the Gulf of Alaska, regardless of the time of year the sonar may be employed in the Gulf of Alaska, there should be no overlap in time or space with subsistence hunts due to the geographic restrictions on the sonar use (i.e., coastal standoff range and OBIA restrictions). These restrictions will prevent the Navy from generating a sound field that reaches the shallow coastal and inshore areas of the Gulf of Alaska where harvest of the two pinniped species occurs. The possible employment of SURTASS LFA sonar in the Gulf of Alaska will not cause abandonment of any harvest/hunting locations, will not displace any subsistence users, nor place physical barriers between marine mammals and the hunters. No mortalities of marine mammals have been associated with the employment of SURTASS LFA sonar and the Navy undertakes a suite of mitigation measures whenever SURTASS LFA sonar is actively transmitting. Therefore, NMFS has preliminarily determined that the possible future employment of SURTASS LFA sonar will not lead to unmitigable adverse impacts on the availability of marine mammal species or stocks for subsistence uses in the Gulf of Alaska.

In August 2011, the Navy sent a letter to the Native Affairs and Natural Resources Advisor, Alaska Command at Elmendorf Air Force base requesting that they provide copies of the SURTASS LFA Sonar DSEIS/SOEIS (DoN, 2011) to pertinent native groups that participate in subsistence hunting in the Gulf of Alaska. To date, the Navy has not received any requests from Alaskan tribes for government-to-government consultation pursuant to Executive Order 13175. The Navy will continue to keep the Alaskan tribes informed of the timeframes of any future SURTASS LFA sonar exercises planned for the area.

Endangered Species Act

There are 15 marine mammal species under NMFS' jurisdiction that are listed as endangered or threatened under the ESA with confirmed or possible occurrence in potential operational areas for SURTASS LFA: the blue, fin, sei humpback, bowhead, North Atlantic right, North Pacific right, southern right, gray, and sperm whales, as well as the western and eastern distinct population segments (DPS) of the Steller sea lion, Mediterranean monk seal, Hawaiian monk seal, the eastern DPS of the Steller sea lion; the Guadalupe fur seal and the southern DPS of the spotted seal.

On October 4, 1999, the Navy submitted a Biological Assessment to NMFS to initiate consultation under section 7 of the ESA for its SURTASS LFA sonar activities. NMFS concluded consultation with the Navy on this action on May 30, 2002. The conclusion of that consultation was that operation of the SURTASS LFA sonar system for testing, training and military operations and the issuance by NMFS of incidental take authorizations for this activity are not likely to jeopardize the continued existence of any endangered or threatened species under the jurisdiction of NMFS. The Navy and NMFS conducted additional consultations prior to issuance of the annual LOAs.

On June 9, 2006, the Navy submitted a Biological Assessment to NMFS to initiate consultation under section 7 of the ESA for the 2007–2012 SURTASS LFA sonar activities and NMFS' authorization for incidental take under the MMPA. NMFS concluded consultation with the Navy on this action on August 17, 2007. The conclusion of that consultation was that operation of the SURTASS LFA sonar system for testing, training and military operations and the issuance by NMFS of MMPA incidental take authorizations for this activity are not likely to jeopardize the continued existence of any endangered or threatened species under the jurisdiction of NMFS or result in the destruction or adverse modification of critical habitat. As with the first rule, the Navy and NMFS conducted additional consultations prior to issuance of the annual LOAs.

The Navy will consult with NMFS pursuant to section 7 of the ESA, and NMFS will also consult internally on the issuance of regulations and LOAs under section 101(a)(5)(A) of the MMPA for SURTASS LFA sonar activities. NMFS will conclude consultation with itself and the Navy prior to making a determination on the issuance of the final rule and LOAs.

The USFWS is responsible for regulating the take of the several marine mammal species including the southern sea otter, polar bear, walrus, West African manatee, Amazonian manatee, West Indian manatee, and dugong. None of these species occur in geographic areas that overlap with SURTASS LFA sonar operations. Therefore, the Navy has determined that SURTASS LFA sonar training, testing, and military operations will have no effect on the endangered or threatened species or their critical habitat of the ESA-listed species under the jurisdiction of the USFWS. Thus, no consultation with the USFWS pursuant to Section 7 of the ESA will occur.

National Environmental Policy Act

NMFS has participated as a cooperating agency on the Navy's Draft Supplemental Environmental Impact Statement/Supplemental Overseas Environmental Impact Statement (DSEIS/SOEIS) for employment of SURTASS LFA sonar, published on August 19, 2011. The Navy's DSEIS is posted on the Navy's Web site at *http://www.surtass-lfa-eis.com*. NMFS intends to adopt the Navy's Final SEIS/SOEIS, if adequate and appropriate. If the Navy's Final SEIS/SOEIS is deemed inadequate, NMFS would supplement the existing analysis to ensure that we comply with NEPA prior to the issuance of the final rule or LOA.

