DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 218

[Docket No. 170918908–8501–01]

RIN 0648–BH29

Taking and Importing Marine Mammals; Taking Marine Mammals Incidental to the U.S. Navy Training and Testing Activities in the Hawaii-Southern California Training and Testing Study Area

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

ACTION: Proposed rule; request for comments and information.

SUMMARY: NMFS has received a request from the U.S. Navy (Navy) for authorization to take marine mammals incidental to the training and testing activities conducted in the Hawaii-Southern California Training and Testing (HSTT) Study Area. Pursuant to the Marine Mammal Protection Act (MMPA), NMFS is requesting comments on its proposal to issue regulations and subsequent Letters of Authorization (LOA) to the Navy to incidentally take marine mammals during the specified activities. NMFS will consider public comments prior to issuing any final rule and making final decisions on the issuance of the requested MMPA authorizations. Agency responses to public comments will be summarized in the final rule. The Navy's activities qualify as military readiness activities pursuant to the MMPA, as amended by the National Defense Authorization Act for Fiscal Year 2004 (2004 NDAA).

DATES: Comments and information must be received no later than August 9, 2018.

ADDRESSES: You may submit comments, identified by NOAA–NMFS–2018–0071, by any of the following methods:

- *Electronic submissions:* Submit all electronic public comments via the Federal eRulemaking Portal, Go to *www.regulations.gov/#!docketDetail;D=NOAA-NMFS-2018-0071*, click the ''Comment Now!'' icon, complete the required fields, and enter or attach your comments.
- *Mail:* Submit comments to Jolie Harrison, Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service, 1315 East-West Highway, Silver Spring, MD 20910–3225.
- *Fax:* (301) 713–0376; Attn: Jolie Harrison.

Instructions: Comments sent by any other method, to any other address or individual, or received after the end of the comment period, may not be considered by NMFS. All comments received are a part of the public record and will generally be posted for public viewing on *www.regulations.gov* without change. All personal identifying information (*e.g.,* name, address, etc.), confidential business information, or otherwise sensitive information submitted voluntarily by the sender 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, or Adobe PDF file formats only.

FOR FURTHER INFORMATION CONTACT: Stephanie Egger, Office of Protected Resources, NMFS; phone: (301) 427–8401. Electronic copies of the application and supporting documents, as well as a list of the references cited in this document, may be obtained online at: *www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-military-readiness-activities*. In case of problems accessing these documents, please call the contact listed above.

SUPPLEMENTARY INFORMATION:

Background

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

An authorization for incidental takings shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s), will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (where relevant), and if the permissible methods of taking and requirements pertaining to the mitigation, monitoring and reporting of such takings are set forth.

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.

NMFS has defined ''unmitigable adverse impact'' in 50 CFR 216.103 as an impact resulting from the specified activity:

(1) That is likely to reduce the availability of the species to a level insufficient for a harvest to meet subsistence needs by: (i) Causing the marine mammals to abandon or avoid hunting areas; (ii) directly displacing subsistence users; or (iii) placing physical barriers between the marine mammals and the subsistence hunters; and

(2) That cannot be sufficiently mitigated by other measures to increase the availability of marine mammals to allow subsistence needs to be met.

The MMPA states that the term ''take'' means to harass, hunt, capture, kill or attempt to harass, hunt, capture, or kill any marine mammal.

The 2004 NDAA (Pub. L. 108–136) removed the ''small numbers'' and ''specified geographical region'' limitations indicated above and amended the definition of ''harassment'' as it applies to a ''military readiness activity'' to read as follows (Section 3(18)(B) of the MMPA): (i) Any act that injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild (Level A Harassment); or (ii) Any act that disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns, including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering, to a point where such behavioral patterns are abandoned or significantly altered (Level B Harassment).

Summary of Request

On September 13, 2017, NMFS received an application from the Navy requesting incidental take regulations and two LOAs to take individuals of 39 marine mammal species by Level A and B harassment incidental to training and testing activities (categorized as military readiness activities) from the use of sonar and other transducers, in-water detonations, air guns, and impact pile driving/vibratory extraction in the HSTT Study Area over five years. In addition, the Navy is requesting incidental take authorization by serious injury or mortality of ten takes of two species due to explosives and for up to three takes of large whales from vessel strikes over the five-year period. The Navy's training and testing activities would occur over five years beginning in December 2018. On October 13, 2017, the Navy sent an amendment to its application and Navy's rulemaking/LOA application was considered final and complete.

The Navy requests two five-year LOAs, one for training and one for testing activities to be conducted within the HSTT Study Area (which extends from the north-central Pacific Ocean, from the mean high tide line in Southern California west to Hawaii and the International Date Line), including the Hawaii and Southern California (SOCAL) Range Complexes, as well as the Silver Strand Training Complex and overlapping a small portion of the Point Mugu Sea Range. The Hawaii Range Complex encompasses ocean areas around the Hawaiian Islands, extending from 16 degrees north latitude to 43 degrees north latitude and from 150 degrees west longitude to the International Date Line. The SOCAL Range Complex is located approximately between Dana Point and San Diego, California, and extends southwest into the Pacific Ocean and also includes a small portion of the Point Mugu Sea Range. The Silver Strand Training Complex is an integrated set of training areas located on and adjacent to the Silver Strand, a narrow, sandy isthmus separating the San Diego Bay from the Pacific Ocean. Please refer to Figure 1–1 of the Navy's rulemaking/LOA application for a map of the HSTT Study Area, Figures 2–1 to 2–4 for the Hawaii Operating Area (where the majority of training and testing activities occur within the Hawaii Range Complex), Figures 2–5 to 2–7 for the SOCAL Range Complex, and Figure 2–8 for the Silver Strand Training Complex. The following types of training and testing, which are classified as military readiness activities pursuant to the MMPA, as amended by the 2004 NDAA, would be covered under the LOAs (if authorized): Amphibious warfare (in-water detonations), anti-submarine warfare (sonar and other transducers, in-water detonations), surface warfare (in-water detonations), mine warfare (sonar and other transducers, in-water detonations), and other warfare activities (sonar and other transducers, pile driving, air guns).

This will be NMFS's third rulemaking (Hawaii and Southern California were separate rules in Phase I) for HSTT activities under the MMPA. NMFS published the first two rules for Phase I effective from January 5, 2009, through January 5, 2014, (74 FR 1456; on January 12, 2009) and effective January 14, 2009, through January 14, 2014 (74 FR 3882 on January 21, 2009) for Hawaii and Southern California, respectively. The rulemaking for Phase II (combined both Hawaii and Southern California) is applicable from December 24, 2013, through December 24, 2018 (78 FR 78106; on December 24, 2013). For this third rulemaking, the Navy is proposing to conduct similar activities as they have conducted over the past nine years under the previous rulemakings.

Background of Request

The Navy's mission is to organize, train, equip, and maintain combat-ready naval forces capable of winning wars, deterring aggression, and maintaining freedom of the seas. This mission is mandated by Federal law (10 U.S.C. 5062), which ensures the readiness of the naval forces of the United States. The Navy executes this responsibility by training and testing at sea, often in designated operating areas (OPAREA) and testing and training ranges. The Navy must be able to access and utilize these areas and associated sea space and air space in order to develop and maintain skills for conducting naval activities.

The Navy proposes to conduct training and testing activities within the HSTT Study Area. The Navy has been conducting similar military readiness activities in the Study Area since the 1940s. The tempo and types of training and testing activities have fluctuated because of the introduction of new technologies, the evolving nature of international events, advances in warfighting doctrine and procedures, and changes in force structure (organization of ships, weapons, and personnel). Such developments influence the frequency, duration, intensity, and location of required training and testing activities, but the basic nature of sonar and explosive events conducted in the HSTT Study Area has remained the same.

The Navy's rulemaking/LOA application reflects the most up to date compilation of training and testing activities deemed necessary to accomplish military readiness requirements. The types and numbers of activities included in the proposed rule account for fluctuations in training and testing in order to meet evolving or emergent military readiness requirements.

Description of the Specified Activity

The Navy is requesting authorization to take marine mammals incidental to conducting training and testing activities. The Navy has determined that acoustic and explosives stressors are most likely to result in impacts on marine mammals that could rise to the level of harassment. Detailed descriptions of these activities are provided in the HSTT Draft Environmental Impact Statement (DEIS)/Overseas EIS (OEIS) (DEIS/OEIS) and in the Navy's rule making/LOA application (*www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-military-readiness-activities*) and are summarized here.

Overview of Training and Testing Activities

The Navy routinely trains and tests in the HSTT Study Area in preparation for national defense missions. Training and testing activities covered in the Navy's rulemaking/LOA application are briefly described below, and in more detail within Chapter 2 of the HSTT DEIS/OEIS.

Primary Mission Areas

The Navy categorizes its activities into functional warfare areas called primary mission areas. These activities generally fall into the following seven primary mission areas: Air warfare; amphibious warfare; anti-submarine warfare (ASW); electronic warfare; expeditionary warfare; mine warfare (MIW); and surface warfare (SUW). Most activities addressed in the HSTT DEIS/OEIS are categorized under one of the primary mission areas; the testing community has three additional categories of activities for vessel evaluation, unmanned systems, and acoustic and oceanographic science and technology. Activities that do not fall within one of these areas are listed as ''other activities.'' Each warfare community (surface, subsurface, aviation, and special warfare) may train in some or all of these primary mission areas. The testing community also categorizes most, but not all, of its testing activities under these primary mission areas.

The Navy describes and analyzes the impacts of its training and testing activities within the HSTT DEIS/OEIS and the Navy's rulemaking/LOA application. In its assessment, the Navy concluded that sonar and other transducers, in-water detonations, air guns, and pile driving/removal were the stressors that would result in impacts on marine mammals that could rise to the level of harassment (and serious injury or mortality by explosives or by vessel strike) as defined under the MMPA. The Navy's rulemaking/LOA application provides the Navy's assessment of potential effects from these stressors in terms of the various warfare mission areas in which they would be conducted. In terms of Navy's primary warfare areas, this includes:

- Amphibious warfare (in-water detonations);
- ASW (sonar and other transducers, in-water detonations);
- SUW (in-water detonations);
- MIW (sonar and other transducers, in-water detonations); and
- Other warfare activities (sonar and other transducers, impact pile driving/vibratory removal, air guns).

The Navy's training and testing activities in air warfare, electronic warfare, and expeditionary warfare do not involve sonar or other transducers, in-water detonations, pile driving/removal, air guns or any other stressors that could result in harassment, serious injury, or mortality of marine mammals. Therefore, activities in the air, electronic or expeditionary warfare areas are not discussed further in this proposed rule, but are analyzed fully in the Navy's HSTT DEIS/OEIS.

Amphibious Warfare

The mission of amphibious warfare is to project military power from the sea to the shore (*i.e.,* attack a threat on land by a military force embarked on ships) through the use of naval firepower and expeditionary landing forces. Amphibious warfare operations range from small unit reconnaissance or raid missions to large scale amphibious exercises involving multiple ships and aircraft combined into a strike group.

Amphibious warfare training ranges from individual, crew, and small unit events to large task force exercises. Individual and crew training include amphibious vehicles and naval gunfire support training. Such training includes shore assaults, boat raids, airfield or port seizures, and reconnaissance. Large scale amphibious exercises involve ship-to-shore maneuver, naval fire support, such as shore bombardment, and air strike and attacks on targets that are in close proximity to friendly forces.

Testing of guns, munitions, aircraft, ships, and amphibious vessels and vehicles used in amphibious warfare is often integrated into training activities and, in most cases, the systems are used in the same manner in which they are used for fleet training activities. Amphibious warfare tests, when integrated with training activities or conducted separately as full operational evaluations on existing amphibious vessels and vehicles following maintenance, repair, or modernization, may be conducted independently or in conjunction with other amphibious ship and aircraft activities. Testing is performed to ensure effective ship-to-shore coordination and transport of personnel, equipment, and supplies. Tests may also be conducted periodically on other systems, vessels, and aircraft intended for amphibious operations to assess operability and to investigate efficacy of new technologies.

Anti-Submarine Warfare

The mission of ASW is to locate, neutralize, and defeat hostile submarine forces that threaten Navy forces. ASW is based on the principle that surveillance and attack aircraft, ships, and submarines all search for hostile submarines. These forces operate together or independently to gain early warning and detection, and to localize, track, target, and attack submarine threats. ASW training addresses basic skills such as detecting and classifying submarines, as well as evaluating sounds to distinguish between enemy submarines and friendly submarines, ships, and marine life. More advanced training integrates the full spectrum of ASW from detecting and tracking a submarine to attacking a target using either exercise torpedoes (*i.e.,* torpedoes that do not contain a warhead) or simulated weapons. These integrated ASW training exercises are conducted in coordinated, at-sea training events involving submarines, ships, and aircraft. Testing of ASW systems is conducted to develop new technologies and assess weapon performance and operability with new systems and platforms, such as unmanned systems. Testing uses ships, submarines, and aircraft to demonstrate capabilities of torpedoes, missiles, countermeasure systems, and underwater surveillance and communications systems. Tests may be conducted as part of a large-scale fleet training event involving submarines, ships, fixed-wing aircraft, and helicopters. These integrated training events offer opportunities to conduct research and acquisition activities and to train crews in the use of new or newly enhanced systems during a large-scale, complex exercise.

Mine Warfare

The mission of MIW is to detect, classify, and avoid or neutralize (disable) mines to protect Navy ships and submarines and to maintain free access to ports and shipping lanes. MIW also includes offensive mine laying to gain control of or deny the enemy access to sea space. Naval mines can be laid by ships, submarines, or aircraft. MIW neutralization training includes exercises in which ships, aircraft, submarines, underwater vehicles, unmanned vehicles, or marine mammal detection systems search for mine shapes. Personnel train to destroy or disable mines by attaching underwater explosives to or near the mine or using remotely operated vehicles to destroy the mine. Towed influence mine sweep systems mimic a particular ship's magnetic and acoustic signature, which would trigger a real mine causing it to explode.

Testing and development of MIW systems is conducted to improve sonar, laser, and magnetic detectors intended to hunt, locate, and record the positions of mines for avoidance or subsequent neutralization. MIW testing and development falls into two primary categories: Mine detection or classification, and mine countermeasure and neutralization. Mine detection or classification testing involves the use of air, surface, and subsurface vessels and uses sonar, including towed and sidescan sonar, and unmanned vehicles to locate and identify objects underwater. Mine detection and classification systems are sometimes used in conjunction with a mine neutralization system. Mine countermeasure and neutralization testing includes the use of air, surface, and subsurface units to evaluate the effectiveness of detection systems, countermeasure and neutralization systems. Most neutralization tests use mine shapes, or non-explosive practice mines, to evaluate a new or enhanced capability. For example, during a mine neutralization test, a previously located mine is destroyed or rendered nonfunctional using a helicopter or manned/unmanned surface vehicle based system that may involve the deployment of a towed neutralization system.

A small percentage of MIW tests require the use of high-explosive mines to evaluate and confirm the ability of the system or the crews conducting the training or testing to neutralize a high-explosive mine under operational conditions. The majority of MIW systems are deployed by ships, helicopters, and unmanned vehicles. Tests may also be conducted in support of scientific research to support these new technologies.

Surface Warfare (SUW)

The mission of SUW is to obtain control of sea space from which naval forces may operate, and conduct offensive action against other surface, subsurface, and air targets while also defending against enemy forces. In conducting SUW, aircraft use guns, air-launched cruise missiles, or other precision-guided munitions; ships employ torpedoes, naval guns, and surface-to-surface missiles; and submarines attack surface ships using torpedoes or submarine-launched, anti-ship cruise missiles. SUW includes surface-to-surface gunnery and missile exercises; air-to-surface gunnery, bombing, and missile exercises; submarine missile or torpedo launch events, and the use of other munitions against surface targets.

Testing of weapons used in SUW is conducted to develop new technologies and to assess weapon performance and operability with new systems and platforms, such as unmanned systems. Tests include various air-to-surface guns and missiles, surface-to-surface guns and missiles, and bombing tests. Testing events may be integrated into training activities to test aircraft or aircraft systems in the delivery of munitions on a surface target. In most cases the tested systems are used in the same manner in which they are used for fleet training activities.

Other Warfare Activities

Naval forces conduct additional training, testing and maintenance activities, which fall under other primary mission areas that are not listed above. The HSTT DEIS/OEIS combines these training and testing activities together in an ''other activities'' grouping for simplicity. These training and testing activities include, but are not limited to, sonar maintenance for ships and submarines, submarine navigation and under-ice certification, elevated causeway system (pile driving and removal), and acoustic and oceanographic research. These activities include the use of various sonar systems, impact pile driving/vibratory extraction, and air guns.

Overview of Major Training Exercises and Other Exercises Within the HSTT Study Area

A major training exercise (MTE) is comprised of several ''unit level'' range exercises conducted by several units operating together while commanded and controlled by a single commander. These exercises typically employ an exercise scenario developed to train and evaluate the strike group in naval tactical tasks. In an MTE, most of the activities being directed and coordinated by the strike group commander are identical in nature to the activities conducted during individual, crew, and smaller unit level training events. In an MTE, however, these disparate training tasks are conducted in concert, rather than in isolation. Some integrated or coordinated ASW exercises are similar in that they are comprised of several unit level exercises but are generally on a smaller scale than an MTE, are shorter in duration, use fewer assets, and use fewer hours of hull-mounted sonar per exercise. For the purpose of analysis, three key factors are used to identify and group major, integrated, and coordinated exercises including the scale of the exercise, duration of the exercise, and amount of hull-mounted sonar hours modeled/used for the exercise. NMFS considered the effects of all training exercises, not just these major, integrated, and coordinated training exercises in this proposed rule.

Overview of Testing Activities Within the HSTT Study Area

The Navy's research and acquisition community engages in a broad spectrum of testing activities in support of the fleet. These activities include, but are not limited to, basic and applied scientific research and technology development; testing, evaluation, and maintenance of systems (*e.g.,* missiles, radar, and sonar) and platforms (*e.g.,* surface ships, submarines, and aircraft); and acquisition of systems and platforms to support Navy missions and give a technological edge over adversaries. The individual commands within the research and acquisition community included in the Navy's rulemaking/LOA application are the Naval Air Systems Command, the Naval Sea Systems Command, the Office of Naval Research, and the Space and Naval Warfare Systems Command.

Testing activities occur in response to emerging science or fleet operational needs. For example, future Navy experiments to develop a better understanding of ocean currents may be designed based on advancements made by non-government researchers not yet published in the scientific literature. Similarly, future but yet unknown Navy operations within a specific geographic area may require development of modified Navy assets to address local conditions. However, any evolving testing activities that would be covered under this rule would be expected to fall within the range of platforms, activities, sound sources, and other equipment described in this rule and to have impacts that fall within the range (*i.e.,* nature and extent) of those covered within the rule. For example, the Navy identifies ''bins'' of sound sources to facilitate analyses—*i.e.,* they identify frequency and source level bounds to a bin and then analyze the worst case scenario for that bin to understand the impacts of all of the sources that fall within a bin. While the Navy might be aware that sound source *e.g.,* XYZ1 will definitely be used this year, sound source *e.g.,* XYZ2 might evolve for testing three years from now, but if it falls within the bounds of the same sound source bin, it has been analyzed and any resulting take authorized.

Some testing activities are similar to training activities conducted by the fleet. For example, both the fleet and the research and acquisition community fire torpedoes. While the firing of a torpedo might look identical to an observer, the difference is in the purpose of the firing. The fleet might fire the torpedo to practice the procedures for such a firing, whereas the research and acquisition community might be assessing a new torpedo guidance technology or testing it to ensure the torpedo meets performance specifications and operational requirements.

Naval Air Systems Command Testing Activities

Naval Air Systems Command testing activities generally fall in the primary mission areas used by the fleets. Naval Air Systems Command activities include, but are not limited to, the testing of new aircraft platforms (*e.g.,* the F–35 Joint Strike Fighter aircraft), weapons, and systems (*e.g.,* newly developed sonobuoys) that will ultimately be integrated into fleet training activities. In addition to the testing of new platforms, weapons, and systems, Naval Air Systems Command also conducts lot acceptance testing of weapons and systems, such as sonobuoys.

Naval Sea Systems Command Testing Activities

Naval Sea Systems Command activities are generally aligned with the primary mission areas used by the fleets. Additional activities include, but are not limited to, vessel evaluation, unmanned systems, and other testing activities. In the Navy's rulemaking/LOA application, for testing activities occurring at Navy shipyards and piers, only system testing is included.

Testing activities are conducted throughout the life of a Navy ship, from construction through deactivation from the fleet, to verification of performance and mission capabilities. Activities include pierside and at-sea testing of ship systems, including sonar, acoustic countermeasures, radars, torpedoes, weapons, unmanned systems, and radio equipment; tests to determine how the ship performs at sea (sea trials); development and operational test and evaluation programs for new technologies and systems; and testing on all ships and systems that have undergone overhaul or maintenance.

Office of Naval Research Testing Activities

As the Department of the Navy's science and technology provider, the Office of Naval Research provides technology solutions for Navy and Marine Corps needs. The Office of Naval Research's mission is to plan, foster, and encourage scientific research in recognition of its paramount importance as related to the maintenance of future naval power, and the preservation of national security. The Office of Naval Research manages the Navy's basic, applied, and advanced research to foster transition from science and technology to higher levels of research, development, test, and evaluation. The Office of Naval Research is also a parent organization for the Naval Research Laboratory, which operates as the Navy's corporate research laboratory and conducts a broad multidisciplinary program of scientific research and advanced technological development. Testing conducted by the Office of Naval Research in the HSTT Study Area includes acoustic and oceanographic research, large displacement unmanned underwater vehicle (an innovative naval prototype) research, and emerging mine countermeasure technology research.

Space and Naval Warfare Systems Command Testing Activities

Space and Naval Warfare Systems Command is the information warfare systems command for the U.S. Navy. The mission of the Space and Naval Warfare Systems Command is to acquire, develop, deliver, and sustain decision superiority for the warfighter. Space and Naval Warfare Systems Command Systems Center Pacific is the research and development part of Space and Naval Warfare Systems Command focused on developing and transitioning technologies in the area of command, control, communications, computers, intelligence, surveillance, and reconnaissance. Space and Naval Warfare Systems Command Systems Center Pacific conducts research, development, test, and evaluation projects to support emerging technologies for intelligence, surveillance, and reconnaissance; anti-terrorism and force protection; mine countermeasures; anti-submarine warfare; oceanographic research; remote sensing; and communications. These activities include, but are not limited to, the testing of surface and subsurface vehicles; intelligence, surveillance, and reconnaissance/information operations sensor systems; underwater surveillance technologies; and underwater communications.

The proposed training and testing activities were evaluated to identify specific components that could act as stressors (*e.g.,* acoustic and explosive) by having direct or indirect impacts on the environment. This analysis included identification of the spatial variation of the identified stressors.

Description of Acoustic and Explosive Stressors

The Navy uses a variety of sensors, platforms, weapons, and other devices, including ones used to ensure the safety of Sailors and Marines, to meet its mission. Training and testing with these systems may introduce acoustic (sound) energy or shock waves from explosives into the environment. The Navy's rulemaking/LOA application describes specific components that could act as stressors by having direct or indirect impacts on the environment. This analysis includes identification of the spatial variation of the identified stressors. The following subsections describe the acoustic and explosive stressors for biological resources within the Study Area. Stressor/resource interactions that were determined to have de minimus or no impacts (*i.e.,* vessel, aircraft, weapons noise, and explosions in air) were not carried forward for analysis in the Navy's rulemaking/LOA application. NMFS has reviewed the Navy's analysis and conclusions and finds them complete and supportable.

Acoustic Stressors

Acoustic stressors include acoustic signals emitted into the water for a specific purpose, such as sonar, other transducers (devices that convert energy from one form to another—in this case, to sound waves), and air guns, as well as incidental sources of broadband sound produced as a byproduct of impact pile driving and vibratory extraction. Explosives also produce broadband sound but are characterized separately from other acoustic sources due to their unique hazardous characteristics. Characteristics of each of these sound sources are described in the following sections.

In order to better organize and facilitate the analysis of approximately 300 sources of underwater sound used for training and testing by the Navy, including sonars, other transducers, air guns, and explosives, a series of source classifications, or source bins, was developed. The source classification bins do not include the broadband sounds produced incidental to pile driving, vessel or aircraft transits, weapons firing and bow shocks.

The use of source classification bins provides the following benefits: Provides the ability for new sensors or munitions to be covered under existing authorizations, as long as those sources fall within the parameters of a ''bin;'' improves efficiency of source utilization data collection and reporting requirements anticipated under the MMPA authorizations; ensures a conservative approach to all impact estimates, as all sources within a given class are modeled as the most impactful source (highest source level, longest duty cycle, or largest net explosive weight) within that bin; allows analyses to be conducted in a more efficient manner, without any compromise of analytical results; and provides a framework to support the reallocation of source usage (hours/explosives) between different source bins, as long as the total numbers of takes remain within the overall analyzed and authorized limits. This flexibility is required to support evolving Navy training and testing requirements, which are linked to real world events.

Sonar and Other Transducers

Active sonar and other transducers emit non-impulsive sound waves into the water to detect objects, safely navigate, and communicate. Passive sonars differ from active sound sources in that they do not emit acoustic signals; rather, they only receive acoustic information about the environment, or listen. In the Navy's rulemaking/LOA application, the terms sonar and other transducers are used to indicate active sound sources unless otherwise specified.