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 Federal agencies 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, not a small governmental jurisdiction, small organization, or small business, as defined by the RFA. Any requirements imposed by a Letter of Authorization 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: December 22, 2011.

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.*

Subparts T Through W [Added and Reserved]

2. Subparts T through W are added to part 218 and reserved.

3. Subpart X is added to part 218 to read as follows:

Subpart X—Taking and Importing of Marine Mammals; Navy Operations of Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) Sonar

Sec.

Subpart X—Taking and Importing of Marine Mammals; Navy Operations of Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) Sonar

§ 218.230 Specified activity.

Regulations in this subpart apply only to the incidental taking of those marine mammal species specified in paragraph (b) of this section by the U.S. Navy, Department of Defense, while engaged in the operation of no more than four SURTASS LFA sonar systems conducting active sonar operations in areas specified in paragraph (a) of this section. The authorized activities, as specified in a Letter of Authorization issued under §§ 216.106 and 218.238 of this chapter, include the transmission of low frequency sounds from the SURTASS LFA sonar system and the transmission of high frequency sounds from the mitigation sonar described in § 218.234 during routine training and testing as well as during military operations.

(a) The incidental take, by Level A and Level B harassment, of marine mammals from the activity identified in this section may be authorized in certain areas of the Pacific, Atlantic, and Indian Oceans and the Mediterranean Sea, as specified in a Letter of Authorization.

(b) The incidental take, by Level A and Level B harassment, of marine mammals from the activity identified in this section is limited to the following species and species groups:

(1) *Mysticetes*—blue whale (*Balaenoptera musculus*), bowhead whale (*Balaena mysticetus*), Bryde's whale (*Balaenoptera edeni*), fin whale (*Balaenoptera physalus*), gray whale (*Eschrichtius robustus*), humpback whale (*Megaptera novaeangliae*), minke whale (*Balaenoptera acutorostrata*), North Atlantic right whale (*Eubalaena glacialis*), North Pacific right whale (*Eubalena japonica*), pygmy right whale (*Capera marginata*), sei whale (*Balaenoptera borealis*), southern right whale (*Eubalaena australis*),

(2) *Odontocetes*—Andrew's beaked whale (*Mesoplodon bowdoini*), Arnoux's beaked whale (*Berardius arnuxii*), Atlantic spotted dolphin (*Stenella frontalis*), Atlantic white-sided dolphin (*Lagenorhynchus acutus*), Baird's beaked whale (*Berardius bairdii*), Beluga whale (*Dephinapterus leucas*), Blainville's beaked whale (*Mesoplodon densirostris*), Chilean dolphin (*Cephalorhynchus eutropia*), Clymene dolphin (*Stenella clymene*), Commerson's dolphin (*Cephalorhynchus commersonii*), common bottlenose dolphin (*Tursiops truncatus*), Cuvier's beaked whale (*Ziphius cavirostris*), Dall's porpoise (*Phocoenoides dalli*), Dusky dolphin (*Lagenorhynchus obscurus*), dwarf sperm and pygmy sperm whales (*Kogia simus* and *K. breviceps*), false killer whale (*Pseudorca crassidens*), Fraser's dolphin (*Lagenodelphis hosei*), Gervais' beaked whale (*Mesoplodon europaeus*), ginkgo-toothed beaked whale (*Mesoplodon ginkgodens*), Gray's beaked whale (*Mesoplodon grayi*), Heaviside's dolphin (*Cephalorhynchus heavisidii*), Hector's beaked whale (*Mesoplodon hectori*), Hector's dolphin (*Cephalorhynchus hectori*), Hourglass dolphin (*Lagenorhynchus cruciger*), Hubbs' beaked whale (*Mesoplodon carhubbsi*), harbor porpoise (*Phocoena phocoena*), killer whale (*Orca orcinus*), long-beaked common dolphin (*Delphinus capensis*), long-finned pilot whale (*Globicephala melas*), Longman's beaked whale (*Indopacetus pacificus*), melon-headed whale (*Peponocephala electra*), northern bottlenose whale (*Hyperodon ampullatus*), northern right whale dolphin (*Lissodelphis borealis*), Pacific white-sided dolphin (*Lagenorhynchus obliquidens*), pantropical spotted dolphin (*Stenella attenuata*), Peale's dolphin (*Lagenorhynchus australis*), Perrin's beaked whale (*Mesoplodon perrini*), pygmy beaked whale (*Mesoplodon peruvianus*), pygmy killer whale (*Feresa attenuata*), Risso's dolphin (*Grampus griseus*), rough-toothed dolphin (*Steno bredanensis*), Shepherd's beaked whale (*Tasmacetus sheperdii*), short-beaked common dolphin (*Delphinus delphis*), short-finned pilot whale (*Globicephala macrorhynchus*), southern bottlenose whale (*Hyperodon planifrons*), southern right whale dolphin (*Lissodelphis peronii*), Sowerby's beaked whale (*Mesoplodon bidens*), spade-toothed beaked whale (*Mesoplodon traversii*), spectacled porpoise (*Phocoena dioptrica*), sperm whale (*Physeter macrocephalus*), spinner dolphin (*Stenella longirostris*), Stejneger's beaked whale (*Mesoplodon stejnegeri*), strap-toothed beaked whale (*Mesoplodon layardii*), striped dolphin (*Stenella coeruleoalba*), True's beaked whale (*Mesoplodon mirus*), white-beaked dolphin (*Lagenorhynchus albirostris*),