The Navy employs a variety of sonars and other transducers to obtain and transmit information about the undersea environment. Some examples are mid-frequency hull-mounted sonars used to find and track enemy submarines; high-frequency small object detection sonars used to detect mines; high frequency underwater modems used to transfer data over short ranges; and extremely high-frequency (>200 kilohertz (kHz)) Doppler sonars used for navigation, like those used on commercial and private vessels. The characteristics of these sonars and other transducers, such as source level, beam width, directivity, and frequency, depend on the purpose of the source. Higher frequencies can carry more information or provide more information about objects off which they reflect, but attenuate more rapidly. Lower frequencies attenuate less rapidly, so may detect objects over a longer distance, but with less detail.

Propagation of sound produced underwater is highly dependent on environmental characteristics such as bathymetry, bottom type, water depth, temperature, and salinity. The sound received at a particular location will be different than near the source due to the interaction of many factors, including propagation loss; how the sound is reflected, refracted, or scattered; the potential for reverberation; and interference due to multi-path propagation. In addition, absorption greatly affects the distance over which higher-frequency sounds propagate. Because of the complexity of analyzing sound propagation in the ocean environment, the Navy relies on acoustic models in its environmental analyses that consider sound source characteristics and varying ocean conditions across the HSTT Study Area.

The sound sources and platforms typically used in naval activities analyzed in the Navy's rulemaking/LOA application are described in Appendix A (Navy Activity Descriptions) of the HSTT DEIS/OEIS. The effects of these factors are explained in Appendix D (Acoustic and Explosive Concepts) of the HSTT DEIS/OEIS. Sonars and other transducers used to obtain and transmit information underwater during Navy training and testing activities generally fall into several categories of use described below.

Anti-Submarine Warfare

Sonar used during ASW would impart the greatest amount of acoustic energy of any category of sonar and other transducers analyzed in the Navy's rulemaking/LOA application. Types of sonars used to detect enemy vessels include hull-mounted, towed, line array, sonobuoy, helicopter dipping, and torpedo sonars. In addition, acoustic targets and decoys (countermeasures) may be deployed to emulate the sound signatures of vessels or repeat received signals.

Most ASW sonars are mid frequency (1–10 kHz) because mid-frequency sound balances sufficient resolution to identify targets with distance over which threats can be identified. However, some sources may use higher or lower frequencies. Duty cycles (the percentage of time acoustic energy is transmitted) can vary widely, from intermittently active to continuously active. For the duty cycle for the AN/SQS–53C, nominally they produce a 1–2 sec ping every 50–60 sec. Continuous active sonars often have substantially lower source levels but transmit the sonar signal much more frequently (greater than 80 percent of the time) when they are on. The beam width of ASW sonars can be wide-ranging in a search mode or highly directional in a track mode.

Most ASW activities involving submarines or submarine targets would occur in waters greater than 600 feet (ft) deep due to safety concerns about running aground at shallower depths. Sonars used for ASW activities would typically be used in waters greater than 200 meters (m) which can vary from beyond three nautical miles (nmi) to 12 nmi or more from shore depending on local bathymetry. Exceptions include use of dipping sonar by helicopters, maintenance of vessel systems while in port, and system checks while vessels transit to or from port.

Mine Warfare, Small Object Detection, and Imaging

Sonars used to locate mines and other small objects, as well those used in imaging (*e.g.,* for hull inspections or imaging of the seafloor), are typically high frequency or very high frequency. Higher frequencies allow for greater resolution but, due to their greater attenuation, are most effective over shorter distances. Mine detection sonar can be deployed (towed or vessel hull-mounted) at variable depths on moving platforms (ships, helicopters, or unmanned vehicles) to sweep a suspected mined area. Most hull-mounted anti-submarine sonars can also be used in an object detection mode known as ''Kingfisher'' mode. Sonars used for imaging are usually used in close proximity to the area of interest, such as pointing downward near the seafloor.

Mine detection sonar use would be concentrated in areas where practice mines are deployed, typically in water depths less than 200 ft and at established minefields or temporary minefields close to strategic ports and harbors. Kingfisher mode on vessels is most likely to be used when transiting to and from port. Sound sources used for imaging could be used throughout the HSTT Study Area.

Navigation and Safety

Similar to commercial and private vessels, Navy vessels employ navigational acoustic devices including speed logs, Doppler sonars for ship positioning, and fathometers. These may be in use at any time for safe vessel operation. These sources are typically highly directional to obtain specific navigational data.

Communication

Sound sources used to transmit data (such as underwater modems), provide location (pingers), or send a single brief release signal to bottom-mounted devices (acoustic release) may be used throughout the HSTT Study Area. These sources typically have low duty cycles and are usually only used when it is desirable to send a detectable acoustic message.

Classification of Sonar and Other Transducers

Sonars and other transducers are grouped into classes that share an attribute, such as frequency range or purpose of use. Classes are further sorted by bins based on the frequency or bandwidth; source level; and, when warranted, the application in which the source would be used, as follows:

- Frequency of the non-impulsive acoustic source;
  - Low-frequency sources operate below 1 kHz;
  - Mid-frequency sources operate at and above 1 kHz, up to and including 10 kHz;
  - High-frequency sources operate above 10 kHz, up to and including 100 kHz;
  - Very high-frequency sources operate above 100 kHz but below 200 kHz;
- Sound pressure level of the non-impulsive source;
  - Greater than 160 decibels (dB) re 1 micro Pascal (μPa), but less than 180 dB re 1 μPa;
  - Equal to 180 dB re 1 μPa and up to 200 dB re 1 μPa;
  - Greater than 200 dB re 1 μPa;
- Application in which the source would be used;
  - Sources with similar functions that have similar characteristics, such as pulse length (duration of each pulse), beam pattern, and duty cycle.

The bins used for classifying active sonars and transducers that are quantitatively analyzed in the HSTT Study Area are shown in Table 1 below. While general parameters or source characteristics are shown in the table, actual source parameters are classified.

TABLE 1—SONAR AND TRANSDUCERS QUANTITATIVELY ANALYZED

Source class category	Bin	Description
Low-Frequency (LF): Sources that produce signals less than 1 kHz.	LF3	LF sources greater than 200 dB.
	LF4	LF sources equal to 180 dB and up to 200 dB.
	LF5	LF sources less than 180 dB.
	LF6	LF sources greater than 200 dB with long pulse lengths.
Mid-Frequency (MF): Tactical and non-tactical sources that produce signals between 1–10 kHz.	MF1	Hull-mounted surface ship sonars (*e.g.,* AN/SQS–53C and AN/SQS–60).
	MF1K	Kingfisher mode associated with MF1 sonars.
	MF3	Hull-mounted submarine sonars (*e.g.,* AN/BQQ–10).
	MF4	Helicopter-deployed dipping sonars (*e.g.,* AN/AQS–22).
	MF5	Active acoustic sonobuoys (*e.g.,* DICASS).
	MF6	Active underwater sound signal devices (*e.g.,* MK84).
	MF8	Active sources (greater than 200 dB) not otherwise binned.
	MF9	Active sources (equal to 180 dB and up to 200 dB) not otherwise binned.
	MF10	Active sources (greater than 160 dB, but less than 180 dB) not otherwise binned.
	MF11	Hull-mounted surface ship sonars with an active duty cycle greater than 80%.
	MF12	Towed array surface ship sonars with an active duty cycle greater than 80%.
	MF14	Oceanographic MF sonar.
High-Frequency (HF): Tactical and non-tactical sources that produce signals between 10–100 kHz.	HF1	Hull-mounted submarine sonars (*e.g.,* AN/BQQ–10).
	HF3	Other hull-mounted submarine sonars (classified).
	HF4	Mine detection, classification, and neutralization sonar *(e.g.,* AQS–20).
	HF5	Active sources (greater than 200 dB) not otherwise binned.
	HF6	Active sources (equal to 180 dB and up to 200 dB) not otherwise binned.
	HF7	Active sources (greater than 160 dB, but less than 180 dB) not otherwise binned.
	HF8	Hull-mounted surface ship sonars (*e.g.,* AN/SQS–61).
Very High-Frequency Sonars (VHF): Non-tactical sources that produce signals between 100–200 kHz.	VHF1	VHF sources greater than 200 dB.
Anti-Submarine Warfare (ASW): Tactical sources (*e.g.*, active sonobuoys and acoustic counter-measures systems) used during ASW training and testing activities.	ASW1	MF systems operating above 200 dB.
	ASW2	MF Multistatic Active Coherent sonobuoy (*e.g.,* AN/SSQ–125).
	ASW3	MF towed active acoustic countermeasure systems (*e.g.,* AN/SLQ–25).
	ASW4	MF expendable active acoustic device countermeasures (*e.g.,* MK 3).
	ASW5	MF sonobuoys with high duty cycles.
Torpedoes (TORP): Source classes associated with the active acoustic signals produced by torpedoes.	TORP1	Lightweight torpedo (*e.g.,* MK 46, MK 54, or Anti-Torpedo Torpedo).
	TORP2	Heavyweight torpedo (*e.g.,* MK 48).
	TORP3	Heavyweight torpedo (*e.g.,* MK 48).
Forward Looking Sonar (FLS): Forward or upward looking object avoidance sonars used for ship navigation and safety.	FLS2	HF sources with short pulse lengths, narrow beam widths, and focused beam patterns.
Acoustic Modems (M): Systems used to transmit data through the water.	M3	MF acoustic modems (greater than 190 dB).
Swimmer Detection Sonars (SD): Systems used to detect divers and submerged swimmers.	SD1–SD2	HF and VHF sources with short pulse lengths, used for the detection of swimmers and other objects for the purpose of port security.
Synthetic Aperture Sonars (SAS): Sonars in which active acoustic signals are post-processed to form high-resolution images of the seafloor.	SAS1	MF SAS systems.
	SAS2	HF SAS systems.
	SAS3	VHF SAS systems.
	SAS4	MF to HF broadband mine countermeasure sonar.
Broadband Sound Sources (BB): Sonar systems with large frequency spectra, used for various purposes.	BB1	MF to HF mine countermeasure sonar.
	BB2	HF to VHF mine countermeasure sonar.
	BB4	LF to MF oceanographic source.
	BB5	LF to MF oceanographic source.
	BB6	HF oceanographic source.
	BB7	LF oceanographic source.

Notes: ASW: Antisubmarine Warfare; BB: Broadband Sound Sources; FLS: Forward Looking Sonar; HF: High-Frequency; LF: Low-Frequency; M: Acoustic Modems; MF: Mid-Frequency; SAS: Synthetic Aperture Sonars; SD: Swimmer Detection Sonars; TORP: Torpedoes; VHF: Very High-Frequency.

Air Guns

Air guns are essentially stainless steel tubes charged with high-pressure air via a compressor. An impulsive sound is generated when the air is almost instantaneously released into the surrounding water. Small air guns with capacities up to 60 cubic inches (in^3) would be used during testing activities in various offshore areas of the Southern California Range Complex and in the Hawaii Range Complex.

Generated impulses would have short durations, typically a few hundred milliseconds, with dominant frequencies below 1 kHz. The root-mean-square sound pressure level (SPL) and peak pressure (SPL peak) at a distance 1 m from the air gun would be approximately 215 dB re 1 µPa and 227 dB re 1 µPa, respectively, if operated at the full capacity of 60 in^3. The size of the air gun chamber can be adjusted, which would result in lower SPLs and sound exposure level (SEL) per shot.

Pile Driving/Extraction

Impact pile driving and vibratory pile removal would occur during construction of an Elevated Causeway System (ELCAS), a temporary pier that allows the offloading of ships in areas without a permanent port. Construction of the elevated causeway could occur in sandy shallow water coastal areas at Silver Strand Training Complex and at Camp Pendleton, both in the Southern California Range Complex.

Installing piles for elevated causeways would involve the use of an impact hammer (impulsive) mechanism with both it and the pile held in place by a crane. The hammer rests on the pile, and the assemblage is then placed in position vertically on the beach or, when offshore, positioned with the pile in the water and resting on the seafloor. When the pile driving starts, the hammer part of the mechanism is raised up and allowed to fall, transferring energy to the top of the pile. The pile is thereby driven into the sediment by a repeated series of these hammer blows. Each blow results in an impulsive sound emanating from the length of the pile into the water column as well as from the bottom of the pile through the sediment. Because the impact wave travels through the steel pile at speeds faster than the speed of sound in water, a steep-fronted acoustic shock wave is formed in the water (note this shock wave has very low peak pressure compared to a shock wave from an explosive) (Reinhall and Dahl, 2011). An impact pile driver generally operates on average 35 blows per minute.

Pile removal involves the use of vibratory extraction (non-impulsive), during which the vibratory hammer is suspended from the crane and attached to the top of a pile. The pile is then vibrated by hydraulic motors rotating eccentric weights in the mechanism, causing a rapid up and down vibration in the pile. This vibration causes the sediment particles in contact with the pile to lose frictional grip on the pile. The crane slowly lifts up on the vibratory driver and pile until the pile is free of the sediment. Vibratory removal creates continuous non-impulsive noise at low source levels for a short duration.

The source levels of the noise produced by impact pile driving and vibratory pile removal from an actual ELCAS pile driving and removal are shown in Table 2.

TABLE 2—ELEVATED CAUSEWAY SYSTEM PILE DRIVING AND REMOVAL UNDERWATER SOUND LEVELS

Pile size and type	Method	Average sound levels at 10 m
24-in. Steel Pipe Pile	Impact [1]	192 dB re 1 µPa SPL rms. 182 dB re 1 µPa^{2}s SEL (single strike).
24-in. Steel Pipe Pile	Vibratory [2]	146 dB re 1 µPa SPL rms. 145 dB re 1 µPa^{2}s SEL (per second of duration).

[1] Illingworth and Rodkin (2016).
[2] Illingworth and Rodkin (2015).
Notes: in = inch, SEL = Sound Exposure Level, SPL = Sound Pressure Level, rms = root mean squared, dB re 1 µPa = decibels referenced to 1 micropascal.

In addition to underwater noise, the installation and removal of piles also results in airborne noise in the environment. Impact pile driving creates in-air impulsive sound about 100 dBA re 20 µPa at a range of 15 m (Illingworth and Rodkin, 2016). During vibratory extraction, the three aspects that generate airborne noise are the crane, the power plant, and the vibratory extractor. The average sound level recorded in air during vibratory extraction was about 85 dBA re 20 µPa (94 dB re 20 µPa) within a range of 10–15 m (Illingworth and Rodkin, 2015).

The size of the pier and number of piles used in an ELCAS event is approximately 1,520 ft long, requiring 119 supporting piles. Construction of the ELCAS would involve intermittent impact pile driving over approximately 20 days. Crews work 24 hours (hrs) a day and would drive approximately 6 piles in that period. Each pile takes about 15 minutes to drive with time taken between piles to reposition the driver. When training events that use the ELCAS are complete, the structure would be removed using vibratory methods over approximately 10 days. Crews would remove about 12 piles per 24-hour period, each taking about 6 minutes to remove.

Pile driving for ELCAS training would occur in shallower water, and sound could be transmitted on direct paths through the water, be reflected at the water surface or bottom, or travel through bottom substrate. Soft substrates such as sand bottom at the proposed ELCAS locations would absorb or attenuate the sound more readily than hard substrates (rock), which may reflect the acoustic wave. Most acoustic energy would be concentrated below 1,000 hertz (Hz) (Hildebrand, 2009).

Explosive Stressors

This section describes the characteristics of explosions during naval training and testing. The activities analyzed in the Navy's rulemaking/LOA application that use explosives are described in Appendix A (Navy Activity Descriptions) of the HSTT DEIS/OEIS. Explanations of the terminology and metrics used when describing explosives in the Navy's rulemaking/LOA application are also in Appendix D (Acoustic and Explosive Concepts) of the HSTT DEIS/OEIS.

The near-instantaneous rise from ambient to an extremely high peak pressure is what makes an explosive shock wave potentially damaging. Farther from an explosive, the peak pressures decay and the explosive waves propagate as an impulsive, broadband sound. Several parameters influence the effect of an explosive: The weight of the explosive warhead, the type of explosive material, the boundaries and characteristics of the propagation medium, and, in water, the detonation depth. The net explosive weight, the explosive power of a charge expressed as the equivalent weight of trinitrotoluene (TNT), accounts for the first two parameters. The effects of these factors are explained in Appendix D (Acoustic and Explosive Concepts) of the HSTT DEIS/OEIS.

Explosions in Water

Explosive detonations during training and testing activities are associated with high-explosive munitions, including, but not limited to, bombs, missiles, rockets, naval gun shells, torpedoes, mines, demolition charges, and explosive sonobuoys. Explosive detonations during training and testing involving the use of high-explosive munitions (including bombs, missiles, and naval gun shells), could occur in the air or at the water's surface. Explosive detonations associated with torpedoes and explosive sonobuoys could occur in the water column; mines and demolition charges could be detonated in the water column or on the ocean bottom. Most detonations would occur in waters greater than 200 ft in depth, and greater than 3 nmi from shore, although most mine warfare, demolition, and some testing detonations would occur in shallow water close to shore. Those that occur close to shore are typically conducted on designated ranges.

In order to better organize and facilitate the analysis of explosives used by the Navy during training and testing that could detonate in water or at the water surface, explosive classification bins were developed. The use of explosive classification bins provides the same benefits as described for acoustic source classification bins in Section 1.4.1 (Acoustic Stressors) of the Navy's rulemaking/LOA application.

Explosives detonated in water are binned by net explosive weight. The bins of explosives that are proposed for use in the Study Area are shown in Table 3 below.

TABLE 3—EXPLOSIVES ANALYZED

Bin	Net explosive weight [1] (lb)	Example explosive source
E1	0.1–0.25	Medium-caliber projectile.
E2	>0.25–0.5	Medium-caliber projectile.
E3	>0.5–2.5	Large-caliber projectile.
E4	>2.5–5	Mine neutralization charge.
E5	>5–10	5-inch projectile.
E6	>10–20	Hellfire missile.
E7	>20–60	Demo block/shaped charge.
E8	>60–100	Light-weight torpedo.
E9	>100–250	500 lb. bomb.
E10	>250–500	Harpoon missile.
E11	>500–650	650 lb. mine.
E12	>650–1,000	2,000 lb. bomb.
E13 [2]	>1,000–1,740	Mat weave.

[1] Net Explosive Weight refers to the equivalent amount of TNT.

[2] E13 is not modeled for protected species impacts in water because most energy is lost into the air or to the bottom substrate due to detonation in very shallow water. In addition, activities are confined to small cove without regular marine mammal occurrence. These are not single charges, but multiple smaller charges detonated simultaneously or within a short time period.

Propagation of explosive pressure waves in water is highly dependent on environmental characteristics such as bathymetry, bottom type, water depth, temperature, and salinity, which affect how the pressure waves are reflected, refracted, or scattered; the potential for reverberation; and interference due to multi-path propagation. In addition, absorption greatly affects the distance over which higher frequency components of explosive broadband noise can propagate. Appendix D (Acoustic and Explosive Concepts) of the HSTT DEIS/OEIS explains the characteristics of explosive detonations and how the above factors affect the propagation of explosive energy in the water. Because of the complexity of analyzing sound propagation in the ocean environment, the Navy relies on acoustic models in its environmental analyses that consider sound source characteristics and varying ocean conditions across the HSTT Study Area.

Explosive Fragments

Marine mammals could be exposed to fragments from underwater explosions associated with the specified activities. When explosive ordnance (*e.g.,* bomb or missile) detonates, fragments of the weapon are thrown at high-velocity from the detonation point, which can injure or kill marine mammals if they are struck. These fragments may be of variable size and are ejected at supersonic speed from the detonation. The casing fragments will be ejected at velocities much greater than debris from any target due to the proximity of the casing to the explosive material. Risk of fragment injury reduces exponentially with distance as the fragment density is reduced. Fragments underwater tend to be larger than fragments produced by in-air explosions (Swisdak and Montaro, 1992). Underwater, the friction of the water would quickly slow these fragments to a point where they no longer pose a threat. Opposingly, the blast wave from an explosive detonation moves efficiently through the seawater. Because the ranges to mortality and injury due to exposure to the blast wave are likely to far exceed the zone where fragments could injure or kill an animal, the threshold are assumed to encompass risk due to fragmentation.

Other Stressor—Vessel Strike

There is a very small chance that a vessel utilized in training or testing activities could strike a large whale. Vessel strikes have the potential to result in incidental take from serious injury and/or mortality. Vessel strikes are not specific to any particular training or testing activity, but rather a limited, sporadic, and incidental result of Navy vessel movement within the Study Area. Vessel strikes from commercial, recreational, and military vessels are known to seriously injure and occasionally kill cetaceans (Abramson *et al.,* 2011; Berman-Kowalewski *et al.,* 2010; Calambokidis, 2012; Douglas *et al.,* 2008; Laggner, 2009; Lammers *et al.,* 2003; Van der Hoop *et al.,* 2012; Van der Hoop *et al.,* 2013), although reviews of the literature on ship strikes mainly involve collisions between commercial vessels and whales (Jensen and Silber, 2003; Laist *et al.,* 2001). Vessel speed, size, and mass are all important factors in determining potential impacts of a vessel strike to marine mammals (Conn and Silber, 2013; Gende *et al.,* 2011; Silber *et al.,* 2010; Vanderlaan and Taggart, 2007;

Wiley *et al.,* 2016). For large vessels, speed and angle of approach can influence the severity of a strike. The average speed of large Navy ships ranges between 10 and 15 knots (kn) and submarines generally operate at speeds in the range of 8–13 kn, while a few specialized vessels can travel at faster speeds. By comparison, this is slower than most commercial vessels where full speed for a container ship is typically 24 kn (Bonney and Leach, 2010). Additional information on Navy vessel movements is provided in the Specified Activities section.

The Center for Naval Analysis conducted studies to determine traffic patterns of Navy and non-Navy vessels in the HSTT Study Area (Mintz, 2016; Mintz and Filadelfo, 2011; Mintz, 2012; Mintz and Parker, 2006). The most recent analysis covered the 5-year period from 2011 to 2015 for vessels over 65 ft in length (Mintz, 2016). Categories of vessels included in the study were U.S. Navy surface ship traffic and non-military civilian traffic such as cargo vessels, bulk carriers, commercial fishing vessels, oil tankers, passenger vessels, tugs, and research vessels (Mintz, 2016). In the Hawaii Range Complex, civilian commercial shipping comprised 89 percent of total vessel traffic while Navy ship traffic accounted for eight percent (Mintz, 2016). In the Southern California Range Complex civilian commercial shipping comprised 96 percent of total vessel traffic while Navy ship traffic accounted for four percent (Mintz, 2016).

Navy ships transit at speeds that are optimal for fuel conservation or to meet training and testing requirements. Small craft (for purposes of this analysis, less than 18 m in length) have much more variable speeds (0–50+ kn, dependent on the activity). Submarines generally operate at speeds in the range of 8–13 kn. While these speeds are considered averages and representative of most events, some vessels need to operate outside of these parameters for certain times or during certain activities. For example, to produce the required relative wind speed over the flight deck, an aircraft carrier engaged in flight operations must adjust its speed through the water accordingly. Also, there are other instances such as launch and recovery of a small rigid hull inflatable boat; vessel boarding, search, and seizure training events; or retrieval of a target when vessels would be dead in the water or moving slowly ahead to maintain steerage. There are a few specific events, including high-speed tests of newly constructed vessels, where vessels would operate at higher speeds.

Large Navy vessels (greater than 18 m in length) within the offshore areas of range complexes and testing ranges operate differently from commercial vessels in ways that may reduce potential whale collisions. Surface ships operated by or for the Navy have multiple personnel assigned to stand watch at all times, when a ship or surfaced submarine is moving through the water (underway). A primary duty of personnel standing watch on surface ships is to detect and report all objects and disturbances sighted in the water that may indicate a threat to the vessel and its crew, such as debris, a periscope, surfaced submarine, or surface disturbance. Per vessel safety requirements, personnel standing watch also report any marine mammals sighted in the path of the vessel as a standard collision avoidance procedure. All vessels proceed at a safe speed so they can take proper and effective action to avoid a collision with any sighted object or disturbance, and can be stopped within a distance appropriate to the prevailing circumstances and conditions.

Specified Activities

Proposed Training Activities

The Navy's Specified Activities are presented and analyzed as a representative year of training to account for the natural fluctuation of training cycles and deployment schedules that generally influences the actual level of training that occurs year after year in any five-year period. Using a representative level of activity rather than a maximum tempo of training activity in every year is more reflective of the amount of hull-mounted mid-frequency active sonar estimated to be necessary to meet training requirements. It also means that the Navy is requesting fewer hours of hull-mounted mid-frequency active sonar. Both unit-level training and major training exercises have been adjusted to meet this representative year, as discussed below. For the purposes of the Navy's rulemaking/LOA application, the Navy assumes that some unit-level training would be conducted using synthetic means (*e.g.,* simulators). Additionally, the Specified Activities analysis assumes that some unit-level active sonar training will be accounted for during the conduct of coordinated and major training exercises.

The Optimized Fleet Response Plan and various training plans identify the number and duration of training cycles that could occur over a five-year period. The Specified Activities considers fluctuations in training cycles and deployment schedules that do not follow a traditional annual calendar but instead are influenced by in-theater demands and other external factors. Similar to unit-level training, the Specified Activities does not analyze a maximum number carrier strike group Composite Training Unit Exercises (one type of major exercise) every year, but instead assumes a maximum number of exercises would occur during two years of any five-year period and that a lower number of exercises would occur in the other 3 years (described in Estimate Take section).

The training activities that the Navy proposes to conduct in the HSTT Study Area are summarized in Table 4. The table is organized according to primary mission areas and includes the activity name, associated stressors applicable to the Navy's rulemaking/LOA application, description of the activity, sound source bin, the locations of those activities in the HSTT Study Area, and the number of Specified Activities. For further information regarding the primary platform used (*e.g.,* ship or aircraft type) see Appendix A (Navy Activity Descriptions) of the HSTT DEIS/OEIS.