(3) *Pinnipeds*—Australian sea lion (*Neophoca cinerea*), California sea lion (*Zalophus californianus*), Galapagos fur seal (*Arctocephalus galapagoensis*), Galapagos sea lion (*Zalophus wollebaeki*), gray seal (*Halichoerus grypus*), Guadalupe fur seal (*Arctocephalus townsendi*), harbor seal (*Phoca vitulina*), harp seal (*Pagophilus

groenlandicus), Hawaiian monk seal (*Monachus schauinslandi*), hooded seal (*Cystophora cristata*), Juan Fernadez fur seal (*Arctocephalus philippi*), Mediterranean monk seal (*Monachus monachus*), New Zealand fur seal (*Arctocephalus forsteri*), New Zealand fur seal (*Phocarctos hookeri*), northern elephant seal (*Mirounga angustirostris*), northern fur seal (*Callorhinus ursinus*), ribbon seal (*Phoca fasciata*), South African and Australian fur seals (*Arctocephalus pusillus*), South American fur seal (*Arctocephalus australis*), South American sea lion (*Otaria flavescens*), southern elephant seal (*Mirounga leonina*), spotted seal (*Phoca largha*), Steller sea lion (*Eumetopias jubatus*), subantarctic fur seal (*Arctocephalus tropicalis*).

§ 218.231 Effective dates. [Reserved]

§ 218.232 Permissible methods of taking.

(a) Under Letters of Authorization issued pursuant to §§ 216.106 and 218.238 of this chapter, the Holder of the Letter of Authorization may incidentally, but not intentionally, take marine mammals by Level A and Level B harassment within the areas described in § 218.230(a), provided that the activity is in compliance with all terms, conditions, and requirements of this subpart and the appropriate Letter of Authorization.

(b) The Holder of the Letter of Authorization must conduct the activities identified in § 218.230 in a manner that minimizes, to the greatest extent practicable, any adverse impacts on marine mammals and their habitat.

(c) The incidental take of marine mammals under the activities identified in § 218.230 is limited to the species listed in § 218.230(b) by the method of take indicated in paragraphs (c)(2), (c)(3), (c)(4), and (c)(5) of this section.

(1) The Navy must maintain a running calculation/estimation of takes of each species over the effective period of this subpart.

(2) Level B Harassment will not exceed 12 percent of any marine mammal stock listed in § 218.230(b)(1) through (3) annually over the course of the five-year regulations. This annual per-stock cap of 12 percent applies regardless of the number of LFA vessels operating.

(3) Level A harassment of no more than six mysticetes (total), of any of the species listed in § 218.230(b)(1) over the course of the five-year regulations.

(4) Level A harassment of no more than 25 odontocetes (total), of any of the species listed in § 218.230(b)(2) over the course of the five-year regulations.

(5) Level A harassment of no more than 25 pinnipeds (total), of any of the species listed in § 218.230(b)(3) over the course of the five-year regulations.

§ 218.233 Prohibitions.

No person in connection with the activities described in § 218.230 may:

(a) Take any marine mammal not specified in § 218.230(b);

(b) Take any marine mammal specified in § 218.230 other than by incidental take as specified in § 218.232(c)(2), (c)(3), (c)(4), and (c)(5);

(c) Take any marine mammal specified in § 218.230 if NMFS makes a determination that such taking results in more than a negligible impact on the species or stocks of such marine mammal; or

(d) Violate, or fail to comply with, any of the terms, conditions, or requirements of this subpart or a Letter of Authorization issued under § 216.106 and 218.238 of this chapter.

§ 218.234 Mitigation.

The Navy must conduct the activity identified in § 218.230 in a manner that minimizes, to the greatest extent practicable, adverse impacts on marine mammals and their habitats. When conducting operations identified in § 218.230, the mitigation measures described in this section and in any Letter of Authorization issued under § 216.106 and § 218.238 of this chapter must be implemented.

(a) *Personnel Training—Lookouts:* (1) The Navy shall train the lookouts in the most effective means to ensure quick and effective communication within the command structure in order to facilitate implementation of protective measures if they spot marine mammals.

(2) The Navy will hire one or more marine mammal biologist qualified in conducting at-sea marine mammal visual monitoring from surface vessels to train and qualify designated ship personnel to conduct at-sea visual monitoring.

(b) *General Operating Procedures:* (1) Prior to SURTASS LFA sonar operations, the Navy will promulgate executive guidance for the administration, execution, and compliance with the environmental regulations under this subpart and Letters of Authorization.

(2) The Holder of a Letter of Authorization will not transmit the SURTASS LFA sonar signal at a frequency greater than 500 Hz.

(c) *LFA Mitigation Zone and 1-km Buffer Zone:* (1) Prior to commencing and during SURTASS LFA sonar transmissions, the Holder of a Letter of Authorization will determine the propagation of LFA sonar signals in the ocean and the distance from the SURTASS LFA sonar source to the 180-decibel (dB) re: 1 μPa isopleth.

(2) The Holder of a Letter of Authorization will establish an 180-dB LFA mitigation zone around the surveillance vessel that is equal in size to the 180-dB re: 1 μPa isopleth (i.e., the area subjected to sound pressure levels of 180 dB or greater) as well as a one-kilometer (1-km) buffer zone around the LFA mitigation zone. If a marine mammal is detected, through monitoring required under § 218.235, within or about to enter the LFA mitigation zone plus the 1-km buffer zone, the Holder of the Authorization will immediately delay or suspend SURTASS LFA sonar transmissions.

(d) *Resumption of SURTASS LFA sonar transmissions:* (1) The Holder of a Letter of Authorization will not resume SURTASS LFA sonar transmissions earlier than 15 minutes after:

(i) All marine mammals have left the area of the LFA mitigation and buffer zones; and

(ii) There is no further detection of any marine mammal within the LFA mitigation and buffer zones 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 Holder of a Letter of Authorization will 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;

(ii) Prior to any SURTASS LFA sonar calibrations or testing that are not part of regular SURTASS LFA sonar transmissions described in § 218.230; and

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

(2) The Holder of a Letter of Authorization will 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) The Holder of a Letter of Authorization will not operate the SURTASS LFA sonar such that:

(i) The SURTASS LFA sonar sound field exceeds 180 dB re: 1 μPa (rms) at a distance less than 12 nautical miles (nmi) (22 kilometers (km)) from any coastline, including offshore islands;

(ii) The SURTASS LFA sonar sound field exceeds 180 dB re: 1 μPa (rms) at a distance less than 1 km (0.5 nm) seaward of the outer perimeter of any offshore biologically important area designated in § 218.234(f)(1)(iii) during the period specified.

(iii) Offshore Biologically Important Areas (OBIAs) for marine mammals (with specified periods) for SURTASS LFA sonar operations include the following:

Name of area	Location of area	Months of importance
Georges Bank	40°00′ N, 72°30′ W 39°37′ N, 72°09′ W. 39°54′ N, 71°43′ W. 40°02′ N, 71°20′ W. 40°08′ N, 71°01′ W. 40°04′ N, 70°44′ W. 40°00′ N, 69°24′ W. 40°16′ N, 68°27′ W. 40°34′ N, 67°13′ W. 41°00′ N, 66°24′ W. 41°52′ N, 65°47′ W. 42°20′ N, 66°06′ W. 42°18′ N, 67°23′ W.	Year-round.
Roseway Basin Right Whale Conservation Area	43°05′ N, 65°40′ 43°05′ N, 65°03′ W. 42°45′ N, 65°40′ W. 42°45′ N, 65°03′ W.	June through December, annually.
Great South Channel, U.S. Gulf of Maine, and Stellwagen Bank National Marine Sanctuary (NMS).	41°00.000′ N, 69°05.000′ W 42°09.000′ N, 67°08.400′ W. 42°53.436′ N, 67°43.873′ W. 44°12.541′ N, 67°16.847′ W. 44°14.911′ N, 67°08.936′ W. 44°21.538′ N, 67°03.663′ W. 44°26.736′ N, 67°09.596′ W. 44°16.805′ N, 67°27.394′ W. 44°11.118′ N, 67°56.398′ W. 43°59.240′ N, 68°08.263′ W. 43°36.800′ N, 68°46.496′ W. 43°33.925′ N, 69°19.455′ W. 43°32.008′ N, 69°44.504′ W. 43°21.922′ N, 70°06.257′ W. 43°04.084′ N, 70°21.418′ W. 42°51.982′ N, 70°31.965′ W. 42°45.187′ N, 70°23.396′ W. 42°39.068′ N, 70°30.188′ W. 42°32.892′ N, 70°35.873′ W. 42°07.748′ N, 70°28.257′ W. 42°05.592′ N, 70°02.136′ W. 42°03.664′ N, 69°44.000′ W. 41°40.000′ N, 69°45.000′ W.	January 1 to November 14, annually.
Southeastern U.S. Right Whale Seasonal Habitat.	Critical Habitat Boundaries are coastal waters between 31°15′ N and 30°15′ N from the coast out 15 nautical miles (nmi); and the coastal waters between 30°15′ N and 28°00′ N from the coast out 5 nmi. (50 CFR § 226.13(c)). OBIA Boundaries are coastal waters between 31°15′ N and 30°15′ N from 12 to 15 nmi.	November 15 to January 15, annually.
North Pacific Right Whale Critical Habitat	57°03′ N, 153°00′ W 57°18′ N, 151°30′ W 57°00′ N, 151°30′ W. 56°45′ N, 153°00′ W. (50 CFR § 226.215).	March through August, annually.
Silver Bank and Navidad Bank	Silver Bank 20°38.899 N, 69°23.640′ W 20°55.706′ N, 69°57.984′ W. 20°25.221′ N, 70°00.387′ W 20°12.833′ N, 69°40.604′ W. 20°13.918′ N, 69°31.518′ W. 20°28.680′ N, 69°31.900′ W. Navidad Bank: 20°15.596′ N, 68°47.967′ W 20°11.971′ N, 68°54.810′ W. 19°52.514′ N, 69°00.443′ W. 19°54.957′ N, 68°51.430′ W. 19°51.513′ N, 68°41.399′ W.	December through April, annually.