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Table 4. Proposed Training Activities Analyzed within the HSTT Study Area.

Stressor Category	*Activity Name*	*Description*	*Source Bin*	*Location*	*Annual # of Activities*	*5-Year # of Activities*	*Duration per Activity*
Major Training Exercises – Large Integrated Anti-Submarine Warfare							
Acoustic	Composite Training Unit Exercise[1]	Aircraft carrier and carrier air wing integrates with surface and submarine units in a challenging multi-threat operational environment that certifies them ready to deploy.	ASW1, ASW2, ASW3, ASW4, ASW5, HF1, LF6, MF1, MF3, MF4, MF5, MF11, MF12	SOCAL	2-3	12	21 days
Acoustic	Rim of the Pacific Exercise[1]	A biennial multinational training exercise in which navies from Pacific Rim nations and others assemble in Pearl Harbor, Hawaii, to conduct training throughout the Hawaiian Islands in a number of warfare areas. Marine mammal systems may be used during a Rim of the Pacific exercise. Components of a Rim of the Pacific exercise, such as certain mine warfare and amphibious training, may be conducted in the Southern California Range Complex.	ASW2, ASW3, ASW4, HF1, HF3, HF4, M3, MF1, MF3, MF4, MF5, MF11	HRC	0-1	2	30 days
				SOCAL	0-1	2	

Major Training Exercises – Medium Integrated Anti-Submarine Warfare							
Acoustic	Fleet Exercise/Sustainment Exercise[1]	Aircraft carrier and carrier air wing integrates with surface and submarine units in a challenging multi-threat operational environment to maintain ability to deploy.	ASW1, ASW2, ASW3, ASW4, HF1, LF6, MF1, MF3, MF4, MF5, MF11, MF12	HRC	1	3	Up to 10 days
				SOCAL	5	22	
Acoustic	Undersea Warfare Exercise	Elements of the anti-submarine warfare tracking exercise combine in this exercise of multiple air, surface, and subsurface units, over a period of several days. Sonobuoys are released from aircraft. Active and passive sonar used.	ASW3, ASW4, HF1, LF6, MF1, MF3, MF4, MF5, MF11, MF12	HRC	3	12	4 days
Integrated/Coordinated Training – Small Integrated Anti-Submarine Warfare Training							
Acoustic	Navy Undersea Warfare Training and Assessment Course Surface Warfare Advanced Tactical Training	Multiple ships, aircraft, and submarines integrate the use of their sensors to search for, detect, classify, localize, and track a threat submarine in order to launch an exercise torpedo.	ASW3, ASW4, HF1, MF1, MF3, MF4, MF5	HRC	1	2	2-5 days
				SOCAL	2-3	12	
Integrated/Coordinated Training – Medium Coordinated Anti-Submarine Warfare Training							
Acoustic	Submarine Commanders Course	Train prospective submarine Commanding Officers to operate against surface, air, and subsurface threats.	ASW3, ASW4, HF1, MF1, MF3, MF4, MF5, TORP1, TORP2	HRC	2	10	2-3 days
				SOCAL	2	2	

Integrated/Coordinated Training – Small Coordinated Anti-Submarine Warfare Training							
Acoustic	Amphibious Ready Group/Marine Expeditionary Unit Exercise Group Sail Independent Deployer Certification Exercise/Tailored Anti-Submarine Warfare Training	Small-scale, short duration, coordinated anti-submarine warfare exercises	ASW2, ASW3, ASW4, HF1, MF1, MF3, MF4, MF5, MF11	HRC	2	10	2-3 days
				SOCAL	10-14	58	
Amphibious Warfare							
Explosive	Naval Surface Fire Support Exercise – at Sea	Surface ship uses large-caliber gun to support forces ashore; however, land target simulated at sea. Rounds impact water and are scored by passive acoustic hydrophones located at or near target area.	Large-caliber HE rounds (E5)	HRC (W188)	15	75	8 hours
Acoustic	Amphibious Marine Expeditionary Unit Exercise	Navy and Marine Corps forces conduct advanced integration training in preparation for deployment certification.	ASW1, LF6, MF1, MF3, MF11, MF12, HF1	SOCAL	2-3	12	5-7 days
Acoustic	Amphibious Marine Expeditionary Unit Integration Exercise	Navy and Marine Corps forces conduct integration training at sea in preparation for deployment certification.	None	SOCAL	2-3	12	Up to 21 days

Acoustic	Marine Expeditionary Unit Composite Training Unit Exercise	Amphibious Ready Group exercises are conducted to validate the Marine Expeditionary Unit's readiness for deployment and includes small boat raids; visit, board, search, and seizure training; helicopter and mechanized amphibious raids; and a non-combatant evacuation operation.	ASW2, ASW3, ASW4, HF1, MF1, MF3, MF4, MF5, MF11	SOCAL	2-3	12	Up to 21 days
Anti-Submarine Warfare							
Acoustic	Anti-Submarine Warfare Torpedo Exercise – Helicopter	Helicopter crews search for, track, and detect submarines. Recoverable air launched torpedoes are employed against submarine targets.	MF4, MF5, TORP1	HRC	6	30	2-5 hours
				SOCAL	104	520	
Acoustic	Anti-Submarine Warfare Torpedo Exercise – Maritime Patrol Aircraft	Maritime patrol aircraft crews search for, track, and detect submarines. Recoverable air launched torpedoes are employed against submarine targets.	MF5, TORP1	HRC	10	50	2-8 hours
				SOCAL	25	125	
Acoustic	Anti-Submarine Warfare Torpedo Exercise – Ship	Surface ship crews search for, track, and detect submarines. Exercise torpedoes are used during this event.	ASW3, MF1, TORP1	HRC	50	250	2-5 hours
				SOCAL	117	585	
Acoustic	Anti-Submarine Warfare Torpedo Exercise – Submarine	Submarine crews search for, track, and detect submarines. Exercise torpedoes are used during this event.	ASW4, HF1, MF3, TORP2	HRC	48	240	8 hours
				SOCAL	13	65	
Acoustic	Anti-Submarine Warfare Tracking Exercise –	Helicopter crews search for, track, and detect submarines.	MF4, MF5	HRC	159	795	2-4 hours
				SOCAL, PMSR	524	2,620	

	Helicopter			HSTT Transit Corridor	6	30	
Acoustic	Anti-Submarine Warfare Tracking Exercise – Maritime Patrol Aircraft	Maritime patrol aircraft aircrews search for, track, and detect submarines. Recoverable air launched torpedoes are employed against submarine targets.	MF5	HRC	32	160	2-8 hours
				SOCAL, PMSR	56	280	
Acoustic	Anti-Submarine Warfare Tracking Exercise – Ship	Surface ship crews search for, track, and detect submarines.	ASW3, MF1, MF11, MF12	HRC	224	1,120	2-4 hours
				SOCAL, PMSR	423	2,115	
Acoustic	Anti-Submarine Warfare Tracking Exercise – Submarine	Submarine crews search for, track, and detect submarines.	ASW4, HF1, HF3, MF3	HRC	200	1,000	8 hours
				SOCAL, PMSR	50	250	
				HSTT Transit Corridor	7	35	
Explosive, Acoustic	Service Weapons Test	Air, surface, or submarine crews employ explosive torpedoes against virtual targets.	HF1, MF3, MF6, TORP2, Explosive torpedoes (E11)	HRC	2	10	8 hours
				SOCAL	1	5	
Mine Warfare							
Acoustic	Airborne Mine Countermeasure – Mine Detection	Helicopter aircrews detect mines using towed or laser mine detection systems.	HF4	SOCAL	10	50	2 hours
Explosive, Acoustic	Civilian Port Defense – Homeland Security Anti-Terrorism/Force Protection Exercises	Maritime security personnel train to protect civilian ports against enemy efforts to interfere with access to those ports.	HF4, SAS2 E2, E4	Pearl Harbor, HI	1	5	Multiple days
				San Diego, CA	1-3	12	

Explosive	Marine Mammal Systems	The Navy deploys trained bottlenose dolphins (*Tursiops truncatus*) and California sea lions (*Zalophus californianus*) as part of the marine mammal mine-hunting and object-recovery system.	E7	HRC	10	50	Varies
				SOCAL	175	875	
Acoustic	Mine Countermeasure Exercise – Ship Sonar	Ship crews detect and avoid mines while navigating restricted areas or channels using active sonar.	HF4, HF8, MF1K	HRC	30	150	Up to 15 hours
				SOCAL	92	460	
Acoustic	Mine Countermeasure Exercise - Surface	Mine countermeasure ship crews detect, locate, identify, and avoid mines while navigating restricted areas or channels, such as while entering or leaving port.	HF4	SOCAL	266	1,330	Up to 15 hours
Explosive, Acoustic	Mine Countermeasures Mine Neutralization Remotely Operated Vehicle	Ship, small boat, and helicopter crews locate and disable mines using remotely operated underwater vehicles.	HF4, E4	HRC	6	30	1.5 to 4 hours
				SOCAL	372	1,860	
Explosive	Mine Neutralization Explosive Ordnance Disposal	Personnel disable threat mines using explosive charges.	E4, E5, E6, E7	HRC (Puuloa)	20	100	Up to 4 hours
				SOCAL (IB, TAR 2, TAR 3, TAR 21, SWAT 3, SOAR)	194	970	
Acoustic	Submarine Mine Exercise	Submarine crews practice detecting mines in a designated area.	HF1	HRC	40	200	6 hours
				SOCAL	12	60	

Acoustic	Surface Ship Object Detection	Ship crews detect and avoid mines while navigating restricted areas or channels using active sonar.	MF1K, HF8	HRC	42	210	Up to 15 hours
				SOCAL	164	820	
Explosive	Underwater Demolitions Multiple Charge – Mat Weave and Obstacle Loading	Military personnel use explosive charges to destroy barriers or obstacles to amphibious vehicle access to beach areas.	E10, E13	SOCAL (TAR 2, TAR 3)	18	90	4 hours
Explosive	Underwater Demolition Qualification and Certification	Navy divers conduct various levels of training and certification in placing underwater demolition charges.	E6, E7	HRC (Puuloa)	25	125	Varies
				SOCAL (TAR 2)	120	600	
Surface Warfare							
Explosive	Bombing Exercise Air-to-Surface	Fixed-wing aircrews deliver bombs against surface targets.	E12[2]	HRC	187	935	1 hour
				SOCAL	640	3,200	
				HSTT Transit Corridor	5	25	
Explosive	Gunnery Exercise Surface-to-Surface Boat Medium-Caliber	Small boat crews fire medium-caliber guns at surface targets.	E1, E2	HRC	10	50	1 hour
				SOCAL	14	70	
Explosive	Gunnery Exercise Surface-to-Surface Ship Large-caliber	Surface ship crews fire large-caliber guns at surface targets.	E5	HRC	32	160	Up to 3 hours
				SOCAL	200	1,000	
				HSTT Transit Corridor	13	65	
Explosive	Gunnery Exercise Surface-to-Surface Ship Medium-Caliber	Surface ship crews fire medium-caliber guns at surface targets.	E1, E2	HRC	50	250	2-3 hours
				SOCAL	180	900	
				HSTT Transit Corridor	40	200	

Explosive, Acoustic	Independent Deployer Certification Exercise/Tailored Surface Warfare Training	Multiple ships, aircraft and submarines conduct integrated multi-warfare training with a surface warfare emphasis. Serves as a ready-to-deploy certification for individual surface ships tasked with surface warfare missions.	E1, E3, E6, E10	SOCAL	1	5	15 days
Explosive	Integrated Live Fire Exercise	Naval Forces defend against a swarm of surface threats (ships or small boats) with bombs, missiles, rockets, and small-, medium- and large-caliber guns.	E1, E3, E6, E10	HRC (W188A)	1	5	6-8 hours
				SOCAL (SOAR)	1	5	
Explosive	Missile Exercise Air-to-Surface	Fixed-wing and helicopter aircrews fire air-to-surface missiles at surface targets.	E6, E8, E10	HRC	10	50	1 hour
				SOCAL	210	1,050	
Explosive	Missile Exercise Air-to-Surface Rocket	Helicopter aircrews fire both precision-guided and unguided rockets at surface targets.	E3	HRC	227	1,135	1 hour
				SOCAL	246	1,230	
Explosive	Missile Exercise Surface-to-Surface	Surface ship crews defend against surface threats (ships or small boats) and engage them with missiles.	E6, E10	HRC (W188)	20	100	2-5 hours
				SOCAL (W291)	10	50	
Explosive, Acoustic	Sinking Exercise	Aircraft, ship, and submarine crews	TORP2, E5, E10,	HRC	1–3	7	4-8 hours, over 1-2

		deliberately sink a seaborne target, usually a decommissioned ship made environmentally safe for sinking according to U.S. Environmental Protection Agency standards, with a variety of munitions.	E12	SOCAL	0–1	1	days
Pile driving	Elevated Causeway System	A pier is constructed off of the beach. Piles are driven into the bottom with an impact hammer. Piles are removed from seabed via vibratory extractor. Only in-water impacts are analyzed.	Impact hammer or vibratory extractor	SOCAL	2	10	Up to 30 days
Acoustic	Kilo Dip	Functional check of the dipping sonar prior to conducting a full test or training event on the dipping sonar.	MF4	HRC	60	300	1.5 hours
				SOCAL	2,400	12,000	
Acoustic	Submarine Navigation Exercise	Submarine crews operate sonar for navigation and object detection while transiting into and out of port during reduced visibility.	HF1, MF3	Pearl Harbor, HI	220	1,100	Up to 2 hours
				San Diego Bay, CA	80	400	
Acoustic	Submarine Sonar Maintenance and Systems Checks	Maintenance of submarine sonar systems is conducted pierside or at sea.	MF3	HRC	260	1,300	Up to 1 hour
				Pearl Harbor, HI	260	1,300	
				SOCAL	93	465	
				San Diego Bay, CA	92	460	
				HSTT Transit Corridor	10	50	

Acoustic	Submarine Under Ice Certification	Submarine crews train to operate under ice. Ice conditions are simulated during training and certification events.	HF1	HRC	12	60	5 days
				SOCAL	6	30	
Acoustic	Surface Ship Sonar Maintenance and Systems Checks	Maintenance of surface ship sonar systems is conducted pierside or at sea.	HF8, MF1	HRC	75	375	Up to 4 hours
				Pearl Harbor, HI	80	400	
				SOCAL	250	1,250	
				San Diego, CA	250	1,250	
				HSTT Transit Corridor	8	40	
Acoustic	Unmanned Underwater Vehicle Training – Certification and Development	Unmanned underwater vehicle certification involves training with unmanned platforms to ensure submarine crew proficiency. Tactical development involves training with various payloads for multiple purposes to ensure that the systems can be employed effectively in an operational environment.	FLS2, M3, SAS2	HRC	25	125	2 days
				SOCAL	10	50	

Notes: HRC = Hawaii Range Complex, SOCAL = Southern California Range Complex, HSTT = Hawaii-Southern California Training and Testing, PMRF = Pacific Missile Range Facility, BARSTUR = Barking Sands Tactical Underwater Range, BSURE = Barking Sands Underwater Range Expansion, PMSR = Point Mugu Sea Range Overlap, TAR = Training Area and Range, SOAR = Southern California Anti-Submarine Warfare Range, IB = Imperial Beach Minefield

1. Any non-antisubmarine warfare activity that could occur is captured in the individual activities.

2. For the Bombing Exercise Air-to-Surface, all activities were analyzed with exact bins NEW.

Proposed Testing Activities

Testing activities covered in the Navy's rulemaking/LOA application are described in Table 5 through Table 8. The five-year Specified Activities presented here is based on the level of testing activities anticipated to be conducted into the reasonably foreseeable future, with adjustments that account for changes in the types and tempo (increases or decreases) of testing activities to meet current and future military readiness requirements. The Specified Activities includes the testing of new platforms, systems, and related equipment that will be introduced after December 2018 and during the period of the rule. The majority of testing activities that would be conducted under the Specified Activities are the same or similar as those conducted currently or in the past. The Specified Activities includes the testing of some new systems using new technologies and takes into account inherent uncertainties in this type of testing.

Under the Specified Activities, the Navy proposes a range of annual levels of testing that reflects the fluctuations in testing programs by recognizing that the maximum level of testing will not be conducted each year, but further indicates a five-year maximum for each activity that will not be exceeded. The Specified Activities contains a more realistic annual representation of activities, but includes years of a higher maximum amount of testing to account for these fluctuations.

The tables include the activity name, associated stressor(s), description of the activity, sound source bin, the areas where the activity is conducted, and the number of activities per year and per five years. Not all sound sources are used with each activity. Under the ''Annual # of Activities'' column, activities show either a single number or a range of numbers to indicate the number of times that activity could occur during any single year. The ''5-Year # of Activities'' is the maximum times an activity would occur over the 5-year period of this request. More detailed activity descriptions can be found in the HSTT DEIS/OEIS.

Naval Air Systems Command

Table 5 summarizes the proposed testing activities for the Naval Air Systems Command analyzed within the HSTT Study Area.

Table 5. Proposed Naval Air Systems Command Testing Activities Analyzed within the HSTT Study Area.

Stressor Category	*Activity Name*	*Description*	*Source Bin*	*Location*	*Annual # of Activities*	*5-Year # of Activities*	*Typical Duration per Activity*
Anti-Submarine Warfare							
Acoustic	Anti-Submarine Warfare Torpedo Test	This event is similar to the training event torpedo exercise. Test evaluates anti-submarine warfare systems onboard rotary-wing and fixed-wing aircraft and the ability to search for, detect, classify, localize, track, and attack a submarine or similar target.	MF5, TORP1	HRC	17-22	95	2-6 hrs
				SOCAL	35-71	247	
Explosive, Acoustic	Anti-Submarine Warfare Tracking Test – Helicopter	This event is similar to the training event anti-submarine tracking exercise – helicopter. The test evaluates the sensors and systems used to detect and track submarines and to ensure that helicopter systems used to deploy the tracking systems perform to specifications.	MF4, MF5, E3	SOCAL	30-132	252	2 hrs
Explosive, Acoustic	Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft	The test evaluates the sensors and systems used by maritime patrol aircraft to detect and track submarines and to ensure that aircraft systems used to deploy the tracking systems perform to specifications and meet operational requirements.	ASW2, ASW5, MF5, MF6, E1, E3	HRC	54-61	284	4-6 hrs
				SOCAL	58-68	310	
Explosive, Acoustic	Sonobuoy Lot Acceptance Test	Sonobuoys are deployed from surface vessels and aircraft to verify the integrity and performance of a lot or group of sonobuoys in advance of delivery to the fleet for operational use.	ASW2, ASW5, HF5, HF6, LF4, MF5, MF6, E1, E3, E4	SOCAL	160	800	6 hrs
Mine Warfare							
Acoustic	Airborne Dipping Sonar Minehunting Test	A mine-hunting dipping sonar system that is deployed from a helicopter and uses high-frequency sonar for the detection and classification of bottom and moored mines.	HF4	SOCAL	0-12	12	2 hrs

Explosive	Airborne Mine Neutralization System Test	A test of the airborne mine neutralization system that evaluates the system's ability to detect and destroy mines from an airborne mine countermeasures capable helicopter (e.g., MH-60). The airborne mine neutralization system uses up to four unmanned underwater vehicles equipped with high-frequency sonar, video cameras, and explosive and non-explosive neutralizers.	E4	SOCAL	11-31	75	2.5 hrs
Acoustic	Airborne Sonobuoy Minehunting Test	A mine-hunting system made up of sonobuoys deployed from a helicopter. A field of sonobuoys, using high-frequency sonar, is used for detection and classification of bottom and moored mines.	HF6	SOCAL	3-9	21	2 hrs
Surface Warfare							
Explosive	Air-to-Surface Bombing Test	This event is similar to the training event bombing exercise air-to-surface. Fixed-wing aircraft test the delivery of bombs against surface maritime targets with the goal of evaluating the bomb, the bomb carry and delivery system, and any associated systems that may have been newly developed or enhanced.	E9	HRC	8	40	2 hrs
				SOCAL	14	70	
Explosive	Air-to-Surface Gunnery Test	This event is similar to the training event gunnery exercise air-to-surface. Fixed-wing and rotary-wing aircrews evaluate new or enhanced aircraft guns against surface maritime targets to test that the gun, gun ammunition, or associated systems meet required specifications or to train aircrew in the operation of a new or enhanced weapons system.	E1	HRC	5	25	2-2.5 hrs
				SOCAL	30-60	240	
Explosive	Air-to-Surface Missile Test	This event is similar to the training event missile exercise air-to-surface. Test may involve both fixed-wing and rotary-wing aircraft launching missiles at surface maritime targets to evaluate the weapons system or as part of another systems integration test.	E6, E9, E10	HRC	18	90	2-4 hrs
				SOCAL	48-60	276	
Explosive	Rocket Test	Rocket tests are conducted to evaluate the integration, accuracy,	E3	HRC	2	10	1.5-2.5 hrs

		performance, and safe separation of guided and unguided 2.75-inch rockets fired from a hovering or forward flying helicopter or tilt rotor aircraft.		SOCAL	18-22	102	
Other Testing Activities							
Acoustic	Kilo Dip	Functional check of a helicopter deployed dipping sonar system (e.g., AN/AQS-22) prior to conducting a testing or training event using the dipping sonar system.	MF4	SOCAL	0-6	6	1.5 hrs
Acoustic	Undersea Range System Test	Post installation node survey and test and periodic testing of range Node transmit functionality.	MF9	HRC	11-28	90	8 hrs

Table 6 summarizes the proposed testing activities for the Naval Sea Systems Command analyzed within the HSTT Study Area.

Table 6. Proposed Naval Sea Systems Command Testing Activities Analyzed within the HSTT Study Area.

Stressor Category	*Activity Name*	*Description*	*Source Bin*	*Location*	*Annual # of Activities*	*5-Year # of Activities*	*Typical Duration per Activity*
Anti-Submarine Warfare							
Acoustic	Anti-Submarine Warfare Mission Package Testing	Ships and their supporting platforms (e.g., rotary-wing aircraft and unmanned aerial systems) detect, localize, and prosecute submarines.	ASW1, ASW2, ASW3, ASW5, MF1, MF4, MF5, MF12, TORP1	HRC	22	110	4-8 hrs per day over 1-2 weeks
				SOCAL	23	115	
Acoustic	At-Sea Sonar Testing	At-sea testing to ensure systems are fully functional in an open ocean environment.	ASW3, ASW4, HF1, LF4, LF5, M3, MF1, MF1K, MF2, MF3, MF5, MF9, MF10, MF11	HRC	16	78	4 hrs-11 days
				HRC - SOCAL	1	5	
				SOCAL	20-21	99	
Acoustic	Countermeasure Testing	Countermeasure testing involves the testing of systems that will detect, localize, and track incoming weapons, including marine vessel targets. Testing includes surface ship torpedo defense systems and marine vessel stopping payloads.	ASW3, ASW4, HF5, TORP1, TORP2	HRC	8	40	4 hrs-6 days
				HRC - SOCAL	4	20	
				SOCAL	11	55	
				HSTT Transit Corridor	2	10	
Acoustic	Pierside Sonar Testing	Pierside testing to ensure systems are fully functional in a controlled pierside environment prior to at-sea test activities.	HF1, HF3, HF8, M3, MF1, MF3, MF9	Pearl Harbor, HI	7	35	Up to 3 weeks, intermittent sonar use
				San Diego, CA	7	35	
Acoustic	Submarine Sonar Testing/Maintenance	Pierside and at-sea testing of submarine systems occurs periodically following major maintenance periods and for routine maintenance.	HF1, HF3, M3, MF3	HRC	4	20	Up to 3 weeks, intermittent sonar use
				Pearl Harbor, HI	17	85	
				San Diego, CA	24	120	

Acoustic	Surface Ship Sonar Testing/Maintenance	Pierside and at-sea testing of ship systems occurs periodically following major maintenance periods and for routine maintenance.	ASW3, MF1, MF1K, MF9, MF10	HRC	3	15	Up to 3 weeks, intermittent sonar use
				Pearl Harbor, HI	3	15	
				San Diego, CA	3	15	
				SOCAL	3	15	
Explosive, Acoustic	Torpedo (Explosive) Testing	Air, surface, or submarine crews employ explosive and non-explosive torpedoes against artificial targets.	ASW3, HF1, HF5, HF6, MF1, MF3, MF4, MF5, MF6, TORP1, TORP2, E8, E11	HRC	8	40	1-2 days, daylight hours only
				HRC SOCAL	3	15	
				SOCAL	8	40	
Acoustic	Torpedo (Non-Explosive) Testing	Air, surface, or submarine crews employ non-explosive torpedoes against submarines or surface vessels.	ASW3, ASW4, HF1, HF6, M3, MF1, MF3, MF4, MF5, MF6, TORP1, TORP2, TORP3	HRC	8	40	Up to 2 weeks
				HRC SOCAL	9	45	
				SOCAL	8	40	
Mine Warfare							
Explosive, Acoustic	Mine Countermeasure and Neutralization Testing	Air, surface, and subsurface vessels neutralize threat mines and mine-like objects.	HF4, E4	SOCAL	11	55	1-10 days, intermittent use of systems
Explosive, Acoustic	Mine Countermeasure Mission Package Testing	Vessels and associated aircraft conduct mine countermeasure operations.	HF4, SAS2, E4	HRC	19	80	1-2 weeks, intermittent use of systems
				SOCAL	58	290	
Acoustic	Mine Detection and Classification Testing	Air, surface, and subsurface vessels and systems detect and classify and avoid mines and mine-like objects. Vessels also assess their potential susceptibility to mines and mine-like objects.	HF1, HF8, MF1, MF5	HRC	2	10	Up to 24 days, up to 12 hrs acoustic daily
				HRC SOCAL	2	6	
				SOCAL	11	55	
Surface Warfare							
Explosive	Gun Testing – Large-Caliber	Surface crews test large-caliber guns to defend against surface targets.	E3	HRC	7	35	1-2 weeks
				HRC - SOCAL	72	360	
				SOCAL	7	35	

Explosive	Gun Testing – Medium-Caliber	Surface crews test medium-caliber guns to defend against surface targets.	E1	HRC	4	20	1-2 weeks
				HRC - SOCAL	48	240	
				SOCAL	4	20	
Explosive	Missile and Rocket Testing	Missile and rocket testing includes various missiles or rockets fired from submarines and surface combatants. Testing of the launching system and ship defense is performed.	E6	HRC	13	65	1 day-2 weeks
				HRC - SOCAL	24	120	
				SOCAL	20	100	
Unmanned Systems							
Acoustic	Unmanned Surface Vehicle System Testing	Testing involves the production or upgrade of unmanned surface vehicles. This may include tests of mine detection capabilities, evaluations of the basic functions of individual platforms, or complex events with multiple vehicles.	HF4, SAS2	HRC	3	15	Up to 10 days
				SOCAL	4	20	
Acoustic	Unmanned Underwater Vehicle Testing	Testing involves the production or upgrade of unmanned underwater vehicles. This may include tests of mine detection capabilities, evaluations of the basic functions of individual platforms, or complex events with multiple vehicles.	HF4, MF9	HRC	3	15	Up to 35 days
				SOCAL	291	1,455	
Vessel Evaluation							
Acoustic	Submarine Sea Trials – Weapons System Testing	Submarine weapons and sonar systems are tested at-sea to meet the integrated combat system certification requirements.	HF1, M3, MF3, MF9, MF10, TORP2	HRC	1	5	Up to 7 days
				SOCAL	1	5	
Explosive	Surface Warfare Testing	Tests the capabilities of shipboard sensors to detect, track, and engage surface targets. Testing may include ships defending against surface targets using explosive and non-explosive rounds, gun system structural test firing, and demonstration of the response to Call for Fire against land-based targets (simulated by sea-based locations).	E1, E5, E8	HRC	9	45	7 days
				HRC - SOCAL	63	313	
				SOCAL	14-16	72	
Acoustic	Undersea Warfare Testing	Ships demonstrate capability of countermeasure systems and underwater surveillance, weapons engagement, and communications systems. This tests ships ability to detect, track, and engage undersea targets.	ASW4, HF4, HF8, MF1, MF4, MF5, MF6, TORP1, TORP2	HRC	7	35	Up to 10 days
				HRC SOCAL	12-16	32	
				SOCAL	11	51	

Acoustic	Vessel Signature Evaluation	Surface ship, submarine and auxiliary system signature assessments. This may include electronic, radar, acoustic, infrared and magnetic signatures.	ASW3	HRC	4	20	Typically 1-5 days, up to 20 days
				HRC SOCAL	36	180	
				SOCAL	24	120	
Other Testing Activities							
Acoustic	Insertion/Extraction	Testing of submersibles capable of inserting and extracting personnel and payloads into denied areas from strategic distances.	M3, MF9	HRC	1	5	Up to 30 days
				SOCAL	1	5	
Acoustic	Signature Analysis Operations	Surface ship and submarine testing of electromagnetic, acoustic, optical, and radar signature measurements.	HF1, M3, MF9	HRC	2	10	Multiple days
				SOCAL	1	5	

Notes: HRC = Hawaii Range Complex, SOCAL = Southern California Range Complex, HSTT = Hawaii-Southern California Training and Testing, CA = California, HI = Hawaii

Office of Naval Research

Table 7 summarizes the proposed testing activities for the Office of Naval Research analyzed within the HSTT Study Area.

Table 7. Proposed Office of Naval Research Testing Activities Analyzed within the HSTT Study Area.

Stressor Category	*Activity Name*	*Description*	*Source Bin*	*Location*	*Annual # of Activities*	*5-Year # of Activities*	*Typical Duration per Activity*
Acoustic and Oceanographic Science and Technology							
Explosive, Acoustic	Acoustic and Oceanographic Research	Research using active transmissions from sources deployed from ships and unmanned underwater vehicles. Research sources can be used as proxies for current and future Navy systems.	AG, ASW2, BB4, BB9, LF3, LF4, LF5, MF8, MF9, MF9, MF9, E3	HRC	2	10	Up to 14 days
				SOCAL	4	20	
Acoustic	Long Range Acoustic Communications	Bottom mounted acoustic source off of the Hawaiian Island of Kauai will transmit a variety of acoustic communications sequences.	LF4	HRC	3	15	Year-round, 200 days of active transmission

Notes: HRC = Hawaii Range Complex, SOCAL = Southern California Range Complex

Space and Naval Warfare Systems Command

Table 8 summarizes the proposed testing activities for the Space and Naval Warfare Systems Command analyzed within the HSTT Study Area.

Table 8. Space and Naval Warfare Systems Command Proposed Testing Activities Within the HSTT Study Area.

Stressor Category	*Activity Name*	*Description*	*Source Bin*	*Location*	*Annual # of Activities*	*5-Year # of Activities*	*Typical Duration per Activity*
Acoustic	Anti-Terrorism/Force Protection	Testing sensor systems that can detect threats to naval piers, ships, and shore infrastructure.	SD1	San Diego, CA	14	70	1 day
				SOCAL	16	80	
Acoustic	Communications	Testing of underwater communications and networks to extend the principles of FORCEnet below the ocean surface.	ASW2, ASW5, HF6, LF4	HRC	0-1	3	5 days, 6-8 hrs per day
				SOCAL	10	50	
Acoustic	Energy and Intelligence, Surveillance, and Reconnaissance Sensor Systems	Develop, integrate, and demonstrate Intelligence, Surveillance, and Reconnaissance systems and in-situ energy systems to support deployed systems.	AG, HF2, HF7, LF4, LF5, LF6, MF10	HRC	11-15	61	5 days, 6-8 hrs per day
				SOCAL	49-55	253	
				HSTT Transit Corridor	8	40	
Acoustic	Vehicle Testing	Testing of surface and subsurface vehicles and sensor systems, which may involve Unmanned Underwater Vehicles, gliders, and Unmanned Surface Vehicles.	BB4, FLS2, FLS3, HF6, LF3, M3, MF9, MF13, SAS1, SAS2, SAS3	HRC	4	20	5 days, 6-8 hrs per day
				SOCAL	166	830	
				HSTT Transit Corridor	2	10	

Notes: HRC = Hawaii Range Complex, SOCAL = Southern California Range Complex, HSTT = Hawaii-Southern California Training and Testing, CA = California

Summary of Acoustic and Explosive Sources Analyzed for Training and Testing

Table 9 through Table 12 show the acoustic source classes and numbers, explosive source bins and numbers, air gun sources, and pile driving and removal activities associated with Navy training and testing activities in the HSTT Study Area that were analyzed in the Navy's rulemaking/LOA application. Table 9 shows the acoustic source classes (*i.e.,* LF, MF, and HF) that could occur in any year under the Specified Activities for training and testing activities. Under the Specified Activities, acoustic source class use would vary annually, consistent with the number of annual activities summarized above. The five-year total for the Specified Activities takes into account that annual variability.

Table 9. Acoustic Source Classes Analyzed and Numbers Used During Training and Testing Activities in the HSTT Study Area.

Source Class Category	*Bin*	*Description*	*Unit*[1]	*Training*		*Testing*	
				Annual[2]	*5-year Total*	*Annual*[2]	*5-year Total*
Low-Frequency (LF): Sources that produce signals less than 1 kHz	LF3	LF sources greater than 200 dB	H	0	0	195	975
	LF4	LF sources equal to 180 dB and up to 200 dB	H	0	0	589 – 777	3,131
			C	0	0	20	100
	LF5	LF sources less than 180 dB	H	0	0	1,814 – 2,694	9,950
	LF6	LF sources greater than 200 dB with long pulse lengths	H	121 – 167	668	40–80	240
Mid-Frequency (MF): Tactical and non-tactical sources that produce signals between 1 and 10 kHz	MF1	Hull-mounted surface ship sonars (e.g., AN/SQS-53C and AN/SQS-61)	H	5,779 – 6,702	28,809	1,540	5,612
	MF1K	Kingfisher mode associated with MF1 sonars	H	100	500	14	70
	MF2[3]	Hull-mounted surface ship sonars (e.g., AN/SQS-56)	H	0	0	54	270
	MF3	Hull-mounted submarine sonars (e.g., AN/BQQ-10)	H	2,080 – 2,175	10,440	1,311	6,553
	MF4	Helicopter-deployed dipping sonars (e.g., AN/AQS-22 and AN/AQS-13)	H	414 – 489	2,070	311 – 475	1,717
	MF5	Active acoustic sonobuoys (e.g., DICASS)	C	5,704 – 6,124	28,300	5,250 – 5,863	27,120
Mid-Frequency (MF): Tactical and non-tactical sources that produce signals between 1 and 10 kHz	MF6	Active underwater sound signal devices (e.g., MK 84)	C	9	45	1,141 – 1,226	5,835
	MF8	Active sources (greater than 200 dB) not otherwise binned	H	0	0	70	350
	MF9	Active sources (equal to 180 dB	H	0	0	5,139 – 5,165	25,753

		and up to 200 dB) not otherwise binned					
	MF10	Active sources (greater than 160 dB, but less than 180 dB) not otherwise binned	H	0	0	1,824–1,992	9,288
	MF11	Hull-mounted surface ship sonars with an active duty cycle greater than 80%	H	718 – 890	3,597	56	280
	MF12	Towed array surface ship sonars with an active duty cycle greater than 80%	H	161 – 215	884	660	3,300
	MF13	MF sonar source	H	0	0	300	1,500
High-Frequency (HF): Tactical and non-tactical sources that produce signals between 10 and 100 kHz	HF1	Hull-mounted submarine sonars (e.g., AN/BQQ-10)	H	1,795 – 1,816	8,939	772	3,859
	HF2	HF Marine Mammal Monitoring System	H	0	0	120	600
	HF3	Other hull-mounted submarine sonars (classified)	H	287	1,345	110	549
High-Frequency (HF): Tactical and non-tactical sources that produce signals between 10 and 100 kHz	HF4	Mine detection, classification, and neutralization sonar (e.g., AN/SQS-20)	H	2,316	10,380	16,299 – 16,323	81,447
	HF5	Active sources (greater than 200 dB) not otherwise binned	H	0	0	960	4,800
			C	0	0	40	200
	HF6	Active sources (equal to 180 dB and up to 200 dB) not otherwise binned	H	0	0	1,000 – 1,009	5,007
	HF7	Active sources (greater than 160 dB, but less than 180 dB) not otherwise binned	H	0	0	1,380	6,900
	HF8	Hull-mounted surface ship sonars (e.g., AN/SQS-61)	H	118	588	1,032	3,072

Anti-Submarine Warfare (ASW): Tactical sources (e.g., active sonobuoys and acoustic countermeasures systems) used during ASW training and testing activities	ASW1	MF systems operating above 200 dB	H	194 – 261	1,048	470	2,350
	ASW2	MF Multistatic Active Coherent sonobuoy (e.g., AN/SSQ-125)	C	688–790	3,346	4,334 – 5,191	23,375
	ASW3	MF towed active acoustic countermeasure systems (e.g., AN/SLQ-25)	H	5,005 – 6,425	25,955	2,741	13,705
Anti-Submarine Warfare (ASW): Tactical sources (e.g., active sonobuoys and acoustic countermeasures systems) used during ASW training and testing activities	ASW4	MF expendable active acoustic device countermeasures (e.g., MK 3)	C	1,284 – 1,332	6,407	2,244	10,910
	ASW5 [4]	MF sonobuoys with high duty cycles	H	220– 300	1,260	522–592	2,740
Torpedoes (TORP): Source classes associated with the active acoustic signals produced by torpedoes	TORP 1	Lightweight torpedo (e.g., MK 46, MK 54, or Anti-Torpedo Torpedo)	C	231–237	1,137	923 – 971	4,560
	TORP 2	Heavyweight torpedo (e.g., MK 48)	C	521 – 587	2,407	404	1,948
	TORP 3		C	0	0	45	225
Forward Looking Sonar (FLS): Forward or upward looking object avoidance sonars used for ship navigation and safety	FLS2	HF sources with short pulse lengths, narrow beam widths, and focused beam patterns	H	28	140	448 – 544	2,432
	FLS3	VHF sources with short pulse lengths, narrow beam widths, and focused beam patterns	H	0	0	2,640	13,200
Acoustic Modems (M): Systems used to transmit data through the water	M3	MF acoustic modems (greater than 190 dB)	H	61	153	518	2,588
Swimmer Detection Sonars (SD): Systems used to detect divers and submerged swimmers	SD1	HF and VHF sources with short pulse lengths, used for the detection of swimmers and other objects for	H	0	0	10	50

		the purpose of port security					
Synthetic Aperture Sonars (SAS): Sonars in which active acoustic signals are post-processed to form high-resolution images of the seafloor	SAS1	MF SAS systems	H	0	0	1,960	9,800
	SAS2	HF SAS systems	H	900	4,498	8,584	42,920
	SAS3	VHF SAS systems	H	0	0	4,600	23,000
	SAS4	MF to HF broadband mine countermeasure sonar	H	42	210	0	0
Broadband Sound Sources (BB): Sonar systems with large frequency spectra, used for various purposes	BB4	LF to MF oceanographic source	H	0	0	810 – 1,170	4,434
	BB7	LF oceanographic source	C	0	0	28	140
	BB9	MF optoacoustic source	H	0	0	480	2,400

[1] H = hours; C = count (e.g., number of individual pings or individual sonobuoys).
[2] Expected annual use may vary per bin because the number of events may vary from year to year, as described in Section 1.5 (Specified Activities).
[3] MF2/MF2K are sources on frigate class ships, which were decommissioned during Phase II.
[4] Formerly ASW2 (H) in Phase II.
Notes: dB = decibel(s), kHz = kilohertz

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Table 10 shows the number of air guns shots proposed in the HSTT Study Area for training and testing activities.

TABLE 10—TRAINING AND TESTING AIR GUN SOURCES QUANTITATIVELY ANALYZED IN THE HSTT STUDY AREA

Source class category	Bin	Unit [1]	Training		Testing	
			Annual	5-year total	Annual	5-year total
Air Guns (AG): Small underwater air guns	AG	C	0	0	844	4,220

[1] C = count. One count (C) of AG is equivalent to 100 air gun firings.

Table 11 summarizes the impact pile driving and vibratory pile removal activities that would occur during a 24-hour period. Annually, for impact pile driving, the Navy will drive 119 piles, two times a year for a total of 238 piles. Over the 5-year period of the rule, the Navy will drive a total of 1190 piles by impact pile driving. Annually, for vibratory pile extraction, the Navy will extract 119 piles, two times a year for a total of 238 piles. Over the 5-year period of the rule, the Navy will extract a total of 1190 piles by vibratory pile extraction.

TABLE 11—SUMMARY OF PILE DRIVING AND REMOVAL ACTIVITIES PER 24-HOUR PERIOD IN THE HSTT STUDY AREA

Method	Piles per 24-hour period	Time per pile (minutes)	Total estimated time of noise per 24-hour period (minutes)
Pile Driving (Impact)	6	15	90
Pile Removal (Vibratory)	12	6	72

Table 12 shows the number of in-water explosives that could be used in any year under the Specified Activities for training and testing activities. Under the Specified Activities, bin use would vary annually, consistent with the number of annual activities summarized above. The five-year total for the Specified Activities takes into account that annual variability.

TABLE 12—EXPLOSIVE SOURCE BINS ANALYZED AND NUMBERS USED DURING TRAINING AND TESTING ACTIVITIES IN THE HSTT STUDY AREA

Bin	Net explosive weight (lb)	Example explosive source	Modeled underwater detonation depths (ft)[1]	Training		Testing	
				Annual	5-year total	Annual	5-year total
E1	0.1–0.25	Medium-caliber projectiles	0.3, 60	2,940	14,700	8,916–15,216	62,880
E2	>0.25–0.5	Medium-caliber projectiles	0.3, 50	1,746	8,730	0	0
E3	>0.5–2.5	Large-caliber projectiles	0.3, 60	2,797	13,985	2,880–3,124	14,844
E4	>2.5–5	Mine neutralization charge	10, 16, 33, 50, 61, 65, 650	38	190	634–674	3,065
E5	>5–10	5 in projectiles	0.3, 10, 50	4,730–4,830	23,750	1,400	7,000
E6	>10–20	Hellfire missile	0.3, 10, 50, 60	592	2,872	26–38	166
E7	>20–60	Demo block/shaped charge.	10, 50, 60	13	65	0	0
E8	>60–100	Lightweight torpedo	0.3, 150	33–88	170	57	285
E9	>100–250	500 lb bomb	0.3	410–450	2,090	4	20
E10	>250–500	Harpoon missile	0.3	219–224	1,100	30	150
E11	>500–650	650 lb mine	61, 150	7–17	45	12	60
E12	>650–1,000	2,000 lb bomb	0.3	16–21	77	0	0
E13	>1,000–1,740	Multiple Mat Weave charges.	NA[2]	9	45	0	0

[1] Net Explosive Weight refers to the amount of explosives; the actual weight of a munition may be larger due to other components.
[2] Not modeled because charge is detonated in surf zone; not a single E13 charge, but multiple smaller charges detonated in quick succession.
Notes: in = inch(es), lb = pound(s), ft = feet.

Vessel Movement

Vessels used as part of the Specified Activities include ships, submarines, unmanned vessels, and boats ranging in size from small, 22 ft (7 m) rigid hull inflatable boats to aircraft carriers with lengths up to 1,092 ft (333 m). Large Navy ships greater than 60 ft (18 m) generally operate at speeds in the range of 10 to 15 kn for fuel conservation. Submarines generally operate at speeds in the range of 8 to 13 kn in transits and less than those speeds for certain tactical maneuvers. Small craft, less than 60 ft (18 m) in length, have much more variable speeds (dependent on the activity). Speeds generally range from 10 to 14 kn. While these speeds for large and small craft are representative of most events, some vessels need to temporarily operate outside of these parameters.

The number of Navy vessels used in the HSTT Study Area varies based on military training and testing requirements, deployment schedules, annual budgets, and other unpredictable factors. Most training and testing activities involve the use of vessels. These activities could be widely dispersed throughout the HSTT Study Area, but would be typically conducted near naval ports, piers, and range areas. Navy vessel traffic would especially be concentrated near San Diego, California and Pearl Harbor, Hawaii. There is no seasonal differentiation in Navy vessel use. The majority of large vessel traffic occurs between the installations and the OPAREAS. Support craft would be more concentrated in the coastal waters in the areas of naval installations, ports and ranges. Activities involving vessel movements occur intermittently and are variable in duration, ranging from a few hours up to two weeks.

Standard Operating Procedures

For training and testing to be effective, personnel must be able to safely use their sensors and weapon systems as they are intended to be used in a real-world situation and to their optimum capabilities. While standard operating procedures are designed for the safety of personnel and equipment and to ensure the success of training and testing activities, their implementation often yields additional benefits to environmental, socioeconomic, public health and safety, and cultural resources.

Navy standard operating procedures have been developed and refined over years of experience and are broadcast via numerous naval instructions and manuals, including, but not limited to:

- Ship, submarine, and aircraft safety manuals;
- Ship, submarine, and aircraft standard operating manuals;
- Fleet Area Control and Surveillance Facility range operating instructions;
- Fleet exercise publications and instructions;
- Naval Sea Systems Command test range safety and standard operating instructions;
- Navy instrumented range operating procedures;
- Naval shipyard sea trial agendas;
- Research, development, test, and evaluation plans;
- Naval gunfire safety instructions;
- Navy planned maintenance system instructions and requirements;
- Federal Aviation Administration regulations; and
- International Regulations for Preventing Collisions at Sea.

Because standard operating procedures are essential to safety and mission success, the Navy considers them to be part of the Specified Activities, and has included them in the environmental analysis. Standard operating procedures that are recognized as providing a potential benefit to marine mammals during training and testing activities are noted below and discussed in more detail within the HSTT DEIS/OEIS.

- Vessel Safety
- Weapons Firing Safety
- Target Deployment Safety
- Towed In-Water Device Safety
- Pile Driving Safety

Standard operating procedures (which are implemented regardless of their secondary benefits) are different from mitigation measures (which are designed entirely for the purpose of avoiding or reducing potential impacts on the environment). Refer to Section 1.5.5 Standing Operating Procedures of the Navy's rulemaking/LOA application for greater detail.

Duration and Location

Training and testing activities would be conducted in the HSTT Study Area throughout the year from 2018 through 2023 for the five-year period covered by the regulations. The HSTT Study Area (see Figure 1.1–1 of the Navy's rulemaking/LOA application) is comprised of established operating and warning areas across the north-central Pacific Ocean, from the mean high tide line in Southern California west to Hawaii and the International Date Line. The Study Area includes the at-sea areas of three existing range complexes (the Hawaii Range Complex, the SOCAL Range Complex, and the Silver Strand Training Complex), and overlaps a portion of the Point Mugu Sea Range (PMSR). Also included in the Study Area are Navy pierside locations in Hawaii and Southern California, Pearl Harbor, San Diego Bay, and the transit corridor [1] on the high seas where sonar training and testing may occur. A Navy range complex consists of geographic areas that encompasses a water component (above and below the surface), airspace, and may encompass a land component where training and testing of military platforms, tactics, munitions, explosives, and electronic warfare systems occur. Range complexes include OPAREAs and special use airspace, which may be further divided to provide better control of the area and events being conducted for safety reasons. Please refer to the regional maps provided in the Navy's rulemaking/LOA application (Figures 2–1 through 2–8) for additional detail of the range complexes and testing ranges. The range complexes and testing ranges are described in the following sections.

Hawaii Range Complex

The Hawaii Range Complex encompasses ocean areas located around the Hawaiian Islands chain. The ocean areas extend from 16 degrees north latitude to 43 degrees north latitude and from 150 degrees west longitude to the International Date Line, forming an area approximately 1,700 nmi by 1,600 nmi. The largest component of the Hawaii Range Complex is the Temporary OPAREA, extending north and west from the island of Kauai, and comprising over two million square nautical miles (nmi^2) of air and sea space. The Temporary OPAREA is used primarily for missile testing by the Pacific Missile Range Facility (PMRF), and those missile tests are not part of the Navy's rulemaking/LOA application and are covered under other NEPA analysis. Other non-Navy entities such as various academic institutions and other Department of Defense agencies (DoD) such as the U.S. Air Force conduct activities in the PMRF. The PMRF activities referred to in the HSTT EIS/DEIS are very high altitude missile defense tests conducted by the Missile Defense Agency (MDA) (a non-Navy DoD command). For this rulemaking/LOA application, the area is used for Navy ship transits throughout the year. Despite the Temporary OPAREA's size, nearly all of the training and testing activities in the Hawaii Range Complex (HRC) take place within the smaller Hawaii OPAREA, that portion of the range complex immediately surrounding the island chain from Hawaii to Kauai (Figures 2–1 through 2–4 of the Navy's application). The Hawaii OPAREA consists of 235,000 nmi^2 of special use airspace and ocean areas. The HRC includes over 115,000 nmi^2 of combined special use airspace and air traffic control assigned airspace. As depicted in Figure 2–1 of the Navy's application, this airspace is almost entirely over the ocean and includes warning areas, air traffic controlled assigned airspace, and restricted areas.

The Hawaii Range Complex includes the ocean areas as described above, as well as specific training areas around the islands of Kauai, Oahu, and Maui (Figures 2–2, 2–3, and 2–4 respectively of the Navy's application). The Hawaii Range Complex also includes the ocean portion of the PMRF on Kauai, which is both a fleet training range and a fleet and DoD testing range. The facility includes 1,100 nmi^2 of instrumented ocean area at depths between 129 ft and 15,000 ft. The Hawaii Range Complex also includes the ocean areas around the designated Papahanaumokuakea Marine National Monument, referred hereafter as the Monument. Establishment of the Monument in June 2006 triggered a number of prohibitions on activities conducted in the Monument area. However, all military activities and exercises were specifically excluded from the listed prohibitions as long as the military exercises and activities are carried out in a manner that avoids, to the extent practicable and consistent with operational requirements, adverse impacts on monument resources and qualities. In 2016, the Monument was expanded from its original 139,818 square miles (mi^2) to 582,578 mi^2. The expansion of the Monument was primarily to the west—away from the portion of the Hawaii Range Complex where most training and testing activities are proposed to occur— and retained the military exclusion language contained in the monument designation.

Southern California Range Complex

The SOCAL Range Complex is located between Dana Point and San Diego, and extends southwest into the Pacific Ocean (Figures 2–5, 2–6, and 2–7 of the Navy's application). Although the range complex extends more than 600 nmi beyond land, most activities occur with 200 nmi of Southern California. The two primary components of the SOCAL Range Complex are the ocean OPAREAs and the special use airspace. These components encompass 120,000 nmi^2 of sea space and 113,000 nmi^2 of special use airspace. Most of the special use airspace in the SOCAL Range Complex is defined by W–291 (Figure 2–5 of the Navy's application). This warning area extends vertically from the ocean surface to 80,000 ft above mean sea level and encompasses 113,000 nmi^2 of airspace. The SOCAL Range Complex includes approximately 120,000 nmi^2 of sea and undersea space, largely defined as that ocean area underlying the Southern California special use airspace described above. The SOCAL Range Complex also extends beyond this airspace to include the surface and subsurface area from the northeastern border of W–291 to the coast of San Diego County, and includes San Diego Bay.