Name of area	Location of area	Months of importance
Coastal waters of Gabon, Congo and Equatorial Guinea.	An exclusion zone following the 500-m isobath extending from 3°31.055′ N, 9°12.226′ E in the north offshore of Malabo southward to 8°57.470′ S, 12°55.873′ E offshore of Luanda.	June through October.
Patagonian Shelf Break	Between 200- and 2000-m isobaths and the following latitudes: 35°00′ S, 39°00′ S, 40°40′ S, 42°30′ S, 46°00′ S, 48°50′ S.	Year-round.
Southern Right Whale Seasonal Habitat	Coastal waters between 42°00′ S and 43°00′ S from 12 to 15 nmi including the enclosed bays of Golfo Nuevo, Golfo San Jose and San Matias. Golfos San Jose and San Nuevo are within 22 km (12 nmi) coastal exclusion zone.	May through December, annually.
Central California National Marine Sanctuaries	Single stratum boundary created from the Cordell Bank (15 CFR 922.10), Gulf of the Farallones (15 CFR 922.80), and Monterey Bay (15 CFR 922.30) NMS legal boundaries. Monterey Bay NMS includes the Davidson Seamount Management Zone.	June through November, annually.
Antarctic Convergence Zone	30° E to 80° E, 45° S 80° E to 150° E, 55° S. 150° E to 50° W, 60° S. 50° W to 30° E, 50° S.	October through March, annually.
Piltun and Chayvo offshore feeding grounds in the Sea of Okhotsk.	54°09.436′ N, 143°47.408′ W 54°09.436′ N, 143°17.354′ W. 54°01.161′ N, 143°17.354′ W. 53°53.580′ N, 143°13.398′ W. 53°26.963′ N, 143°28.230′ W. 53°07.013′ N, 143°35.481′ W. 52°48.705′ N, 143°38.447′ W. 52°32.077′ N, 143°37.788′ W. 52°21.605′ N, 143°34.163′ W. 52°09.470′ N, 143°26.582′ W. 51°57.686′ N, 143°30.208′ W. 51°36.033′ N, 143°42.794′ W. 51°08.082′ N, 143°51.301′ W. 51°08.082′ N, 144°16.742′ W. 51°24.514′ N, 144°11.139′ W. 51°48.116′ N, 144°10.809′ W. 52°03.194′ N, 144°20.363′ W. 52°23.235′ N, 144°10.150′ W. 52°28.674′ N, 144°12.787′ W. 52°42.523′ N, 144°10.150′ W. 53°12.972′ N, 143°55.648′ W. 53°18.505′ N, 143°56.637′ W. 53°23.041′ N, 143°53.011′ W. 53°28.250′ N, 143°53.341′ W. 53°44.039′ N, 143°49.056′ W. 53°53.207′ N, 143°50.045′ W. 53°59.819′ N, 143°48.067′ W.	June through November, annually.
Coastal waters off Madagascar	16°03′55.04″ S, 50°27′12.59″ E 16°12′23.03″ S, 51°03′37.38″ E. 24°30′45.06″ S, 48°26′00.94″ E. 24°15′28.07″ S, 47°46′51.16″ E. 22°18′00.74″ S, 48°14′13.52″ E. 20°52′24.12″ S, 48°43′13.49″ E. 19°22′33.24″ S, 49°15′45.47″ E. 18°29′46.08″ S, 49°37′32.25″ E. 17°38′27.89″ S, 49°44′27.17″ E. 17°24′39.12″ S, 49°39′17.03″ E. 17°19′35.34″ S, 49°54′23.82″ E. 16°45′41.71″ S, 50°15′56.35″ E.	July through September, annually for humpback whale breeding and November through December, annually for migrating blue whales.
Madagascar Plateau, Madagascar Ridge, and Walters Shoal.	25°55′20.00″ S, 44°05′15.45″ E 25°46′31.36″ S, 47°22′35.90″ E. 27°02′37.71″ S, 48°03′31.08″ E. 35°13′51.37″ S, 46°26′19.98″ E. 35°14′28.59″ S, 42°35′49.20″ E. 31°36′57.96″ S, 42°37′49.35″ E. 27°41′11.21″ S, 44°30′11.01″ E.	November through December, annually.
Ligurian-Corsican-Provencal Basin and Western Pelagos Sanctuary in the Mediterranean Sea.	42°50.271′ N, 06°31.883′ E 42°55.603′ N, 06°43.418′ E. 43°04.374′ N, 06°52.165′ E. 43°12.600′ N, 07°10.440′ E.	July to August, annually.