Point Mugu Sea Range Overlap

A small portion (approximately 1,000 nmi^2) of the Point Mugu Sea Range is included in the HSTT Study Area (Figure 2–5 of the Navy's application). Only that part of the Point Mugu Sea Range is used by the Navy for anti-submarine warfare training. This training uses sonar, is conducted in the course of major training exercises, and is analyzed in this request.

Silver Strand Training Complex

The Silver Strand Training Complex is an integrated set of training areas located on and adjacent to the Silver Strand, a narrow, sandy isthmus separating the San Diego Bay from the Pacific Ocean. It is divided into two non-contiguous areas: Silver Strand Training Complex-North and Silver Strand Training Complex-South (Figure 2–8 of the Navy's application). The Silver Strand Training Complex-North includes 10 oceanside boat training lanes (numbered as Boat Lanes 1–10), ocean anchorage areas (numbered 101–178), bayside water training areas (Alpha through Hotel), and the Lilly Ann drop zone. The boat training lanes are each 500 yards (yd) wide stretching 4,000 yd seaward and forming a 5,000

[1] Vessel transit corridors are the routes typically used by Navy assets to traverse from one area to another. The route depicted in Figure 1–1 of the Navy's rulemaking/LOA application is the shortest route between Hawaii and Southern California, making it the quickest and most fuel efficient. Depicted vessel transit corridor is notional and may not represent the actual routes used by ships and submarines transiting from Southern California to Hawaii and back. Actual routes navigated are based on a number of factors including, but not limited to, weather, training, and operational requirements.

yd long contiguous training area. The Silver Strand Training Complex-South includes four oceanside boat training lanes (numbered as Boat Lanes 11–14) and the TA-Kilo training area.

The anchorages lie offshore of Coronado in the Pacific Ocean and overlap a portion of Boat Lanes 1–10. The anchorages are each 654 yd in diameter and are grouped together in an area located primarily due west of Silver Strand Training Complex-North, east of Zuniga Jetty and the restricted areas on approach to the San Diego Bay entrance.

Ocean Operating Areas Outside the Bounds of Existing Range Complexes (Transit Corridor)

In addition to the range complexes that are part of the Study Area, a transit corridor outside the boundaries of the range complexes is also included as part of the Study Area in the analysis. Although not part of any defined range complex, this transit corridor is important to the Navy in that it provides adequate air, sea, and undersea space in which vessels and aircraft conduct training and some sonar maintenance and testing while enroute between Southern California and Hawaii. The transit corridor, notionally defined by the great circle route (*e.g.,* shortest distance) from San Diego to the center of the Hawaii Range Complex, as depicted in Figure 1–1 of the Navy's application, is generally used by ships transiting between the SOCAL Range Complex and Hawaii Range Complex. While in transit, ships and aircraft would, at times, conduct basic and routine unit level activities such as gunnery, bombing, and sonar training, testing, and maintenance, as long as the activities do not interfere with the primary objective of reaching their intended destination.

Pierside Locations, Pearl Harbor, and San Diego Bay

The Study Area includes select pierside locations where Navy surface ship and submarine sonar maintenance testing occur. For purposes of the Navy's application, pierside locations include channels and routes to and from Navy ports, and facilities associated with Navy ports and shipyards. These locations in the Study Area are located at Navy ports and naval shipyards in Pearl Harbor, Hawaii and in San Diego Bay, California (Figure 2–9 of the Navy's application). In addition, some training and testing activities occur throughout San Diego Bay.

Description of Marine Mammals and Their Habitat in the Area of the Specified Activities

Marine mammal species and their associated stocks that have the potential to occur in the HSTT Study Area are presented in Table 13 along with an abundance estimate, an associated coefficient of variation value, and best/minimum abundance estimates. The Navy proposes to take individuals of 39 marine mammal species by Level A and B harassment incidental to training and testing activities from the use of sonar and other transducers, in-water detonations, air guns, and impact pile driving/vibratory extraction activities. In addition, the Navy is requesting ten mortalities of two marine mammal stocks from explosives, and three takes of large whales by serious injury or mortality from vessel strikes over the five-year period. One marine mammal species, the Hawaiian monk seal, has critical habitat designated under the Endangered Species Act in the HSTT Study Area (described below).

Information on the status, distribution, abundance, population trends, and ecology of marine mammals in the HSTT Study Area may be found in Chapter 4 of the Navy's rulemaking/LOA application. Additional information on the general biology and ecology of marine mammals are included in the HSTT DEIS/OEIS. In addition, NMFS annually publishes Stock Assessment Reports (SARs) for all marine mammals in U.S. Exclusive Economic Zone (EEZ) waters, including stocks that occur within the HSTT Study Area and are found specifically in the U.S. Pacific Marine Mammal SAR (Carretta *et al.,* 2017) (see *https://www.fisheries.noaa.gov/resource/document/us-pacific-marine-mammal-stock-assessments-2016*).

The species carried forward for analysis (and described in Table 13 below) are those likely to be found in the HSTT Study Area based on the most recent data available, and do not include stocks or species that may have once inhabited or transited the area but have not been sighted in recent years (*e.g.,* species which were extirpated because of factors such as nineteenth and twentieth century commercial exploitation). Extralimital species, species that would not be considered part of the HSTT seasonal species assemblage (*e.g.,* North Pacific right whale, any tropical odontocete species in SOCAL), were not included in the analysis.

TABLE 13—MARINE MAMMALS OCCURRENCE WITHIN THE HSTT STUDY AREA

Common name	Scientific name	Stock	Status		Occurrence	Seasonal absence	Stock abundance (CV)/minimum population
			MMPA	ESA			
Blue whale	*Balaenoptera musculus.*	Eastern North Pacific.	Depleted	Endangered	Southern California.		1,647 (0.07)/1,551
		Central North Pacific.	Depleted	Endangered	Hawaii	Summer	81 (1.14)/38
Bryde's whale	*Balaenoptera brydei/edeni.*	Eastern Tropical Pacific.			Southern California.		unknown
		Hawaiian	Depleted		Hawaii		798 (0.28)/633
Fin whale	*Balaenoptera physalus.*	California, Oregon, and Washington.	Depleted	Endangered	Southern California.		9,029 (0.12)/8,127
		Hawaiian	Depleted	Endangered	Hawaii	Summer	58 (1.12)/27
Gray whale	*Eschrichtius robustus.*	Eastern North Pacific.			Southern California.		20,990 (0.05)/20,125
		Western North Pacific.	Depleted	Endangered	Southern California.		140 (0.04)/135
Humpback whale	*Megaptera novaeangliae.*	California, Oregon, and Washington.	Depleted	Threatened/Endangered [1].	Southern California.		1,918 (0.03)/1,876
		Central North Pacific.			Hawaii	Summer	10,103 (0.30)/7,890
Minke whale	*Balaenoptera acutorostrata.*	California, Oregon, and Washington.			Southern California.		636 (0.72)/369
		Hawaiian			Hawaii	Summer	unknown

TABLE 13—MARINE MAMMALS OCCURRENCE WITHIN THE HSTT STUDY AREA—Continued

Common name	Scientific name	Stock	Status		Occurrence	Seasonal absence	Stock abundance (CV)/minimum population
			MMPA	ESA			
Sei whale	*Balaenoptera borealis.*	Eastern North Pacific.	Depleted	Endangered	Southern California.		519 (0.4)/374
		Hawaii	Depleted	Endangered	Hawaii	Summer	178 (0.90)/93
Sperm whale	*Physeter macrocephalus.*	California, Oregon, and Washington.	Depleted	Endangered	Southern California.		2,106 (0.58)/1,332
		Hawaiian	Depleted	Endangered	Hawaii		3,354 (0.34)/2,539
Pygmy sperm whale.	*Kogia breviceps*	California, Oregon, and Washington.			Southern California.	Winter and Fall	4,111 (1.12)/1,924
		Hawaiian			Hawaii		unknown
Dwarf sperm whale.	*Kogia sima*	California, Oregon, and Washington.			Southern California.		unknown
		Hawaiian			Hawaii		unknown
Baird's beaked whale.	*Berardius bairdii*	California, Oregon, and Washington.			Southern California.		847 (0.81)/466
Blainville's beaked whale.	*Mesoplodon densirostris.*	Hawaiian			Hawaii		2,338 (1.13)/1,088
Cuvier's beaked whale.	*Ziphius cavirostris.*	California, Oregon, and Washington.			Southern California.		6,590 (0.55)/4,481
		Hawaiian			Hawaii		1,941 na/1,142
Longman's beaked whale.	*Indopacetus pacificus.*	Hawaiian			Hawaii		4,571 (0.65)/2,773
Mesoplodon beaked whales.	*Mesoplodon spp.*	California, Oregon, and Washington.			Southern California.		694 (0.65)/389
Common Bottlenose dolphin.	*Tursiops truncatus.*	California Coastal.			Southern California.		453 (0.06)/346
		California, Oregon, and Washington Offshore.					1,924 (0.54)/1,255
		Hawaiian Pelagic			Hawain		5,950 (0.59)/3,755
		Kauai and Niihau			Hawaii		184 (0.11)/168
		Oahu			Hawaii		743 (0.54)/485
		4-Islands			Hawaii		191 (0.24)/156
		Hawaii Island			Hawaii		128 (0.13)/115
False killer whale	*Pseudorca crassidens.*	Main Hawaiian Islands Insular.	Depleted	Endangered	Hawaii		151 (0.20)/92
		Hawaii Pelagic			Hawaii		1,540 (0.66)/928
		Northwestern Hawaiian Islands.			Hawaii		617 (1.11)/290
Fraser's dolphin	*Lagenodelphis hosei.*	Hawaiian			Hawaii		16,992 (0.66)/10,241
Killer whale	*Orcinus orca*	Eastern North Pacific Offshore.			Southern California.		240 (0.49)/162
		Eastern North Pacific Transient/West Coast Transient [2].			Southern California.		243 unknown/243
		Hawaiian			Hawaii		101 (1.00)/50
Long-beaked common dolphin.	*Delphinus capensis.*	California			Southern California.		101,305 (0.49)/68,432
Melon-headed whale.	*Peponocephala electra.*	Hawaiian Islands			Hawaii		5,794 (0.20)/4,904
		Kohala Resident					447 (0.12)/404
Northern right whale dolphin.	*Lissodelphis borealis.*	California, Oregon, and Washington.			Southern California.		26,556 (0.44)/18,608
Pacific white-sided dolphin.	*Lagenorhynchus obliquidens.*	California, Oregon, and Washington.			Southern California.		26,814 (0.28)/21,195
Pantropical spotted dolphin.	*Stenella attenuata.*	Oahu			Hawaii		unknown
		4-Islands					unknown
		Hawaii Island			Hawaii		unknown
		Hawaii Pelagic			Hawaii		15,917 (0.40)/11,508
Pygmy killer whale	*Feresa attenuata*	Tropical			Southern California.	Winter & Spring	unknown
		Hawaiian			Hawaii		3,433 (0.52)/2,274
Risso's dolphins	*Grampus griseus*	California, Oregon, and Washington.			Southern California.		6,336 (0.32)/4,817
		Hawaiian			Hawaii		7,256 (0.41)/5,207
Rough-toothed dolphin.	*Steno bredanensis.*	na [3]			Southern California.		unknown
		Hawaiian			Hawaii		6,288 (0.39)/4,581

TABLE 13—MARINE MAMMALS OCCURRENCE WITHIN THE HSTT STUDY AREA—Continued

Common name	Scientific name	Stock	Status		Occurrence	Seasonal absence	Stock abundance (CV)/minimum population
			MMPA	ESA			
Short-beaked common dolphin.	*Delphinus delphis.*	California, Oregon, and Washington.			Southern California.		969,861 (0.17)/839,325
Short-finned pilot whale.	*Globicephala macrorhynchus.*	California, Oregon, and Washington.			Southern California.		836 (0.79)/466
		Hawaiian			Hawaii		12,422 (0.43)/8,782
Spinner dolphin	*Stenella longirostris.*	Hawaii Pelagic			Hawaii		unknown
		Hawaii Island					631 (0.04)/585
		Oahu and 4-Islands.			Hawaii		355 (0.09)/329
		Kauai and Niihau			Hawaii		601 (0)/509
		Kure and Midway			Hawaii		unknown
		Pearl and Hermes.			Hawaii		unknown
Striped dolphin	*Stenella coeruleoalba.*	California, Oregon, and Washington.			Southern California.		29,211 (0.20)/24,782
		Hawaiian			Hawaii		20,650 (0.36)/15,391
Dall's porpoise	*Phocoenoides dalli.*	California, Oregon, and Washington.			Southern California.		25,750 (0.45)/17,954
Harbor seal	*Phoca vitulina*	California			Southern California.		30,968 na/27,348
Hawaiian monk seal.	*Neomonachus schauinslandi.*	Hawaiian	Depleted	Endangered	Hawaii		1,272 na/1,205
Northern elephant seal.	*Mirounga angustirostris.*	California			Southern California.		179,000 na/81,368
California sea lion	*Zalophus californianus.*	U.S. Stock			Southern California.		296,750 na/153,337
Guadalupe fur seal.	*Arctocephalus townsendi.*	Mexico to California.	Depleted	Threatened	Southern California.		20,000 na/15,830
Northern fur seal	*Callorhinus ursinus.*	California			Southern California.		14,050 na/7,524

Notes:

[1] The two humpback whale Distinct Population Segments making up the California, Oregon, and Washington stock present in Southern California are the Mexico Distinct Population Segment, listed under ESA as Threatened, and the Central America Distinct Population Segment, which is listed under ESA as Endangered.

[2] This stock is mentioned briefly in the Pacific Stock Assessment Report (Carretta *et al.,* 2017) and referred to as the ''Eastern North Pacific Transient'' stock; however, the Alaska Stock Assessment Report contains assessments of all transient killer whale stocks in the Pacific and the Alaska Stock Assessment Report refers to this same stock as the ''West Coast Transient'' stock (Muto *et al.,* 2017).

[3] Rough-toothed dolphin has a range known to include the waters off Southern California, but there is no recognized stock or data available for the U.S west coast.

Below, we include additional information about the marine mammals in the area of the Specified Activities, where available, that will inform our analysis, such as identifying areas of important habitat or known behaviors, or where Unusual Mortality Events (UME) have been designated.

Critical Habitat

Currently there is one marine mammal, the ESA-listed Hawaiian monk seal, with designated critical habitat within the HSTT Study Area. However, critical habitat for ESA-listed Main Hawaiian Islands insular false killer whale was recently proposed in November 2017 (82 FR 51186; November 3, 2017), designating waters from the 45 m depth contour to the 3200 m depth contour around the main Hawaiian Islands from Niihau east to Hawaii. However, some areas were proposed for exclusion based on considerations of economic and national security impacts.

Critical habitat for Hawaiian monk seals was designated in 1986 (51 FR 16047; April 30, 1986) and later revised in 1988 (53 FR 18988; May 26, 1988) and in 2015 (80 FR 50925; August 21, 2015) (NOAA, 2015a) (Figure 4–1 of the Navy's application). The essential features of the critical habitat were identified as: (1) Adjacent terrestrial and aquatic areas with characteristics preferred by monk seals for pupping and nursing; (2) shallow, sheltered aquatic areas adjacent to coastal locations preferred by monk seals for pupping and nursing; (3) marine areas from 0 to 500 m in depth preferred by juvenile and adult monk seals for foraging; (4) areas with low levels of anthropogenic disturbance; (5) marine areas with adequate prey quantity and quality; and (6) significant areas used by monk seals for hauling out, resting, or molting (NOAA, 2015a).

In the Northwestern Hawaiian Islands Hawaiian monk seal critical habitat includes all beach areas, sand spits and islets, including all beach crest vegetation to its deepest extent inland as well as the seafloor and marine habitat 10 m in height above the seafloor from the shoreline out to the 200 m depth contour around Kure Atoll, Midway Atoll, Pearl and Hermes Reef, Lisianski Island, Laysan Island, Maro Reef, Gardner Pinnacles, French Frigate Shoals, Necker Island and Nihoa Island. In the main Hawaiian Islands, Hawaiian monk seal critical habitat includes the seafloor and marine habitat to 10 m above the seafloor from the 200 m depth contour through the shoreline and extending into terrestrial habitat 5 m inland from the shoreline between identified boundary points around Kaula Island (includes marine habitat only, some excluded areas see areas, Niihau (includes marine habitat from 10 m–200 m in depth; some excluded areas), Kauai, Oahu, Maui Nui (including Kahoolawe, Lanai, Maui, and Molokai), Hawaii.

The approximate area encompassed by the Northwestern Hawaiian Islands was designated as the Papahanaumokuakea Monument in 2006, in part to protect the habitat of the Hawaiian monk seal. Hawaiian monk seals are managed as a single stock. There are six main reproductive subpopulations at: French Frigate Shoals, Laysan Island, Lisianski Island, Pearl and Hermes Reef, Midway Island, and Kure Atoll in the northwestern Hawaiian Islands.

Biologically Important Areas

Biologically Important Areas (BIAs) include areas of known importance for reproduction, feeding, or migration, or areas where small and resident populations are known to occur (Van Parijs, 2015). Unlike critical habitat, these areas are not formally designated pursuant to any statute or law, but are a compilation of the best available science intended to inform impact and mitigation analyses. An interactive map of the BIAs may be found here: *https://cetsound.noaa.gov/biologically-important-area-map*.

In Hawaii, 21 BIAs fall within or overlap with the HSTT Study Area. These include 11 small and resident population areas for species including dwarf sperm whales, Blainville's beaked whales, Cuvier's beaked whales, pygmy killer whales, short-finned pilot whales, melon-headed whales, false killer whales, pantropical spotted dolphins, spinner dolphins, rough-toothed dolphins, and common bottlenose dolphins (see Appendix K of the HSTT DEIS/OEIS for figures depicting these areas). In addition, six non-contiguous areas located adjacent to the eight main Hawaiian Islands have been designated as a humpback whale reproductive BIA (Baird *et al.,* 2015c).

Five of the 28 BIAs that were identified for four species off the U.S. west coast (Calambokidis *et al.,* 2015a) are located within or overlapping the SOCAL portion of the Study Area (see Appendix K of the HSTT DEIS/OEIS for figures depicting these areas). These identified areas include four feeding areas for blue whales and a migration area for gray whales (Calambokidis *et al.,* 2015a).

Main Hawaiian Islands Humpback Whale Reproduction BIA

A single biologically important area around and between portions of eight islands was identified for breeding humpback whales in the Main Hawaiian Islands from December through April (Baird *et al.,* 2015a) (see Figure K.3–1 of the HSTT DEIS/OEIS). The Main Hawaiian Islands Humpback Whale Reproduction BIA contains several humpback whale breeding sub-areas off the coasts of Kauai, Niihau, Oahu, Maui, and Hawaii Island. The highest densities of whales occur in waters that are less than 200 m in depth. The Main Hawaiian Islands Humpback Whale Reproduction Area also overlaps the Navy's 4-Islands Region and Hawaii Island Mitigation Areas and Humpback Whale Special Reporting Areas described later in this document (and also shown in Appendix K of the HSTT DEIS/OEIS). The Main Hawaiian Islands Humpback Whale Reproduction BIA also encompasses the entire Humpback Whale National Marine Sanctuary.

Dwarf Sperm Whales Small and Resident Population

A year-round BIA has been identified for a small resident population of dwarf sperm whales located off the island of Hawaii (Mahaffy *et al.,* 2009; Baird *et al.,* 2013a) with sightings between 500 and 1,000 m in depth (Baird et *al.,* 2013a). This BIA also overlaps the Navy's Hawaii Island Mitigation Area described later in this document.

Blainville's Beaked Whales Small and Resident Population

A year-round BIA for a small resident population of Blainville's beaked whales has been identified off the island of Hawaii (McSweeney *et al.,* 2007; Schorr *et al.,* 2009a) with the highest density of groups in water between 500 and 1,500 m in depth, and density decreasing offshore (Baird *et al.,* 2015c). This BIA also overlaps the Navy's Hawaii Island Mitigation Area described later in this document.

Cuvier's Beaked Whales Small and Resident Population

A year-round BIA for a small resident population of Cuvier's beaked whales has been identified off the island of Hawaii with the highest density of groups in water between 1,500 and 4,000 m in depth, and density decreasing offshore (Baird *et al.,* 2015c). This BIA also mostly overlaps the Navy's Hawaii Island Mitigation Area described later in this document.

Pygmy Killer Whales Small and Resident Population

A year-round BIA for a small resident population of pygmy killer whales has been identified for the Hawaii Island resident population. This BIA includes the west side of the island of Hawaii, from northwest of Kawaihae south to the south point of the island, and along the southeast coast of the island. This BIA also overlaps the Navy's Hawaii Island Mitigation Area described later in this document.

Short-Finned Pilot Whales Small and Resident Population

A year- round BIA for a small resident population of short-finned pilot whales has been identified off the island of Hawaii (Baird *et al.,* 2011c, 2013a; Mahaffy, 2012). Short-finned pilot whales are primarily connected to slope habitats off the islands, with the highest density between 1,000 and 2,500 m in depth, dropping off significantly after 2,500 m (Baird e*t al.,* 2013a). This BIA also overlaps the Navy's Hawaii Island Mitigation Area described later in this document.

Melon-Headed Whales Small and Resident Population

A year-round BIA has been identified for a small and resident population of melon-headed whales off the island of Hawaii, primarily using the Kohala area. This BIA also overlaps the Navy's Hawaii Island Mitigation Area described later in this document.

False Killer Whales Small and Resident Population

A year-round BIA has been identified for a small and resident insular population of false killer whales off the coasts of Oahu, Maui, Molokai, Lanai, and Hawaii Island. The known range of this population extends from west of Niihau to east of Hawaii, out to 122 km offshore (Baird *et al.,* 2012). This BIA also partially overlap the Navy's 4-Islands Region and Hawaii Island Mitigation Areas described later in this document.

Pantropical Spotted Dolphins Small and Resident Populations

Three year-round BIAs have been identified for small and resident populations of pantropical spotted dolphin. Three stocks of this species occurs around the main Hawaiian Islands (Oahu, the 4-Island Region, and off the main island of Hawaii). Two of these BIAs also overlap the Navy's 4-Islands Region and Hawaii Island Mitigation Areas described later in this document.

Spinner Dolphins Small and Resident Populations

Year-round BIAs have been identified for five small and resident populations of spinner dolphins. The boundaries of these populations are out to 10 nmi from shore around Kure and Midway Atolls, Pearl and Hermes Reef, Kauai and Niihau, Oahu and the 4-Islands Region and off the main island of Hawaii (Carretta *et al.,* 2014). Two of these BIAs also overlap the Navy's 4-Islands Region and Hawaii Island Mitigation Areas described later in this document.

Rough-Toothed Dolphins Small and Resident Population

A year-round BIA has been identified for a small demographically isolated resident population off the island of Hawaii (Baird *et al.,* 2008a; Albertson, 2015). This species is also found elsewhere among the Hawaiian Islands. The Navy's Hawaii Island Mitigation Area also overlaps with the majority of this BIA described later in this document.

Common Bottlenose Dolphins Small and Resident Populations

Year-round BIAs have been identified for the four insular stocks of bottlenose dolphins in Hawaiian waters. They are found both nearshore and offshore areas (Barlow, 2006), but around the main Hawaiian Islands they are primarily found in depths of less than 1,000 m (Baird *et al.,* 2013a). The Navy's 4-Islands Region Mitigation Area overlaps portions of the BIA off of Molokai, Maui, and Lanai and the Hawaii Island Mitigation Area (described later in this document) includes the entire BIA off of the Island of Hawaii.

Blue Whale Feeding BIAs

There are nine feeding area BIAs identified for blue whales off the U.S. west coast (Calambokidis *et al.,* 2015a), but only four overlap with the SOCAL portion of the HSTT Study Area (see Figure K.4–1 of the HSTT DEIS/OEIS). Two of these feeding areas (the Santa Monica Bay to Long Beach and the San Nicolas Island feeding area BIAs) are at the extreme northern edge and slightly overlap with the SOCAL portion of the HSTT Study Area. The remaining two feeding areas (the Tanner-Cortes Bank and the San Diego feeding area BIAs) are entirely within the SOCAL portion of the HSTT Study Area (Calambokidis *et al.,* 2015a). The feeding behavior for which these areas are designated occurs from June to October (Aquatic Mammals, 2015; Calambokidis *et al.,* 2015a). The San Diego blue whale feeding area overlaps with the Navy's San Diego Arc Mitigation Area as described later in this document.

Gray Whale Migration BIA

Calambokidis *et al.* (2015) identified a gray whale migration area off Southern California and overlapping with all the Southern California portion of the HSTT Study Area north of the border with Mexico (Figure K.4–7). This migration area covers approximately 22,300 km ^{2} of water space within the HSTT Study Area.

National Marine Sanctuaries

Under Title III of the Marine Protection, Research, and Sanctuaries Act of 1972 (also known as the National Marine Sanctuaries Act (NMSA)), NOAA can establish as national marine sanctuaries (NMS), areas of the marine environment with special conservation, recreational, ecological, historical, cultural, archaeological, scientific, educational, or aesthetic qualities. Sanctuary regulations prohibit destroying, causing the loss of, or injuring any sanctuary resource managed under the law or regulations for that sanctuary (15 CFR part 922). NMS are managed on a site-specific basis, and each sanctuary has site-specific regulations. Most, but not all sanctuaries have site-specific regulatory exemptions from the prohibitions for certain military activities. Separately, section 304(d) of the NMSA requires Federal agencies to consult with the Office of National Marine Sanctuaries whenever their Specified Activities are likely to destroy, cause the loss of, or injure a sanctuary resource. There are two national marine sanctuaries managed by the Office of National Marine Sanctuaries within the Study Area, the Hawaiian Islands Humpback Whale NMS and Channel Islands NMS (see Table 6.1–2 and Figures 6.1–3 and 6.1–4 of the HSTT DEIS/OEIS), which are described below.

Hawaiian Islands Humpback Whale NMS

The Hawaiian Islands Humpback Whale NMS is a single-species managed sanctuary, composed of 1,035 nmi^2 of the waters around Maui, Lanai, and Molokai; and smaller areas off the north shore of Kauai, off Hawaii's west coast, and off the north and southeast coasts of Oahu. The Sanctuary is entirely within the HRC of the HSTT Study Area and constitutes one of the world's most important Hawaii humpback whale Distinct Population Segment (DPS) habitats (81 FR 62259; September 8, 2016), and is a primary region for humpback reproduction in the United States (National Marine Sanctuaries Program, 2002). Scientists estimate that more than 50 percent of the entire North Pacific humpback whale population migrates to Hawaiian waters each winter to mate, calve, and nurse their young. The North Pacific humpback whale population has been split into two DPSs. The Hawaii humpback whale DPS migrates to Hawaiian waters each winter and is not listed under the ESA. In addition to protection under the MMPA, the Hawaii humpback whale DPS is protected in sanctuary waters by the Hawaiian Islands NMS. The sanctuary was created to protect humpback whales and shallow, protected waters important for calving and nursing (Office of National Marine Sanctuaries, 2010).

The Hawaiian Islands Humpback Whale NMS overlaps with the Main Hawaiian Islands Humpback Whale Reproduction Area (BIA) identified in Van Parijs (2015) and Baird et al. (2015) (shown in Figure K.3–1 of Appendix K and as discussed in Appendix K, Section K.3.1 (Main Hawaiian Islands Humpback Whale Reproduction Area of the HSTT DEIS/OEIS)).

Channel Islands NMS

The Channel Islands NMS is an ecosystem-based managed sanctuary consisting of an area of 1,109 nmi ^{2} around Anacapa Island, Santa Cruz Island, Santa Rosa Island, San Miguel Island, and Santa Barbara Island to the south. Only 92 nmi ^{2}, or about 8 percent of the sanctuary, occurs within the SOCAL portion of the Study Area (see Figure 6.1–4 of the HSTT DEIS/OEIS). The Study Area overlaps with the sanctuary at Santa Barbara Island. In addition, the Navy has proposed to implement the Santa Barbara Island Mitigation Area around Santa Barbara Island out to 6 nmi as described later in this document (also see Section K.2.2, Mitigation Areas to be Implemented of the HSTT DEIS/OEIS). As an ecosystem-based managed sanctuary, key habitats include kelp forest, surfgrass and eelgrass, intertidal zone, nearshore subtidal, deepwater benthic, and water column habitat. The diversity of habitats onshore and offshore contributes to the high species diversity in the Channel Islands NMS, with more than 195 species of birds, at least 33 species of cetaceans, 4 species of sea turtles, at least 492 species of algae and 4 species of sea grasses, a variety of invertebrates (including two endangered species (black abalone and the white abalone)), and 481 species of fish (NMS, 2009b).

Unusual Mortality Events (UME)

A UME is defined under Section 410(6) of the MMPA as a stranding that is unexpected; involves a significant die-off of any marine mammal population; and demands immediate response. From 1991 to the present, there have been 16 formally recognized UMEs affecting marine mammals in California and Hawaii and involving species under NMFS's jurisdiction. Two UMEs that could be relevant to informing the current analysis are discussed below. Specifically, the California sea lion UME in California is still open, but will be closed soon. The Guadalupe fur seal UME in California is still active and involves an ongoing investigation.

California Sea Lion UME

Elevated strandings of California sea lion pups began in Southern California in January 2013. In 2013, over 1,600 California sea lions stranded alive along the Southern California coastline and over 3,500 live stranded California sea lions stranded on beaches in 2015, which was the highest number on record. Approximately 13,000 California sea lions (both live and dead) stranded from January 1, 2013, through December 31, 2017. Strandings in 2017 have finally returned to baseline (approximately 1,400/yr). The UME is currently defined to include pup and yearling California sea lions (0–2 years of age). Many of the sea lions were emaciated, dehydrated, and very underweight for their age. Findings to date indicate that a likely contributor to the large number of stranded, malnourished pups was a change in the availability of sea lion prey, especially sardines, a high value food source for both weaned pups and nursing mothers. Current data show changes in availability of sea lion prey in Southern California waters was likely a contributor to the UME, and this change was most likely secondary to ecological factors (El Niño and Warm Water Blob). Sardine spawning grounds shifted further offshore in 2012 and 2013, and while other prey were available (market squid and rockfish), these may not have provided adequate nutrition in the milk of sea lion mothers supporting pups or for newly-weaned pups foraging on their own. Although the pups showed signs of some viruses and infections, findings indicate that this event was not caused by disease, but rather by the lack of high quality, close-by food sources for nursing mothers and weaned pups. Current evidence does not support that this UME was caused by a single infectious agent, though a variety of disease-causing bacteria and viruses were found in samples from sea lion pups. This investigation will soon be closed. Please refer to *https://www.fisheries.noaa.gov/national/marine-life-distress/2013-2017-california-sea-lion-unusual-mortality-event-california* for more information on this UME.

Guadalupe Fur Seal UME

Increased strandings of Guadalupe fur seals began along the entire coast of California in January 2015 and were eight times higher than the historical average (approximately 10 seals/yr). Strandings have continued since 2015 and have remained well above average through 2017. As of March 8, 2018, the total number of Guadalupe fur seals to date in the UME is 241. Strandings are seasonal and generally peak in April through June of each year. The Guadalupe fur seal strandings have been mostly weaned pups and juveniles (1–2 years old) with both live and dead strandings occurring. Current findings from the majority of stranded animals include primary malnutrition with secondary bacterial and parasitic infections. This UME is occurring in the same area as the ongoing 2013–2017 California sea lion UME. This investigation is ongoing. Please refer to *https://www.fisheries.noaa.gov/national/marine-life-distress/2015-2018-guadalupe-fur-seal-unusual-mortality-event-california* for more information on this UME.

Marine Mammal Hearing

Hearing is the most important sensory modality for marine mammals underwater, and exposure to anthropogenic sound can have deleterious effects. To appropriately assess the potential effects of exposure to sound, it is necessary to understand the frequency ranges marine mammals are able to hear. Current data indicate that not all marine mammal species have equal hearing capabilities (*e.g.,* Richardson *et al.,* 1995; Wartzok and Ketten, 1999; Au and Hastings, 2008). To reflect this, Southall *et al.* (2007) recommended that marine mammals be divided into functional hearing groups based on directly measured or estimated hearing ranges on the basis of available behavioral response data, audiograms derived using auditory evoked potential techniques, anatomical modeling, and other data. Note that no direct measurements of hearing ability have been successfully completed for mysticetes (*i.e.,* low-frequency cetaceans). Subsequently, NMFS (2016) described generalized hearing ranges for these marine mammal hearing groups. Generalized hearing ranges were chosen based on the approximately 65 dB threshold from the normalized composite audiograms, with the exception for lower limits for low-frequency cetaceans where the lower bound was deemed to be biologically implausible and the lower bound from Southall *et al.* (2007) retained. The functional groups and the associated frequencies are indicated below (note that these frequency ranges correspond to the range for the composite group, with the entire range not necessarily reflecting the capabilities of every species within that group):

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

The pinniped functional hearing group was modified from Southall *et al.* (2007) on the basis of data indicating that phocid species have consistently demonstrated an extended frequency range of hearing compared to otariids, especially in the higher frequency range (Hemilä *et al.,* 2006; Kastelein *et al.,* 2009; Reichmuth and Holt, 2013).

For more detail concerning these groups and associated frequency ranges, please see NMFS (2016) for a review of available information.

Potential Effects of Specified Activities on Marine Mammals and Their Habitat

This section includes a summary and discussion of the ways that components of the specified activity may impact marine mammals and their habitat. The ''Estimated Take of Marine Mammals'' section later in this document includes a quantitative analysis of the number of instances of take that could occur from these activities. The ''Negligible Impact Analysis and Determination'' section considers the content of this section, the ''Estimated Take of Marine Mammals'' section, and the ''Proposed Mitigation'' section, to draw conclusions regarding the likely impacts of these activities on the reproductive success or survivorship of individuals and how those impacts on individuals are likely to impact marine mammal species or stocks.

The Navy has requested authorization for the take of marine mammals that may occur incidental to training and testing activities in the HSTT Study Area. The Navy analyzed potential impacts to marine mammals from acoustic and explosive sources as well as vessel strikes.

Other potential impacts to marine mammals from training and testing activities in the HSTT Study Area were analyzed in the HSTT DEIS/OEIS, in consultation with NMFS as a cooperating agency, and determined to be unlikely to result in marine mammal take. Therefore, the Navy has not requested authorization for take of marine mammals incidental to other components of their Specified Activities, and we agree that take is unlikely to occur from those components. In this proposed rule, NMFS analyzes the potential effects on marine mammals from the activity components that may cause the take of marine mammals: Exposure to acoustic or explosive stressors including non-impulsive (sonar and other active acoustic sources) and impulsive (explosives, impact pile driving, and air guns) stressors, and vessel strikes.

For the purpose of MMPA incidental take authorizations, NMFS's effects assessments serve four primary purposes: (1) To prescribe the permissible methods of taking (*i.e.,* Level B harassment (behavioral harassment and temporary threshold shift (TTS), Level A harassment (permanent threshold shift (PTS) or non-auditory injury), serious injury, or mortality, including an identification of the number and types of take that could occur by harassment, serious injury, or mortality) and to prescribe other means of effecting the least practicable adverse impact on such species or stock and its habitat (*i.e.,* mitigation); (2) to determine whether the specified activities would have a negligible impact on the affected species or stocks of marine mammals (based on the likelihood that the activities would adversely affect the species or stock through effects on annual rates of recruitment or survival); (3) to determine whether the specified activities would have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (however, there are no subsistence communities that would be affected in the HSTT Study Area, so this determination is inapplicable to the HSTT rulemaking); and (4) to prescribe requirements pertaining to monitoring and reporting.

In the Potential Effects Section, NMFS provides a general description of the ways marine mammals may be affected by these activities in the form of mortality, physical trauma, sensory impairment (permanent and temporary threshold shifts and acoustic masking), physiological responses (particular stress responses), behavioral disturbance, or habitat effects. Explosives and vessel strikes, which have the potential to result in incidental take from serious injury and/or mortality, will be discussed in more detail in the Estimated Take of Marine Mammals section. The Estimated Take of Marine Mammals section also discusses how the potential effects on marine mammals from non-impulsive and impulsive sources relate to the MMPA definitions of Level A and Level B Harassment, and quantifies those effects that rise to the level of a take along with the potential effects from vessel strikes. The Negligible Impact Analysis Section assesses whether the proposed authorized take will have a negligible impact on the affected species and stocks.

Potential Effects of Underwater Sound

Note that, in the following discussion, we refer in many cases to a review article concerning studies of noise-induced hearing loss conducted from 1996–2015 (*i.e.,* Finneran, 2015). For study-specific citations, please see that work. Anthropogenic sounds cover a broad range of frequencies and sound levels and can have a range of highly variable impacts on marine life, from none or minor to potentially severe responses, depending on received levels, duration of exposure, behavioral context, and various other factors. The potential effects of underwater sound from active acoustic sources can possibly result in one or more of the following: temporary or permanent hearing impairment, non-auditory physical or physiological effects, behavioral disturbance, stress, and masking (Richardson *et al.,* 1995; Gordon *et al.,* 2004; Nowacek *et al.,* 2007; Southall *et al.,* 2007; Götz *et al.,* 2009). The degree of effect is intrinsically related to the signal characteristics, received level, distance from the source, and duration of the sound exposure. In general, sudden, high level sounds can cause hearing loss, as can longer exposures to lower level sounds. Temporary or permanent loss of hearing will occur almost exclusively for noise within an animal's hearing range. We first describe specific manifestations of acoustic effects before providing discussion specific to the Navy's activities.

Richardson *et al.* (1995) described zones of increasing intensity of effect that might be expected to occur, in relation to distance from a source and assuming that the signal is within an animal's hearing range. First is the area within which the acoustic signal would be audible (potentially perceived) to the animal, but not strong enough to elicit any overt behavioral or physiological response. The next zone corresponds with the area where the signal is audible to the animal and of sufficient intensity to elicit behavioral or physiological responsiveness. Third is a zone within which, for signals of high intensity, the received level is sufficient to potentially cause discomfort or tissue damage to auditory systems. Overlaying these zones to a certain extent is the area within which masking (*i.e.,* when a sound interferes with or masks the ability of an animal to detect a signal of interest that is above the absolute hearing threshold) may occur; the masking zone may be highly variable in size.

We also describe more severe effects (*i.e.,* certain non-auditory physical or physiological effects). Potential effects from impulsive sound sources can range in severity from effects such as behavioral disturbance or tactile perception to physical discomfort, slight injury of the internal organs and the auditory system, or mortality (Yelverton *et al.,* 1973). Non-auditory physiological effects or injuries that theoretically might occur in marine mammals exposed to high level underwater sound or as a secondary effect of extreme behavioral reactions (*e.g.,* change in dive profile as a result of an avoidance reaction) caused by exposure to sound include neurological effects, bubble formation, resonance effects, and other types of organ or tissue damage (Cox *et al.,* 2006; Southall *et al.,* 2007; Zimmer and Tyack, 2007; Tal *et al.,* 2015).

Acoustic Sources

Direct Physiological Effects

Based on the literature, there are two basic ways that non-impulsive sources might directly result in direct physiological effects. Noise-induced loss of hearing sensitivity (more commonly-called ''threshold shift'' (TS)) is the better-understood of these two effects, and the only one that is actually expected to occur. The second effect, acoustically mediated bubble growth and other pressure-related physiological impacts are addressed briefly below, but are not expected to result from the Navy's activities. Separately, an animal's behavioral reaction to an acoustic exposure might lead to physiological effects that might ultimately lead to injury or death, which is discussed later in the Stranding Section.

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 TS. An animal can experience a TTS and/or 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 6 dB or reduced by 30 dB). Repeated sound exposure that leads to TTS could cause PTS. In severe cases of PTS, there can be total or partial deafness, while in most cases the animal has an impaired ability to hear sounds in specific frequency ranges (Kryter, 1985). When PTS occurs, there is physical damage to the sound receptors in the ear (*i.e.,* tissue damage), whereas TTS represents primarily tissue fatigue and is reversible (Southall *et al.,* 2007). 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. In addition, other investigators have suggested that TTS is within the normal bounds of physiological variability and tolerance and does not represent physical injury (*e.g.,* Ward, 1997). Therefore, NMFS does not consider TTS to constitute auditory injury.

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

PTS is considered auditory injury (Southall *et al.,* 2007). Irreparable damage to the inner or outer cochlear hair cells may cause PTS; however, other mechanisms are also involved, such as exceeding the elastic limits of certain tissues and membranes in the middle and inner ears and resultant changes in the chemical composition of the inner ear fluids (Southall *et al.,* 2007).

Although the published body of scientific literature contains numerous theoretical studies and discussion papers on hearing impairments that can occur with exposure to a loud sound, only a few studies provide empirical information on the levels at which noise-induced loss in hearing sensitivity occurs in nonhuman animals. The NMFS 2016 Acoustic Technical Guidance, which was used in the assessment of effects for this action, compiled, interpreted, and synthesized the best available scientific information for noise-induced hearing effects for marine mammals to derive updated thresholds for assessing the impacts of noise on marine mammal hearing, as noted above. For cetaceans, published data on the onset of TTS are limited to the captive bottlenose dolphin, beluga, harbor porpoise, and Yangtze finless porpoise (summarized in Finneran, 2015). TTS studies involving exposure to other Navy activities (*e.g.,* SURTASS LFA) or other low-frequency sonar (below 1 kHz) have never been conducted due to logistical difficulties of conducting experiments with low frequency sound sources. However, there are TTS measurements for exposures to other LF sources, such as seismic air guns. Finneran *et al.* (2015) suggest that the potential for air guns to cause hearing loss in dolphins is lower than previously predicted, perhaps as a result of the low-frequency content of air gun impulses compared to the high-frequency hearing ability of dolphins. Finneran *et al.* (2015) measured hearing thresholds in three captive bottlenose dolphins before and after exposure to ten pulses produced by a seismic air gun in order to study TTS induced after exposure to multiple pulses. Exposures began at relatively low levels and gradually increased over a period of several months, with the highest exposures at peak SPLs from 196 to 210 dB and cumulative (unweighted) SELs from 193–195 dB. No substantial TTS was observed. In addition, behavioral reactions were observed that indicated that animals can learn behaviors that effectively mitigate noise exposures (although exposure patterns must be learned, which is less likely in wild animals than for the captive animals considered in the study). The authors note that the failure to induce more significant auditory effects was likely due to the intermittent nature of exposure, the relatively low peak pressure produced by the acoustic source, and the low-frequency energy in air gun pulses as compared with the frequency range of best sensitivity for dolphins and other mid-frequency cetaceans. For pinnipeds in water, measurements of TTS are limited to harbor seals, elephant seals, and California sea lions (summarized in Finneran, 2015).

Marine mammal hearing plays a critical role in communication with conspecifics and in interpretation of environmental cues for purposes such as predator avoidance and prey capture. Depending on the degree (elevation of threshold in dB), duration (*i.e.,* recovery time), and frequency range of TTS, and the context in which it is experienced, TTS can have effects on marine mammals ranging from discountable to serious similar to those discussed in auditory masking, below. 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 high levels of sound that would be expected to result in this physiological response would also be expected to have behavioral responses of a comparatively more severe or sustained nature is potentially more significant than simple existence of a TTS. However, it is important to note that TTS could occur due to longer exposures to sound at lower levels so that a behavioral response may not be elicited.

Depending on the degree and frequency range, the effects of PTS on an animal could also range in severity, although 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 some cost to the animal.

Acoustically Mediated Bubble Growth and Other Pressure-Related Injury

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 (for example, beaked whales) are theoretically predicted to induce greater supersaturation (Houser *et al.,* 2001b). 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 (in combination with the source levels) of 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. Recent research with *ex vivo* supersaturated bovine tissues suggested that, for a 37 kHz signal, a sound exposure of approximately 215 dB referenced to (re) 1 μPa would be required before microbubbles became destabilized and grew (Crum *et al.,* 2005). Assuming spherical spreading loss and a nominal sonar source level of 235 dB re 1 μPa at 1 m, a whale would need to be within 10 m (33 ft) of the sonar dome to be exposed to such sound levels. Furthermore, tissues in the study were supersaturated by exposing them to pressures of 400–700 kilopascals for periods of hours and then releasing them to ambient pressures. Assuming the equilibration of gases with the tissues occurred when the tissues were exposed to the high pressures, levels of supersaturation in the tissues could have been as high as 400–700 percent. These levels of tissue supersaturation are substantially higher than model predictions for marine mammals (Houser *et al.,* 2001; Saunders *et al.,* 2008). It is improbable that this mechanism is responsible for stranding events or traumas associated with beaked whale strandings because both the degree of supersaturation and exposure levels observed to cause microbubble destabilization are unlikely to occur, either alone or in concert.

Yet another hypothesis (decompression sickness) has speculated 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; Fernández *et al.,* 2012). In this scenario, the rate of ascent would need to be sufficiently rapid to compromise behavioral or physiological protections against nitrogen bubble formation. Alternatively, Tyack *et al.* (2006) studied the deep diving behavior of beaked whales and concluded that: ''Using current models of breath-hold diving, we infer that their natural diving behavior is inconsistent with known problems of acute nitrogen supersaturation and embolism.'' Collectively, these hypotheses can be referred to as ''hypotheses of acoustically mediated bubble growth.''

Although theoretical predictions suggest the possibility for acoustically mediated bubble growth, there is considerable disagreement among scientists as to its likelihood (Piantadosi and Thalmann, 2004; Evans and Miller, 2003; Cox *et al.,* 2006; Rommel *et al.,* 2006). Crum and Mao (1996) hypothesized that received levels would have to exceed 190 dB in order for there to be the possibility of significant bubble growth due to supersaturation of gases in the blood (*i.e.,* rectified diffusion). Work conducted by Crum *et al.* (2005) demonstrated the possibility of rectified diffusion for short duration signals, but at SELs and tissue saturation levels that are highly improbable to occur in diving marine mammals. To date, energy levels (ELs) predicted to cause in vivo bubble formation within diving cetaceans have not been evaluated (NOAA, 2002b). Jepson *et al.* (2003, 2005) and Fernandez *et al.* (2004, 2005, 2012) concluded that in vivo bubble formation, which may be exacerbated by deep, long-duration, repetitive dives may explain why beaked whales appear to be relatively vulnerable to MF/HF sonar exposures. It has also been argued that traumas from some beaked whale strandings are consistent with gas emboli and bubble-induced tissue separations (Jepson *et al.,* 2003); however, there is no conclusive evidence of this (Rommel *et al.,* 2006).

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

In their study, they compared results for previously published time depth recorder data (Hooker and Baird, 1999; Baird *et al.,* 2006, 2008) from Cuvier's beaked whale, Blainville's beaked whale, and northern bottlenose whale. They reported that diving lung volume and extent of the dive response had a large effect on end-dive P_{N2}. Also, results showed that dive profiles had a larger influence on end-dive P_{N2} than body mass differences between species. Despite diel changes (*i.e.,* variation that occurs regularly every day or most days) in dive behavior, P_{N2} levels showed no consistent trend. Model output suggested that all three species live with tissue P_{N2} levels that would cause a significant proportion of decompression sickness cases in terrestrial mammals. The authors concluded that the dive behavior of Cuvier's beaked whale was different from both Blainville's beaked whale, and northern bottlenose whale, 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).

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

To summarize, while there are several hypotheses, there is little data to support the potential for strong, anthropogenic underwater sounds to cause non-auditory physical effects in marine mammals. The available data do not support identification of a specific exposure level above which non-auditory effects can be expected (Southall *et al.,* 2007) or any meaningful quantitative predictions of the numbers (if any) of marine mammals that might be affected in these ways. In addition, such effects, if they occur at all, would be expected to be limited to situations where marine mammals were exposed to high powered sounds at very close range over a prolonged period of time, which is not expected to occur based on the speed of the vessels operating sonar in combination with the speed and behavior of marine mammals in the vicinity of sonar.

Acoustic Masking

Sound can disrupt behavior through masking, or interfering with, an animal's ability to detect, recognize, or discriminate between acoustic signals of interest (*e.g.,* those used for intraspecific communication and social interactions, prey detection, predator avoidance, navigation) (Richardson *et al.,* 1995; Erbe and Farmer, 2000; Tyack, 2000; Erbe *et al.,* 2016). Masking occurs when the receipt of a sound is interfered with by another coincident sound at similar frequencies and at similar or higher intensity, and may occur whether the sound is natural (*e.g.,* snapping shrimp, wind, waves, precipitation) or anthropogenic (*e.g.,* shipping, sonar, seismic exploration) in origin. The ability of a noise source to mask biologically important sounds depends on the characteristics of both the noise source and the signal of interest (*e.g.,* signal-to-noise ratio, temporal variability, direction), in relation to each other and to an animal's hearing abilities (*e.g.,* sensitivity, frequency range, critical ratios, frequency discrimination, directional discrimination, age or TTS hearing loss), and existing ambient noise and propagation conditions. Masking these acoustic signals can disturb the behavior of individual animals, groups of animals, or entire populations.

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, though, the detection of frequencies above those of the masking stimulus decreases also. This principle is expected to apply to marine mammals as well because of common biomechanical cochlear properties across taxa.

Under certain circumstances, marine mammals experiencing significant masking could also be impaired from maximizing their performance fitness in survival and reproduction. Therefore, when the coincident (masking) sound is man-made, it may be considered harassment when disrupting or altering critical behaviors. It is important to distinguish TTS and PTS, which persist after the sound exposure from masking, which occurs during the sound exposure. Because masking (without resulting in TS) is not associated with abnormal physiological function, it is not considered a physiological effect, but rather a potential behavioral effect.

The frequency range of the potentially masking sound is important in determining any potential behavioral impacts. For example, low-frequency signals may have less effect on high-frequency echolocation sounds produced by odontocetes but are more likely to affect detection of mysticete communication calls and other potentially important natural sounds such as those produced by surf and some prey species. The masking of communication signals by anthropogenic noise may be considered as a reduction in the communication space of animals (*e.g.,* Clark *et al.,* 2009; Matthews *et al.,* 2016) and may result in energetic or other costs as animals change their vocalization behavior (*e.g.,* Miller *et al.,* 2000; Foote *et al.,* 2004; Parks *et al.,* 2007; Di Iorio and Clark, 2009; Holt *et al.,* 2009). Masking can be reduced in situations where the signal and noise come from different directions (Richardson *et al.,* 1995), through amplitude modulation of the signal, or through other compensatory behaviors (Houser and Moore, 2014). Masking can be tested directly in captive species (*e.g.,* Erbe, 2008), but in wild populations it must be either modeled or inferred from evidence of masking compensation. There are few studies addressing real-world masking sounds likely to be experienced by marine mammals in the wild (*e.g.,* Branstetter *et al.,* 2013).