Name of area	Location of area	Months of importance
	43°21.720′ N, 07°19.380′ E.	
	43°30.600′ N, 07°32.220′ E.	
	43°33.900′ N, 07°49.920′ E.	
	43°36.420′ N, 08°05.580′ E.	
	43°42.600′ N, 08°22.140′ E.	
	43°50.880′ N, 08°34.500′ E.	
	43°58.560′ N, 08°47.700′ E.	
	43°59.040′ N, 08°56.040′ E.	
	43°57.047′ N, 09°03.540′ E.	
	43°52.260′ N, 09°08.520′ E.	
	43°47.580′ N, 09°13.500′ E.	
	43°36.060′ N, 09°16.620′ E.	
	43°28.440′ N, 09°05.820′ E.	
	43°21.360′ N, 09°02.100′ E.	
	43°16.020′ N, 08°57.240′ E.	
	43°04.440′ N, 08°47.580′ E.	
	42°54.900′ N, 08°35.400′ E.	
	42°45.900′ N, 08°27.540′ E.	
	42°36.060′ N, 08°22.020′ E.	
	42°22.620′ N, 08°15.849′ E.	
	42°07.202′ N, 08°17.174′ E.	
	41°52.800′ N, 08°15.720′ E.	
	41°39.780′ N, 08°05.280′ E.	
	41°28.200′ N, 08°51.600′ E.	
	42°57.060′ N, 06°19.860′ E.	
Hawaiian Islands Humpback Whale NMS and Penguin Bank.	21°10′02.179″ N, 157°30′58.217″ W	November through April, annually.
	21°09′46.815″ N, 157°30′22.367″ W.	
	21°06′39.882″ N, 157°31′00.778″ W.	
	21°02′51.976″ N, 157°30′30.049″ W.	
	20°59′52.725″ N, 157°29′28.591″ W.	
	20°58′05.174″ N, 157°27′35.919″ W.	
	20°55′49.456″ N, 157°30′58.217″ W.	
	20°50′44.729″ N, 157°42′42.418″ W.	
	20°51′02.654″ N, 157°44′45.333″ W.	
	20°53′56.784″ N, 157°46′04.716″ W.	
	20°56′32.988″ N, 157°45′33.987″ W.	
	21°01′27.472″ N, 157°43′10.586″ W.	
	21°05′20.499″ N, 157°39′27.802″ W.	
	21°10′02.179″ N, 157°30′58.217″ W.	
Costa Rica Dome	Centered at 9° N and 88° W	Year-round.
Great Barrier Reef Between 16° S and 21° S	16°01.829′ S, 145°38.783′ E	May through September, annually.
	15°52.215′ S, 146°20.936′ E.	
	17°28.354′ S, 146°59.392′ E.	
	20°16.228′ S, 151°39.674′ E.	
	20°58.381′ S, 150°30.897′ E.	
	20°17.007′ S, 149°38.247′ E.	
	20°10.941′ S, 149°18.247′ E.	
	20°02.403′ S, 149°12.623′ E.	
	19°53.287′ S, 149°03.986′ E.	
	19°49.866′ S, 148°52.135′ E.	
	19°53.287′ S, 148°44.302′ E.	
	19°47.965′ S, 148°36.870′ E.	
	19°47.205′ S, 148°26.024′ E.	
	19°19.978′ S, 147°39.626′ E.	
	19°14.065′ S, 147°37.014′ E.	
	19°08.913′ S, 147°31.993′ E.	
	19°05.667′ S, 147°24.160′ E.	
	19°07.576′ S, 147°18.134′ E.	
	18°51.718′ S, 146°51.219′ E.	
	18°44.258′ S, 146°54.031′ E.	
	18°37.175′ S, 146°51.420′ E.	
	18°31.620′ S, 146°43.385′ E.	
	18°27.595′ S, 146°40.573′ E.	
	17°36.676′ S, 146°20.488′ E.	
	17°20.484′ S, 146°16.671′ E.	
	17°07.745′ S, 146°13.056′ E.	
	16°49.769′ S, 146°11.047′ E.	
	16°41.835′ S, 146°03.817′ E.	
	16°39.706′ S, 145°54.979′ E.	
Bonney Upwelling on the west coast of Australia.	37°12′20.036″ S, 139°31′17.703″ E	December through May, annually.
	37°37′33.815″ S, 139°42′42.508″ E.	
	38°10′36.144″ S, 140°22′57.345″ E.	
	38°44′50.558″ S, 141°33′50.342″ E.	
	39°07′04.125″ S, 141°11′00.733″ E.	

Name of area	Location of area	Months of importance
	37°28′33.179″ S, 139°10′52.263″ E.	
Northern Bay of Bengal and Head of Swatch-of-No-Ground.	20°59.735′ N, 89°07.675′ E	Year-round.
	20°55.494′ N, 89°09.484′ E.	
	20°52.883′ N, 89°12.704′ E.	
	20°55.275′ N, 89°18.133′ E.	
	21°04.558′ N, 89°25.294′ E.	
	21°12.655′ N, 89°25.354′ E.	
	21°13.279′ N, 89°16.833′ E.	
	21°06.347′ N, 89°15.011′ E.	
Olympic Coast NMS and Prairie, Barkley Canyon, and Nitnat Canyon.	Boundaries within 23 nmi (26.5 m; 42.6 km) of the coast from 47°07′ N to 48°30′ N latitude.	Olympic NMS: December, January, March, and May.
	48°30′01.995″ N, 125°58′38.786″ W	Prairie, Barkley Canyon, and Nitnat Canyon: June through September.
	48°16′55.605″ N, 125°38′52.052″ W.	
	48°23′07.353″ N, 125°17′10.935″ W.	
	48°12′38.241″ N, 125°16′42.339″ W.	
	47°58′20.361″ N, 125°31′14.517″ W.	
	47°58′20.361″ N, 126°06′16.322″ W.	
	48°09′46.665″ N, 126°25′48.758″ W.	

(2) [Reserved]

(g) *Operational Exception for the SURTASS LFA Sonar Sound Field*

(1) During military operations SURTASS LFA sonar transmissions may exceed 180 dB re: 1 μPa (rms) within the boundaries of a SURTASS LFA sonar OBIA when: (1) Operationally necessary to continue tracking an existing underwater contact; or (2) operationally necessary to detect a new underwater contact within the OBIA. This exception does not apply to routine training and testing with the SURTASS LFA sonar systems.

(2) [Reserved]

§ 218.235 Requirements for monitoring.

(a) In order to mitigate the taking of marine mammals by SURTASS LFA sonar to the greatest extent practicable, the Holder of a Letter of Authorization issued pursuant to §§ 216.106 and 218.238 of this chapter must:

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

(2) Use low frequency passive SURTASS sonar to listen for 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.

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

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

(2) Continue between transmission pings; and

(3) Continue either for at least 15 minutes after completion of the SURTASS LFA sonar transmission exercise, 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) Holders of Letters of Authorization for activities described in § 218.230 are required to cooperate with the National Marine Fisheries Service and any other federal agency for monitoring the impacts of the activity on marine mammals.

(d) Holders of Letters of Authorization must designate qualified on-site individuals to conduct the mitigation, monitoring and reporting activities specified in the Letter of Authorization.

(e) Holders of Letters of Authorization must conduct all monitoring required under the Letter of Authorization.

§ 218.236 Requirements for reporting.

(a) The Holder of the Letter of Authorization must submit classified and unclassified quarterly mission reports to the Director, Office of Protected Resources, NMFS, no later than 30 days after the end of each quarter beginning on the date of effectiveness of a Letter of Authorization or as specified in the appropriate Letter of Authorization. Each quarterly mission report will include all active-mode missions completed during that quarter. 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 Letter of Authorization; and

(4) Estimates of the percentages of marine mammal species and stocks affected (both for the quarter and cumulatively for the year) covered by the Letter of Authorization.

(b) The Holder of a Letter of Authorization must submit an unclassified annual report to the Director, Office of Protected Resources, NMFS, no later than 45 days after the expiration of a Letter of Authorization. The reports must contain all the information required by the Letter of Authorization.

(c) A final comprehensive report must be submitted to the Director, Office of Protected Resources, NMFS at least 240 days prior to expiration of this subpart. In addition to containing all the information required by any final year Letter of Authorization, this report must 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.

(d) 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.

§ 218.237 Applications for Letters of Authorization.