Masking affects both senders and receivers of acoustic signals and can potentially have long-term chronic effects on marine mammals at the population level as well as at the individual level. Low-frequency ambient sound levels have increased by as much as 20 dB (more than three times in terms of SPL) in the world's ocean from pre-industrial periods, with most of the increase from distant commercial shipping (Hildebrand, 2009). All anthropogenic sound sources, but especially chronic and lower-frequency signals (*e.g.,* from commercial vessel traffic), contribute to elevated ambient sound levels, thus intensifying masking.

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

Risch *et al.* (2012) documented reductions in humpback whale vocalizations in the Stellwagen Bank National Marine Sanctuary concurrent with transmissions of the Ocean Acoustic Waveguide Remote Sensing (OAWRS) low-frequency fish sensor system at distances of 200 km (124 mi) from the source. The recorded OAWRS produced a series of frequency modulated pulses and the signal received levels ranged from 88 to 110 dB re: 1 μPa (Risch, *et al.,* 2012). The authors hypothesized that individuals did not leave the area but instead ceased singing and noted that the duration and frequency range of the OAWRS signals (a novel sound to the whales) were similar to those of natural humpback whale song components used during mating (Risch *et al.,* 2012). Thus, the novelty of the sound to humpback whales in the Navy's Study Area (Navy's Atlantic Fleet Study Area) provided a compelling contextual probability for the observed effects (Risch *et al.,* 2012). However, the authors did not state or imply that these changes had long-term effects on individual animals or populations (Risch *et al.,* 2012).

Redundancy and context can also facilitate detection of weak signals. These phenomena may help marine mammals detect weak sounds in the presence of natural or manmade noise. Most masking studies in marine mammals present the test signal and the masking noise from the same direction. The dominant background noise may be highly directional if it comes from a particular anthropogenic source such as a ship or industrial site. Directional hearing may significantly reduce the masking effects of these sounds by improving the effective signal-to-noise ratio.

The functional hearing ranges of mysticetes, odontocetes, and pinnipeds underwater all overlap the frequencies of the sonar sources used in the Navy's low-frequency active sonar (LFAS)/mid-frequency active sonar (MFAS)/high-frequency active sonar (HFAS) training and testing exercises. Additionally, almost all species' vocal repertoires span across the frequencies of these sonar sources used by the Navy. The closer the characteristics of the masking signal to the signal of interest, the more likely masking is to occur. Although hull-mounted sonar accounts for a large portion of the area ensonified by Navy activities (because of the source strength and number of hours it is conducted), the pulse length and low duty cycle of the MFAS/HFAS signal makes it less likely that masking would occur as a result.

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

Stress Response

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.

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

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

Information has also been collected on the physiological responses of marine mammals to exposure to anthropogenic sounds (Fair and Becker, 2000; Romano *et al.,* 2002; Wright *et al.,* 2008). Various efforts have been undertaken to investigate the impact from vessels (both whale-watching and general vessel traffic noise), and demonstrated impacts do occur (Bain, 2002; Erbe, 2002; Noren *et al.,* 2009; Williams *et al.,* 2006, 2009, 2014a, 2014b; Read *et al.,* 2014; Rolland *et al.,* 2012; Pirotta *et al.,* 2015). This body of research for the most part has investigated impacts associated with the presence of chronic stressors, which differ significantly from the proposed Navy training and testing activities in the HSTT Study Area. For example, in an analysis of energy costs to killer whales, Williams *et al.* (2009) suggested that whale-watching in Canada's Johnstone Strait resulted in lost feeding opportunities due to vessel disturbance, which could carry higher costs than other measures of behavioral change might suggest. Ayres *et al.* (2012) recently reported on research in the Salish Sea (Washington state) involving the measurement of southern resident killer whale fecal hormones to assess two potential threats to the species recovery: Lack of prey (salmon) and impacts to behavior from vessel traffic. Ayres *et al.* (2012) suggested that the lack of prey overshadowed any population-level physiological impacts on southern resident killer whales from vessel traffic. Rolland *et al.* (2012) found that noise reduction from reduced ship traffic in the Bay of Fundy was associated with decreased stress in North Atlantic right whales. In a conceptual model developed by the Population Consequences of Acoustic Disturbance (PCAD) working group, serum hormones were identified as possible indicators of behavioral effects that are translated into altered rates of reproduction and mortality (NRC, 2005). The Office of Naval Research hosted a workshop (Effects of Stress on Marine Mammals Exposed to Sound) in 2009 that focused on this very topic (ONR, 2009). Ultimately, the PCAD working group issued a report (Cochrem, 2014) that summarized information compiled from 239 papers or book chapters relating to stress in marine mammals and concluded that stress responses can last from minutes to hours and, while we typically focus on adverse stress responses, stress response is part of a natural process to help animals adjust to changes in their environment and can also be either neutral or beneficial.

Despite the lack of robust information on stress responses for marine mammals exposed to anthropogenic sounds, studies of other marine animals and terrestrial animals would also 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 high frequency, mid-frequency, and 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 physiological 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.

Behavioral Response/Disturbance

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

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

Ellison *et al.* (2012) outlined an approach to assessing the effects of sound on marine mammals that incorporates contextual-based factors. The authors recommend considering not just the received level of sound, but also the activity the animal is engaged in at the time the sound is received, the nature and novelty of the sound (*i.e.,* is this a new sound from the animal's perspective), and the distance between the sound source and the animal. They submit that this ''exposure context,'' as described, greatly influences the type of behavioral response exhibited by the animal. This sort of contextual information is challenging to predict with accuracy for ongoing activities that occur over large spatial and temporal expanses. However, distance is one contextual factor for which data exist to quantitatively inform a take estimate, and the new method for predicting Level B harassment proposed in this notice does consider distance to the source. Other factors are often considered qualitatively in the analysis of the likely consequences of sound exposure, where supporting information is available.

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

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

Flight Response

A flight response is a dramatic change in normal movement to a directed and rapid movement away from the perceived location of a sound source. Relatively little information on flight responses of marine mammals to anthropogenic signals exist, although observations of flight responses to the presence of predators have occurred (Connor and Heithaus, 1996). Flight responses have been speculated as being a component of marine mammal strandings associated with 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). There are limited data on flight response for marine mammals; however, there are examples of this response in terrestrial species. For instance, the probability of flight responses in Dall's sheep *Ovis dalli dalli* (Frid, 2001), hauled-out ringed seals *Phoca hispida* (Born *et al.,* 1999), Pacific brant (*Branta bernicl nigricans*), and Canada geese (*B. canadensis*) increased as a helicopter or fixed-wing aircraft more directly approached groups of these animals (Ward *et al.,* 1999). Bald eagles (*Haliaeetus leucocephalus*) perched on trees alongside a river were also more likely to flee from a paddle raft when their perches were closer to the river or were closer to the ground (Steidl and Anthony, 1996).

Response to Predator

Evidence suggests that at least some marine mammals have the ability to acoustically identify potential predators. For example, harbor seals that reside in the coastal waters off British Columbia are frequently targeted by certain groups of killer whales, but not others. The seals discriminate between the calls of threatening and non-threatening killer whales (Deecke *et al.,* 2002), a capability that should increase survivorship while reducing the energy required for attending to and responding to all killer whale calls. The occurrence of masking or hearing impairment provides a means by which marine mammals may be prevented from responding to the acoustic cues produced by their predators. Whether or not this is a possibility depends on the duration of the masking/hearing impairment and the likelihood of encountering a predator during the time that predator cues are impeded.

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, an action, 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 speed of approach, 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 equivocal nature of behavioral effects and consequent difficulty in defining and predicting them. Lastly, as noted previously, DeRuiter *et al.* (2013) noted that distance from a sound source may moderate marine mammal reactions in their study of Cuvier's beaked whales showing the whales swimming rapidly and silently away when a sonar signal was 3.4–9.5 km away while showing no such reaction to the same signal when the signal was 118 km away even though the RLs were similar.

Foraging

Disruption of feeding behavior can be difficult to correlate with anthropogenic sound exposure, so it is usually inferred by observed displacement from known foraging areas, the appearance of secondary indicators (*e.g.,* bubble nets or sediment plumes), or changes in dive behavior. Noise from seismic surveys was not found to impact the feeding behavior in western grey whales off the coast of Russia (Yazvenko *et al.,* 2007). Visual tracking, passive acoustic monitoring, and movement recording tags were used to quantify sperm whale behavior prior to, during, and following exposure to air gun arrays at received levels in the range 140–160 dB at distances of 7–13 km, following a phase-in of sound intensity and full array exposures at 1–13 km (Madsen *et al.,* 2006a; Miller *et al.,* 2009). Sperm whales did not exhibit horizontal avoidance behavior at the surface. However, foraging behavior may have been affected. The sperm whales exhibited 19 percent less vocal (buzz) rate during full exposure relative to post exposure, and the whale that was approached most closely had an extended resting period and did not resume foraging until the air guns had ceased firing. The remaining whales continued to execute foraging dives throughout exposure; however, swimming movements during foraging dives were six percent lower during exposure than control periods (Miller *et al.,* 2009). These data raise concerns that air gun surveys may impact foraging behavior in sperm whales, although more data are required to understand whether the differences were due to exposure or natural variation in sperm whale behavior (Miller *et al.,* 2009). Balaenopterid whales exposed to moderate low-frequency signals similar to the ATOC sound source demonstrated no variation in foraging activity (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 SPLs were similar in the latter two studies, the frequency, duration, and temporal pattern of signal presentation were different. These factors, as well as differences in species sensitivity, are likely contributing factors to the differential response. Blue whales exposed to mid-frequency sonar in the Southern California Bight were less likely to produce low frequency calls usually associated with feeding behavior (Melcón *et al.,* 2012). However, Melcón *et al.* (2012) were unable to determine if suppression of low frequency calls reflected a change in their feeding performance or abandonment of foraging behavior and indicated that implications of the documented responses are unknown. Further, it is not known whether the lower rates of calling actually indicated a reduction in feeding behavior or social contact since the study used data from remotely deployed, passive acoustic monitoring buoys. In contrast, blue whales increased their likelihood of calling when ship noise was present, and decreased their likelihood of calling in the presence of explosive noise, although this result was not statistically significant (Melcón *et al.,* 2012). Additionally, the likelihood of an animal calling decreased with the increased received level of mid-frequency sonar, beginning at a SPL of approximately 110–120 dB re 1 µPa (Melcón *et al.,* 2012). Results from the 2010–2011 field season of an ongoing behavioral response study in Southern California waters indicated that, in some cases and at low received levels, tagged blue whales responded to mid-frequency sonar but that those responses were mild and there was a quick return to their baseline activity (Southall *et al.,* 2011; Southall *et al.,* 2012b). 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 will help better inform a determination of whether foraging disruptions incur fitness consequences. Goldbogen *et al.* (2013) monitored behavioral responses of tagged blue whales located in feeding areas when exposed to simulated MFA sonar. Responses varied depending on behavioral context, with some deep feeding whales being more significantly affected (*i.e.,* generalized avoidance; cessation of feeding; increased swimming speeds; or directed travel away from the source) compared to surface feeding individuals that typically showed no change in behavior. The authors indicate that disruption of feeding and displacement could impact individual fitness and health. However, for this to be true, we would have to assume that an individual whale could not compensate for this lost feeding opportunity by either immediately feeding at another location, by feeding shortly after cessation of acoustic exposure, or by feeding at a later time. There is no indication this is the case, particularly since unconsumed prey would likely still be available in the environment in most cases following the cessation of acoustic exposure.

Breathing

Variations in respiration naturally vary with different behaviors and variations in respiration rate as a function of acoustic exposure can be expected to 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 the whale feeding 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, exposure of 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 in understanding species differences in the tolerance of underwater noise when determining the potential for impacts resulting from anthropogenic sound exposure.

Social Relationships

Social interactions between mammals can be affected by noise via the disruption of communication signals or by the displacement of individuals. Disruption of social relationships therefore depends on the disruption of other behaviors (*e.g.,* caused avoidance, masking, etc.). 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). Long-finned pilot whales exposed to three types of disturbance—playbacks of killer whale sounds, naval sonar exposure, and tagging all resulted in increased group sizes (Visser *et al.,* 2016). In response to sonar, pilot whales also spent more time at the surface with other members of the group (Visser *et al.,* 2016). However, social disruptions must be considered in context of the relationships that are affected. While some disruptions may not have deleterious effects, others, such as long-term or repeated disruptions of mother/calf pairs or interruption of mating behaviors, have the potential to affect the growth and survival or reproductive effort/success of individuals.

Vocalizations (Also See Masking Section)

Vocal changes in response to anthropogenic noise can occur across the repertoire of sound production modes used by marine mammals, such as whistling, echolocation click production, calling, and singing. Changes may result in response to a need to compete with an increase in background noise or may reflect an increased vigilance or startle response. For example, in the presence of low-frequency active sonar, humpback whales have been observed to increase the length of their ''songs'' (Miller *et al.,* 2000; Fristrup *et al.,* 2003), possibly due to the overlap in frequencies between the whale song and the low-frequency active sonar. A similar compensatory effect for the presence of low-frequency vessel noise has been suggested for right whales; right whales have been observed to shift the frequency content of their calls upward while reducing the rate of calling in areas of increased anthropogenic noise (Parks *et al.,* 2007; Roland *et al.,* 2012). 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; NOAA, 2014b). 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.

Cerchio *et al.* (2014) used passive acoustic monitoring to document the presence of singing humpback whales off the coast of northern Angola and to opportunistically test for the effect of seismic survey activity on the number of singing whales. Two recording units were deployed between March and December 2008 in the offshore environment; numbers of singers were counted every hour. Generalized Additive Mixed Models were used to assess the effect of survey day (seasonality), hour (diel variation), moon phase, and received levels of noise (measured from a single pulse during each ten-minute sampled period) on singer number. The number of singers significantly decreased with increasing received level of noise, suggesting that humpback whale communication was disrupted to some extent by the survey activity.

Castellote *et al.* (2012) reported acoustic and behavioral changes by fin whales in response to shipping and air gun noise. Acoustic features of fin whale song notes recorded in the Mediterranean Sea and northeast Atlantic Ocean were compared for areas with different shipping noise levels and traffic intensities and during an air gun survey. During the first 72 hrs of the survey, a steady decrease in song received levels and bearings to singers indicated that whales moved away from the acoustic source and out of a Navy Study Area. This displacement persisted for a time period well beyond the 10-day duration of air gun activity, providing evidence that fin whales may avoid an area for an extended period in the presence of increased noise. The authors hypothesize tha fin whale acoustic communication is modified to compensate for increased background noise and that a sensitization process may play a role in the observed temporary displacement.

Seismic pulses at average received levels of 131 dB re 1 micropascal squared per second (μPa2-s) caused blue whales to increase call production (Di Iorio and Clark, 2010). In contrast, McDonald *et al.* (1995) tracked a blue whale with seafloor seismometers and reported that it stopped vocalizing and changed its travel direction at a range of 10 km from the seismic vessel (estimated received level 143 dB re 1 μPa peak-to-peak). Blackwell *et al.* (2013) found that bowhead whale call rates dropped significantly at onset of air gun use at sites with a median distance of 41–45 km from the survey. Blackwell *et al.* (2015) expanded this analysis to show that whales actually increased calling rates as soon as air gun signals were detectable before ultimately decreasing calling rates at higher received levels (*i.e.,* 10-minute cSEL of ~127 dB). Overall, these results suggest that bowhead whales may adjust their vocal output in an effort to compensate for noise before ceasing vocalization effort and ultimately deflecting from the acoustic source (Blackwell *et al.,* 2013, 2015). Captive bottlenose dolphins sometimes vocalized after an exposure to impulse sound from a seismic water gun (Finneran *et al.,* 2010a). These studies demonstrate that even low levels of noise received far from the noise source can induce behavioral responses.

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 they do not become acclimated to the presence of the 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 longer term or repetitive/chronic displacement for some dolphin groups and for manatees has been suggested to be due to the presence of chronic vessel noise (Haviland-Howell *et al.,* 2007; Miksis-Olds *et al.,* 2007). Gray whales have been reported deflecting from customary migratory paths in order to avoid noise from air gun surveys (Malme *et al.,* 1984). Humpback whales showed avoidance behavior in the presence of an active air gun array during observational studies and controlled exposure experiments in western Australia (McCauley *et al.,* 2000a).

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

Also during the LFS SRP, researchers sighted numerous odontocete and pinniped species in the vicinity of the sound exposure tests with LFA sonar. The MF and HF hearing specialists present in California and Hawaii showed no immediately obvious responses or changes in sighting rates as a function of source conditions. Consequently, the researchers concluded that none of these species had any obvious behavioral reaction to LFA sonar signals at received levels similar to those that produced only minor short-term behavioral responses in the baleen whales (*i.e.,* LF hearing specialists). Thus, for odontocetes, the chances of injury and/or significant behavioral responses to 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 MFAS 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 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 second upsweep 209 dB @1–2 kHz every 10 seconds for 10 minutes; Source B: With a 1.0 second upsweep 197 dB @6–7 kHz every 10 seconds for 10 minutes). 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 *et al.* (2007) 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 killer whales were consistent with the results of other studies.

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. LFAS/MFAS/HFAS are considered non-pulse sounds. Southall *et al.* (2007) summarize 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 (included in this preamble by reference and summarized in the following paragraphs below).

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 (of varying similarity to MFAS/HFAS) including: Vessel noise, drilling and machinery playback, low-frequency M-sequences (sine wave with multiple phase reversals) playback, tactical low-frequency active sonar playback, drill ships, Acoustic Thermometry of Ocean Climate (ATOC) source, and non-pulse playbacks. These studies generally indicate no (or very limited) responses to received levels in the 90 to 120 dB re: 1 μPa range and an increasing likelihood of avoidance and other behavioral effects in the 120 to 160 dB re: 1 μPa range. As mentioned earlier, though, contextual variables play a very important role in the reported responses and the severity of effects are not linear when compared to 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 (of varying similarity to MFAS/HFAS) including: Pingers, drilling playbacks, ship and ice-breaking noise, vessel noise, Acoustic Harassment Devices (AHDs), Acoustic Deterrent Devices (ADDs), MFAS, and non-pulse bands and tones. Southall *et al.* (2007) were unable to come to a clear conclusion regarding the results of these studies. In some cases, animals in the field showed significant responses to received levels between 90 and 120 dB re: 1 μPa, while in other cases these responses were not seen in the 120 to 150 dB re: 1 μPa range. The disparity in results was likely due to contextual variation and the differences between the results in the field and laboratory data (animals typically responded at lower levels in the field).

The studies that address responses of high-frequency cetaceans to non-pulse sounds include data gathered both in the field and the laboratory and related to several different sound sources (of varying similarity to MFAS/HFAS) 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 (~90 to 120 dB re: 1 μPa), at least for initial exposures. All recorded exposures above 140 dB re: 1 μPa induced profound and sustained avoidance behavior in wild harbor porpoises (Southall *et al.,* 2007). Rapid habituation was noted in some but not all studies. There are no data to indicate whether other high frequency cetaceans are as sensitive to anthropogenic sound as harbor porpoises.

The studies that address the responses of pinnipeds in water to non-impulsive 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 suggested that exposures to non-pulse sounds between 90 and 140 dB re: 1 μPa generally do not result in strong behavioral responses in pinnipeds in water, but no data exist at higher received levels.

In 2007, the first in a series of behavioral response studies (BRS) on deep diving odontocetes conducted by NMFS, Navy, and other scientists showed one Blainville's beaked whale responding to an MFAS playback. Tyack *et al.* (2011) indicates that the playback began when the tagged beaked whale was vocalizing at depth (at the deepest part of a typical feeding dive), following a previous control with no sound exposure. The whale appeared to stop clicking significantly earlier than usual, when exposed to MF signals in the 130–140 dB (rms) received level range. After a few more minutes of the playback, when the received level reached a maximum of 140–150 dB, the whale ascended on the slow side of normal ascent rates with a longer than normal ascent, at which point the exposure was terminated. The results are from a single experiment and a greater sample size is needed before robust and definitive conclusions can be drawn. Tyack *et al.* (2011) also indicates that Blainville's beaked whales appear to be sensitive to noise at levels well below expected TTS (~160 dB re1μPa). This sensitivity was manifested by an adaptive movement away from a sound source. This response was observed irrespective of whether the signal transmitted was within the band width of MFAS, 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 this 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. Overall the results from the 2007–2008 study conducted showed a change in diving behavior of the Blainville's beaked whale to playback of MFAS and predator sounds (Boyd *et al.,* 2008; Southall *et al.,* 2009; Tyack *et al.,* 2011).

Stimpert *et al.* (2014) tagged a Baird's beaked whale, which was subsequently exposed to simulated MFAS. Received levels of sonar on the tag increased to a maximum of 138 dB re 1μPa, which occurred during the first exposure dive. Some sonar received levels could not be measured due to flow noise and surface noise on the tag.

Reaction to mid-frequency sounds included premature cessation of clicking and termination of a foraging dive, and a slower ascent rate to the surface. Results from a similar behavioral response study in southern California waters have been presented for the 2010–2011 field season (Southall *et al.,* 2011; DeRuiter *et al.,* 2013b). DeRuiter *et al.* (2013b) presented results from two Cuvier's beaked whales that were tagged and exposed to simulated MFAS during the 2010 and 2011 field seasons of the southern California behavioral response study. The 2011 whale was also incidentally exposed to MFAS from a distant naval exercise. Received levels from the MFAS signals from the controlled and incidental exposures were calculated as 84–144 and 78–106 dB re 1 μPa rms, respectively. Both whales showed responses to the controlled exposures, ranging from initial orientation changes to avoidance responses characterized by energetic fluking and swimming away from the source. However, the authors did not detect similar responses to incidental exposure to distant naval sonar exercises at comparable received levels, indicating that context of the exposures (*e.g.,* source proximity, controlled source ramp-up) may have been a significant factor. Specifically, this result suggests that caution is needed when using marine mammal response data collected from smaller, nearer sound sources to predict at what received levels animals may respond to larger sound sources that are significantly farther away—as the distance of the source appears to be an important contextual variable and animals may be less responsive to sources at notably greater distances. Cuvier's beaked whale responses suggested particular sensitivity to sound exposure as consistent with results for Blainville's beaked whale. Similarly, beaked whales exposed to sonar during British training exercises stopped foraging (DSTL, 2007), and preliminary results of controlled playback of sonar may indicate feeding/foraging disruption of killer whales and sperm whales (Miller *et al.,* 2011).

In the 2007–2008 Bahamas study, playback sounds of a potential predator—a killer whale—resulted in a similar but more pronounced reaction, which included longer inter-dive intervals and a sustained straight-line departure of more than 20 km from the area (Boyd *et al.,* 2008; Southall *et al.,* 2009; Tyack *et al.,* 2011). The authors noted, however, that the magnified reaction to the predator sounds could represent a cumulative effect of exposure to the two sound types since killer whale playback began approximately two hours after MF source playback. Pilot whales and killer whales off Norway also exhibited horizontal avoidance of a transducer with outputs in the mid-frequency range (signals in the 1–2 kHz and 6–7 kHz ranges) (Miller *et al.,* 2011). Additionally, separation of a calf from its group during exposure to MFAS playback was observed on one occasion (Miller *et al.,* 2011, 2012). Miller *et al.* (2012) noted that this single observed mother-calf separation was unusual for several reasons, including the fact that the experiment was conducted in an unusually narrow fjord roughly one km wide and that the sonar exposure was started unusually close to the pod including the calf. Both of these factors could have contributed to calf separation. In contrast, preliminary analyses suggest that none of the pilot whales or false killer whales in the Bahamas showed an avoidance response to controlled exposure playbacks (Southall *et al.,* 2009).

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). 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, as well as the results of the DeRuiter *et al.* (2013) study of Cuvier's beaked whales discussed above, further illustrate the importance of behavioral context in understanding and predicting behavioral responses.

Through analysis of the behavioral response studies, a preliminary overarching effect of greater sensitivity to all anthropogenic exposures was seen in beaked whales compared to the other odontocetes studied (Southall *et al.,* 2009). Therefore, recent studies have focused specifically on beaked whale responses to active sonar transmissions or controlled exposure playback of simulated sonar on various military ranges (Defence Science and Technology Laboratory, 2007; Claridge and Durban, 2009; Moretti *et al.,* 2009; McCarthy *et al.,* 2011; Miller *et al.,* 2012; Southall *et al.,* 2011, 2012a, 2012b, 2013, 2014; Tyack *et al.,* 2011). In the Bahamas, Blainville's beaked whales located on the instrumented range will move off-range during sonar use and return only after the sonar transmissions have stopped, sometimes taking several days to do so (Claridge and Durban 2009; Moretti *et al.,* 2009; McCarthy *et al.,* 2011; Tyack *et al.,* 2011). Moretti *et al.* (2014) used recordings from seafloor-mounted hydrophones at the Atlantic Undersea Test and Evaluation Center (AUTEC) to analyze the probability of Blainsville's beaked whale dives before, during, and after Navy sonar exercises.

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

Baleen whales have shown a variety of responses to impulse sound sources, including avoidance, reduced surface intervals, altered swimming behavior, and changes in vocalization rates (Richardson *et al.,* 1995; Gordon *et al.,* 2003; Southall, 2007). While most bowhead whales did not show active avoidance until within 8 km of seismic vessels (Richardson *et al.,* 1995), some whales avoided vessels by more than 20 km at received levels as low as 120 dB re 1 μPa rms. Additionally, Malme *et al.* (1988) observed clear changes in diving and respiration patterns in bowheads at ranges up to 73 km from seismic vessels, with received levels as low as 125 dB re 1 μPa.