(a) To incidentally take marine mammals pursuant to this subpart, the U.S. Navy authority conducting the activity identified in § 218.230 must apply for and obtain a Letter of Authorization in accordance with § 216.106 of this chapter.

(b) The application for a Letter of Authorization must be submitted to the Director, Office of Protected Resources, NMFS, at least 60 days before the date that either the vessel is scheduled to begin conducting SURTASS LFA sonar operations or the previous Letter of Authorization is scheduled to expire.

(c) All applications for a Letter of Authorization must include the following information:

(1) The date(s), duration, and the area(s) where the vessel's activity will occur;

(2) The species and/or stock(s) of marine mammals likely to be found within each area;

(3) The type of incidental taking authorization requested (i.e., take by Level A and/or Level B harassment);

(4) The estimated percentage of marine mammal species/stocks potentially affected in each area for the period of effectiveness of the Letter of Authorization; and

(5) The means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species and the level of taking or impacts on marine mammal populations.

(d) The National Marine Fisheries Service will review an application for a Letter of Authorization in accordance with § 216.104(b) of this chapter and, if adequate and complete, issue a Letter of Authorization.

§ 218.238 Letters of Authorization.

(a) A Letter of Authorization, unless suspended or revoked, will be valid for a period of time not to exceed one year, but may be renewed annually subject to renewal conditions in § 218.239.

(b) Each Letter of Authorization will set forth:

(1) Permissible methods of incidental taking;

(2) Authorized geographic areas for incidental takings;

(3) Means of effecting the least practicable adverse impact on the species of marine mammals authorized for taking, their habitat, and the availability of the species for subsistence uses; and

(4) Requirements for monitoring and reporting incidental takes.

(c) Issuance of a Letter of Authorization will be based on a determination that the level of taking will be consistent with the findings made for the total taking allowable under this subpart.

(d) Notice of issuance or denial of an application for a Letter of Authorization will be published in the **Federal Register** within 30 days of a determination.

§ 218.239 Renewal of Letters of Authorization.

(a) A Letter of Authorization issued for the activity identified in § 218.230 may be renewed upon:

(1) Notification to NMFS that the activity described in the application submitted under § 218.237 will be undertaken and that there will not be a substantial modification to the described activity, mitigation or monitoring undertaken during the upcoming season;

(2) Notification to NMFS of the information identified in § 218.237(c);

(3) Timely receipt of the monitoring reports required under § 218.236, which have been reviewed by NMFS and determined to be acceptable;

(4) A determination by NMFS that the mitigation, monitoring and reporting measures required under §§ 218.234, 218.235, and 218.236 and the previous Letter of Authorization were undertaken and will be undertaken during the upcoming period of validity of a renewed Letter of Authorization; and

(5) A determination by NMFS that the level of taking will be consistent with the findings made for the total taking allowable under this subpart.

(b) If a request for a renewal of a Letter of Authorization indicates that a substantial modification to the described work, mitigation, or monitoring will occur, or if NMFS proposes a substantial modification to the Letter of Authorization, NMFS will provide a period of 30 days for public review and comment on the proposed modification. Amending the areas for upcoming SURTASS LFA sonar operations is not considered a substantial modification to the Letter of Authorization.

(c) A notice of issuance or denial of a renewal of a Letter of Authorization will be published in the **Federal Register** within 30 days of a determination.

§ 218.240 Modifications to Letters of Authorization.

(a) Except as provided in paragraph (b) of this section, no substantial modification (including withdrawal or suspension) to a Letter of Authorization subject to the provisions of this subpart shall be made by NMFS until after notification and an opportunity for public comment has been provided. For purposes of this paragraph, a renewal of a Letter of Authorization, without modification, except for the period of validity and a listing of planned operating areas, or for moving the authorized SURTASS LFA sonar system from one ship to another, is not considered a substantial modification.

(b) 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 § 218.230(b)(1), (2), or (3), NMFS may modify a Letter of Authorization without prior notice and opportunity for public comment. Notification will be published in the **Federal Register** within 30 days of the action.

§ 218.241 Adaptive Management.

NMFS may modify or augment the existing mitigation or monitoring measures (after consulting with the Navy regarding the practicability of the modifications) if doing so creates a reasonable likelihood of more effectively accomplishing the goals of mitigation and monitoring set forth in this subpart. NMFS will provide a period of 30 days for public review and comment if such modifications are substantial. Below are some of the possible sources of new data that could contribute to the decision to modify the mitigation or monitoring measures:

(a) Results from the Navy's monitoring from the previous year's operation of SURTASS LFA sonar.

(b) Compiled results of Navy-funded research and development studies.

(c) Results from specific stranding investigations.

(d) Results from general marine mammal and sound research funded by the Navy or other sponsors.

(e) Any information that reveals marine mammals may have been taken in a manner, extent or number not anticipated by this subpart or subsequent Letters of Authorization.

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