Gray whales migrating along the U.S. west coast showed avoidance responses to seismic vessels by 10 percent of animals at 164 dB re 1 μPa, and by 90 percent of animals at 190 dB re 1 μPa, with similar results for whales in the Bering Sea (Malme, 1986; 1988). In contrast, noise from seismic surveys was not found to impact feeding behavior or exhalation rates while resting or diving in western gray whales off the coast of Russia (Yazvenko *et al.,* 2007; Gailey *et al.,* 2007).

Humpback whales showed avoidance behavior at ranges of five to eight km from a seismic array during observational studies and controlled exposure experiments in western Australia (McCauley, 1998; Todd *et al.,* 1996). Todd found no clear short-term behavioral responses by foraging humpbacks to explosions associated with construction operations in Newfoundland, but did see a trend of increased rates of net entanglement and a shift to a higher incidence of net entanglement closer to the noise source.

Orientation

A shift in an animal's resting state or an attentional change via an orienting response represent behaviors that would be considered mild disruptions if occurring alone. As previously mentioned, the responses may co-occur with other behaviors; for instance, an animal may initially orient toward a sound source, and then move away from it. Thus, any orienting response should be considered in context of other reactions that may occur.

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

Explosive Sources

Underwater explosive detonations send a shock wave and sound energy through the water and can release gaseous by-products, create an oscillating bubble, or cause a plume of water to shoot up from the water surface. The shock wave and accompanying noise are of most concern to marine animals. Depending on the intensity of the shock wave and size, location, and depth of the animal, an animal can be injured, killed, suffer non-lethal physical effects, experience hearing related effects with or without behavioral responses, or exhibit temporary behavioral responses or tolerance from hearing the blast sound. Generally, exposures to higher levels of impulse and pressure levels would result in greater impacts to an individual animal.

Injuries resulting from a shock wave take place at boundaries between tissues of different densities. Different velocities are imparted to tissues of different densities, and this can lead to their physical disruption. Blast effects are greatest at the gas-liquid interface (Landsberg, 2000). Gas-containing organs, particularly the lungs and gastrointestinal tract, are especially susceptible (Goertner, 1982; Hill, 1978; Yelverton *et al.,* 1973). Intestinal walls can bruise or rupture, with subsequent hemorrhage and escape of gut contents into the body cavity. Less severe gastrointestinal tract injuries include contusions, petechiae (small red or purple spots caused by bleeding in the skin), and slight hemorrhaging (Yelverton *et al.,* 1973).

Because the ears are the most sensitive to pressure, they are the organs most sensitive to injury (Ketten, 2000). Sound-related damage associated with sound energy from detonations can be theoretically distinct from injury from the shock wave, particularly farther from the explosion. If a noise is audible to an animal, it has the potential to damage the animal's hearing by causing decreased sensitivity (Ketten, 1995). Lethal impacts are those that result in immediate death or serious debilitation in or near an intense source and are not, technically, pure acoustic trauma (Ketten, 1995). Sublethal impacts include hearing loss, which is caused by exposures to perceptible sounds. Severe damage (from the shock wave) to the ears includes tympanic membrane rupture, fracture of the ossicles, damage to the cochlea, hemorrhage, and cerebrospinal fluid leakage into the middle ear. Moderate injury implies partial hearing loss due to tympanic membrane rupture and blood in the middle ear. Permanent hearing loss also can occur when the hair cells are damaged by one very loud event, as well as by prolonged exposure to a loud noise or chronic exposure to noise. The level of impact from blasts depends on both an animal's location and, at outer zones, on its sensitivity to the residual noise (Ketten, 1995).

Further Potential Effects of Behavioral Disturbance on Marine Mammal Fitness

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 exists for terrestrial species to which we can draw comparisons for marine mammals. Several authors have reported that disturbance stimuli may cause animals to abandon nesting and foraging sites (Sutherland and Crockford, 1993); may cause animals to increase their activity levels and suffer premature deaths or reduced reproductive success when their energy expenditures exceed their energy budgets (Daan *et al.,* 1996; Feare, 1976; Mullner *et al.,* 2004); or may cause animals to experience higher predation rates when they adopt risk-prone foraging or migratory strategies (Frid and Dill, 2002). Each of these studies addressed the consequences of animals shifting from one behavioral state (*e.g.,* resting or foraging) to another behavioral state (*e.g.,* avoidance or escape behavior) because of human disturbance or disturbance stimuli.

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

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

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

Constantine and Brunton (2001) reported that bottlenose dolphins in the Bay of Islands, New Zealand engaged in resting behavior just 5 percent of the time when vessels were within 300 m, compared with 83 percent of the time when vessels were not present. However, Heenehan *et al.* (2016) report that results of a study of the response of Hawaiian spinner dolphins to human disturbance suggest that the key factor is not the sheer presence or magnitude of human activities, but rather the directed interactions and dolphin-focused activities that elicit responses from dolphins at rest. This information again illustrates the importance of context in regard to whether an animal will respond to a stimulus. Miksis-Olds (2006) and Miksis-Olds *et al.* (2005) reported that Florida manatees in Sarasota Bay, Florida, reduced the amount of time they spent milling and increased the amount of time they spent feeding when background noise levels increased. Although the acute costs of these changes in behavior are not likely to exceed an animal's ability to compensate, the chronic costs of these behavioral shifts are uncertain.

Attention is the cognitive process of selectively concentrating on one aspect of an animal's environment while ignoring other things (Posner, 1994). Because animals (including humans) have limited cognitive resources, there is a limit to how much sensory information they can process at any time. The phenomenon called ''attentional capture'' occurs when a stimulus (usually a stimulus that an animal is not concentrating on or attending to) ''captures'' an animal's attention. This shift in attention can occur consciously or subconsciously (for example, 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 treat the stimulus as a disturbance and respond 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 to attend 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 being vigilant, and less time resting or foraging, when aircraft made direct approaches over them (Frid, 2001; Stockwell *et al.,* 1991). Vigilance has also been documented in pinnipeds at haul out sites where resting may be disturbed when seals become alerted and/or flush into the water due to a variety of disturbances, which may be anthropogenic (noise and/or visual stimuli) or due to other natural causes such as other pinnipeds (Richardson *et al.,* 1995; Southall *et al.,* 2007; VanBlaricom, 2010; and Lozano and Hente, 2014).

Several authors have established that long-term and intense disturbance stimuli can cause population 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, 1985). For example, Madsen (1994) reported that pink-footed geese (*Anser brachyrhynchus*) in undisturbed habitat gained body mass and had about a 46 percent reproductive success rate compared with geese in disturbed habitat (being consistently scared off the fields on which they were foraging) which did not gain mass and had a 17 percent reproductive success rate. Similar reductions in reproductive success have been reported for mule deer (*Odocoileus hemionus*) disturbed by all-terrain vehicles (Yarmoloy *et al.,* 1988), caribou (*Rangifer tarandus caribou*) disturbed by seismic exploration blasts (Bradshaw *et al.,* 1998), and caribou disturbed by low-elevation military jet fights (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 and, as a result, reducing the time they might spend foraging and resting (which increases an animal's activity rate and energy demand while decreasing their caloric intake/energy). Ridgway *et al.* (2006) reported that increased vigilance in bottlenose dolphins exposed to sound over a five-day period in open-air, open-water enclosures in San Diego Bay did not cause any sleep deprivation or stress effects such as changes in cortisol or epinephrine levels. An example of this concept with terrestrial species involved a study of grizzly bears (*Ursus horribilis*) that reported that bears disturbed by hikers reduced their energy intake by an average of 12 kilocalories/min (50.2 × 103 kiloJoules/min), and spent energy fleeing or acting aggressively toward hikers (White *et al.,* 1999).

Lusseau and Bejder (2007) present data from three long-term studies illustrating the connections between disturbance from whale-watching boats and population-level effects in cetaceans. In Sharks Bay Australia, the abundance of bottlenose dolphins was compared within adjacent control and tourism sites over three consecutive 4.5-year periods of increasing tourism levels. Between the second and third time periods, in which tourism doubled, dolphin abundance decreased by 15 percent in the tourism area and did not change significantly in the control area. In Fiordland, New Zealand, two populations (Milford and Doubtful Sounds) of bottlenose dolphins with tourism levels that differed by a factor of seven were observed and significant increases in travelling time and decreases in resting time were documented for both. Consistent short-term avoidance strategies were observed in response to tour boats until a threshold of disturbance was reached (average 68 minutes between interactions), after which the response switched to a longer-term habitat displacement strategy. For one population, tourism only occurred in a part of the home range. However, tourism occurred throughout the home range of the Doubtful Sound population and once boat traffic increased beyond the 68-minute threshold (resulting in abandonment of their home range/preferred habitat), reproductive success drastically decreased (increased stillbirths) and abundance decreased significantly (from 67 to 56 individuals in short period). Last, in a study of northern resident killer whales off Vancouver Island, exposure to boat traffic was shown to reduce foraging opportunities and increase traveling time. A simple bioenergetics model was applied to show that the reduced foraging opportunities equated to a decreased energy intake of 18 percent, while the increased traveling incurred an increased energy output of 3–4 percent, which suggests that a management action based on avoiding interference with foraging might be particularly effective.

On a related note, many animals perform vital functions, such as feeding, resting, traveling, and socializing, on a diel cycle (24-hr cycle). Behavioral reactions to noise exposure (such as disruption of critical life functions, displacement, or avoidance of important habitat) are more likely to be significant for fitness if they last more than one diel cycle or recur on subsequent days (Southall *et al.,* 2007). Consequently, a behavioral response lasting less than one day and not recurring on subsequent days is not considered particularly severe unless it could directly affect reproduction or survival (Southall *et al.,* 2007). It is important to note the difference between behavioral reactions lasting or recurring over multiple days and anthropogenic activities lasting or recurring over multiple days. For example, just because an at-sea exercises last for multiple days does not necessarily mean that individual animals will be exposed to those exercises for multiple days or exposed in a manner that would result in a sustained behavioral response.

In order to understand how the effects of activities may or may not impact species and stocks of marine mammals, it is necessary to understand not only what the likely disturbances are going to be, but how those disturbances may affect the reproductive success and survivorship of individuals, and then how those impacts to individuals translate to population-level effects. Following on the earlier work of a committee of the U.S. National Research Council (NRC, 2005), New *et al.* (2014), in an effort termed the Potential Consequences of Disturbance (PCoD), outline an updated conceptual model of the relationships linking disturbance to changes in behavior and physiology, health, vital rates, and population dynamics. In this framework, behavioral and physiological changes can either have direct (acute) effects on vital rates, such as when changes in habitat use or increased stress levels raise the probability of mother-calf separation or predation; they can have indirect and long-term (chronic) effects on vital rates, such as when changes in time/energy budgets or increased disease susceptibility affect health, which then affects vital rates; or they can have no effect to vital rates (New *et al.,* 2014). In addition to outlining this general framework and compiling the relevant literature that supports it, authors have chosen four example species for which extensive long-term monitoring data exist (southern elephant seals, North Atlantic right whales, Ziphidae beaked whales, and bottlenose dolphins) and developed state-space energetic models that can be used to effectively forecast longer-term, population-level impacts from behavioral changes. While these are very specific models with very specific data requirements that cannot yet be applied broadly to project-specific risk assessments for the majority of species, they are a critical first step towards being able to quantify the likelihood of a population level effect.

Stranding and Mortality

The definition for a stranding under title IV of 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 mammal strandings have been linked to a variety of causes, such as illness from exposure to infectious agents, biotoxins, or parasites; starvation; unusual oceanographic or weather events; or anthropogenic causes including fishery interaction, ship strike, entrainment, entrapment, sound exposure, or combinations of these stressors sustained concurrently or in series. Historically, the cause or causes of most strandings have remained unknown (Geraci *et al.,* 1976; Eaton, 1979, Odell *et al.,* 1980; Best, 1982), but the development of trained, professional stranding response networks and improved analyses have led to a greater understanding of marine mammal stranding causes (Simeone and Moore in press).

Numerous studies suggest that the physiology, behavior, habitat, social, 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).

Historically, stranding reporting and response efforts have been inconsistent, although significant improvements have occurred over the last 25 years. Reporting forms for basic (''Level A'') information, rehabilitation disposition, and Human Interaction have been standardized nationally (available at *https://www.fisheries.noaa.gov/national/marine-mammal-protection/level-data-collection-marine-mammal-stranding-events*). However, data collected beyond basic information varies by region (and may vary from case to case), and are not standardized across the United States. Logistical conditions such as weather, time, location, and decomposition state may also affect the ability of the stranding network to thoroughly examine a specimen (Carretta *et al.,* 2016b; Moore *et al.,* 2013). While the investigation of stranded animals provides insight into the types of threats marine mammal populations face, full investigations are only possible and conducted on a small fraction of the total number of strandings that occur, limiting our understanding of the causes of strandings (Carretta *et al.,* 2016a). Additionally, and due to the variability in effort and data collected, the ability to interpret long-term trends in stranded marine mammals is complicated.

Along the coasts of the continental United States and Alaska between 2001 and 2009, there were on average approximately 12,545 cetacean strandings and 39,104 pinniped strandings (51,649 total) per year (National Marine Fisheries Service, 2016i). Several mass strandings (strandings that involve two or more individuals of the same species, excluding a single mother-calf pair) that have occurred over the past two decades have been associated with anthropogenic activities that introduced sound into the marine environment such as naval operations and seismic surveys. An in-depth discussion of strandings is in the Navy's Technical Report on Marine Mammal Strandings Associated with U.S. Navy Sonar Activities (U.S. Navy Marine Mammal Program & Space and Naval Warfare Systems Command Center Pacific, 2017).

Worldwide, there have been several efforts to identify relationships between cetacean mass stranding events and military active sonar (Cox *et al.,* 2006, Hildebrand, 2004; IWC, 2005; Taylor *et al.,* 2004). For example, based on a review of mass stranding events around the world consisting of two or more individuals of Cuvier's beaked whales, records from the International Whaling Commission (IWC)(2005) show that a quarter (9 of 41) were associated with concurrent naval patrol, explosion, maneuvers, or MFAS. D'Amico *et al.* (2009) reviewed beaked whale stranding data compiled primarily from the published literature, which provides an incomplete record of stranding events, as many are not written up for publication, along with unpublished information from some regions of the world.

Most of the stranding events reviewed by the IWC involved beaked whales. A mass stranding of Cuvier's beaked whales in the eastern Mediterranean Sea occurred in 1996 (Frantzis, 1998) and mass stranding events involving Gervais' beaked whales, Blainville's beaked whales, and Cuvier's beaked whales occurred off the coast of the Canary Islands in the late 1980s (Simmonds and Lopez-Jurado, 1991). The stranding events that occurred in the Canary Islands and Kyparissiakos Gulf in the late 1990s and the Bahamas in 2000 have been the most intensively-studied mass stranding events and have been associated with naval maneuvers involving the use of tactical sonar. Other cetacean species with naval sonar implicated in stranding events include harbor porpoise (*Phocoena phocoena*) (Norman *et al.,* 2004, Wright *et al.,* 2013) and common dolphin (*Delphinus delphis*) (Jepson and Deaville 2009).

Strandings Associated With Impulsive Sound

Silver Strand

During a Navy training event on March 4, 2011 at the Silver Strand Training Complex in San Diego, California, three or possibly four dolphins were killed in an explosion. During an underwater detonation training event, a pod of 100 to 150 long-beaked common dolphins were observed moving towards the 700-yd (640.1 m) exclusion zone around the explosive charge, monitored by personnel in a safety boat and participants in a dive boat. Approximately five minutes remained on a time-delay fuse connected to a single 8.76 lb (3.97 kg) explosive charge (C–4 and detonation cord). Although the dive boat was placed between the pod and the explosive in an effort to guide the dolphins away from the area, that effort was unsuccessful and three long-beaked common dolphins near the explosion died. In addition to the three dolphins found dead on March 4, the remains of a fourth dolphin were discovered on March 7, 2011 near Oceanside, California (3 days later and approximately 68 km north of the detonation), which might also have been related to this event. Association of the fourth stranding with the training event is uncertain because dolphins strand on a regular basis in the San Diego area. Details such as the dolphins' depth and distance from the explosive at the time of the detonation could not be estimated from the 250 yd (228.6 m) standoff point of the observers in the dive boat or the safety boat.

These dolphin mortalities are the only known occurrence of a U.S. Navy training or testing event involving impulsive energy (underwater detonation) that caused mortality or injury to a marine mammal. Despite this being a rare occurrence, the Navy has reviewed training requirements, safety procedures, and possible mitigation measures and implemented changes to reduce the potential for this to occur in the future. Discussions of procedures associated with underwater explosives training and other training events are presented in the Proposed Mitigation section.

Kyle of Durness, Scotland

On July 22, 2011 a mass stranding event involving long-finned pilot whales occurred at Kyle of Durness, Scotland. An investigation by Brownlow *et al.* (2015) considered unexploded ordnance detonation activities at a Ministry of Defense bombing range, conducted by the Royal Navy prior to and during the strandings, as a plausible contributing factor in the mass stranding event. While Brownlow *et al.* (2015) concluded that the serial detonations of underwater ordnance were an influential factor in the mass stranding event (along with presence of a potentially compromised animal and navigational error in a topographically complex region) they also suggest that mitigation measures—which included observations from a zodiac only and by personnel not experienced in marine mammal observation, among other deficiencies—were likely insufficient to assess if cetaceans were in the vicinity of the detonations. The authors also cite information from the Ministry of Defense indicating ''an extraordinarily high level of activity'' (*i.e.,* frequency and intensity of underwater explosions) on the range in the days leading up to the stranding.

Gulf of California, Mexico

One stranding event was contemporaneous with and reasonably associated spatially with the use of seismic air guns. This event occurred in the Gulf of California, coincident with seismic reflection profiling by the R/V Maurice Ewing operated by Columbia University's Lamont-Doherty Earth Observatory and involved two Cuvier's beaked whales (Hildebrand, 2004). The vessel had been firing an array of 20 air guns with a total volume of 8,500 in^3 (Hildebrand, 2004; Taylor *et al.,* 2004).

Strandings Associated With Active Sonar

Over the past 21 years, there have been five stranding events coincident with military MF active sonar use in which exposure to sonar is believed to have been a contributing factor: Greece (1996); the Bahamas (2000); Madeira (2000); Canary Islands (2002); and Spain (2006) (Cox et al., 2006; Fernandez, 2006; U.S. Navy Marine Mammal Program & Space and Naval Warfare Systems Command Center Pacific, 2017). These five mass strandings have resulted in about 40 known cetacean deaths consisting mostly of beaked whales and with close linkages to mid-frequency active sonar activity. In these circumstances, exposure to non-impulsive acoustic energy was considered a potential indirect cause of death of the marine mammals (Cox *et al.,* 2006). Only one of these stranding events, the Bahamas (2000), was associated with exercises conducted by the U.S. Navy. Additionally, in 2004, during the Rim of the Pacific (RIMPAC) exercises, between 150 and 200 usually pelagic melon-headed whales occupied the shallow waters of Hanalei Bay, Kauai, Hawaii for over 28 hours. NMFS determined that MFAS was a plausible, if not likely, contributing factor in what may have been a confluence of events that led to the Hanalei Bay stranding. A number of other stranding events coincident with the operation of MFAS, including the death of beaked whales or other species (minke whales, dwarf sperm whales, pilot whales), have been reported; however, the majority have not been investigated to the degree necessary to determine the cause of the stranding. Most recently, the Independent Scientific Review Panel investigating potential contributing factors to a 2008 mass stranding of melon-headed whales in Antsohihy, Madagascar released its final report suggesting that the stranding was likely initially triggered by an industry seismic survey. This report suggests that the operation of a commercial high-powered 12 kHz multi-beam echosounder during an industry seismic survey was a plausible and likely initial trigger that caused a large group of melon-headed whales to leave their typical habitat and then ultimately strand as a result of secondary factors such as malnourishment and dehydration. The report indicates that the risk of this particular convergence of factors and ultimate outcome is likely very low, but recommends that the potential be considered in environmental planning. Because of the association between tactical mid-frequency active sonar use and a small number of marine mammal strandings, the Navy and NMFS have been considering and addressing the potential for strandings in association with Navy activities for years. In addition to the proposed mitigation measures intended to more broadly minimize impacts to marine mammals, the Navy will abide by the Notification and Reporting Plan, which sets out notification, reporting, and other requirements when dead, injured, or stranding whales are detected in certain circumstances.

Greece (1996)

Twelve Cuvier's beaked whales stranded atypically (in both time and space) along a 38.2-km strand of the Kyparissiakos Gulf coast on May 12 and 13, 1996 (Frantzis, 1998). From May 11 through May 15, the North Atlantic Treaty Organization (NATO) research vessel Alliance was conducting sonar tests with signals of 600 Hz and 3 kHz and source levels of 228 and 226 dB re: 1μPa, respectively (D'Amico and Verboom, 1998; D'Spain *et al.,* 2006). The timing and location of the testing encompassed the time and location of the strandings (Frantzis, 1998).

Necropsies of eight of the animals were performed but were limited to basic external examination and sampling of stomach contents, blood, and skin. No ears or organs were collected, and no histological samples were preserved. No apparent abnormalities or wounds were found. Examination of photos of the animals, taken soon after their death, revealed that the eyes of at least four of the individuals were bleeding. Photos were taken soon after their death (Frantzis, 2004). Stomach contents contained the flesh of cephalopods, indicating that feeding had recently taken place (Frantzis, 1998).

All available information regarding the conditions associated with this stranding event were compiled, and many potential causes were examined including major pollution events, prominent tectonic activity, unusual physical or meteorological events, magnetic anomalies, epizootics, and conventional military activities (International Council for the Exploration of the Sea, 2005a). However, none of these potential causes coincided in time or space with the mass stranding, or could explain its characteristics (International Council for the Exploration of the Sea, 2005a). The robust condition of the animals, plus the recent stomach contents, is inconsistent with pathogenic causes. In addition, environmental causes can be ruled out as there were no unusual environmental circumstances or events before or during this time period and within the general proximity (Frantzis, 2004).

Because of the rarity of this mass stranding of Cuvier's beaked whales in the Kyparissiakos Gulf (first one in historical records), the probability for the two events (the military exercises and the strandings) to coincide in time and location, while being independent of each other, was thought to be extremely low (Frantzis, 1998). However, because full necropsies had not been conducted, and no abnormalities were noted, the cause of the strandings could not be precisely determined (Cox *et al.,* 2006). A Bioacoustics Panel convened by NATO concluded that the evidence available did not allow them to accept or reject sonar exposures as a causal agent in these stranding events. The analysis of this stranding event provided support for, but no clear evidence for, the cause-and-effect relationship of tactical sonar training activities and beaked whale strandings (Cox *et al.,* 2006).

Bahamas (2000)

NMFS and the Navy prepared a joint report addressing the multi-species stranding in the Bahamas in 2000, which took place within 24 hrs of U.S. Navy ships using MFAS as they passed through the Northeast and Northwest Providence Channels on March 15–16, 2000. The ships, which operated both AN/SQS–53C and AN/SQS–56, moved through the channel while emitting sonar pings approximately every 24 seconds. Of the 17 cetaceans that stranded over a 36-hr period (Cuvier's beaked whales, Blainville's beaked whales, minke whales, and a spotted dolphin), seven animals died on the beach (five Cuvier's beaked whales, one Blainville's beaked whale, and the spotted dolphin), while the other 10 were returned to the water alive (though their ultimate fate is unknown). As discussed in the Bahamas report (DOC/DON, 2001), there is no likely association between the minke whale and spotted dolphin strandings and the operation of MFAS.

Necropsies were performed on five of the stranded beaked whales. All five necropsied beaked whales were in good body condition, showing no signs of infection, disease, ship strike, blunt trauma, or fishery related injuries, and three still had food remains in their stomachs. Auditory structural damage was discovered in four of the whales, specifically bloody effusions or hemorrhaging around the ears. Bilateral intracochlear and unilateral temporal region subarachnoid hemorrhage, with blood clots in the lateral ventricles, were found in two of the whales. Three of the whales had small hemorrhages in their acoustic fats (located along the jaw and in the melon).

A comprehensive investigation was conducted and all possible causes of the stranding event were considered, whether they seemed likely at the outset or not. Based on the way in which the strandings coincided with ongoing naval activity involving tactical MFAS use, in terms of both time and geography, the nature of the physiological effects experienced by the dead animals, and the absence of any other acoustic sources, the investigation team concluded that MFAS aboard U.S. Navy ships that were in use during the active sonar exercise in question were the most plausible source of this acoustic or impulse trauma to beaked whales. This sound source was active in a complex environment that included the presence of a surface duct, unusual and steep bathymetry, a constricted channel with limited egress, intensive use of multiple, active sonar units over an extended period of time, and the presence of beaked whales that appear to be sensitive to the frequencies produced by these active sonars. The investigation team concluded that the cause of this stranding event was the confluence of the Navy MFAS and these contributory factors working together, and further recommended that the Navy avoid operating MFAS in situations where these five factors would be likely to occur. This report does not conclude that all five of these factors must be present for a stranding to occur, nor that beaked whales are the only species that could potentially be affected by the confluence of the other factors. Based on this, NMFS believes that the operation of MFAS in situations where surface ducts exist, or in marine environments defined by steep bathymetry and/or constricted channels may increase the likelihood of producing a sound field with the potential to cause cetaceans (especially beaked whales) to strand, and therefore, suggests the need for increased vigilance while operating MFAS in these areas, especially when beaked whales (or potentially other deep divers) are likely present.

Madeira, Portugal (2000)

From May 10–14, 2000, three Cuvier's beaked whales were found atypically stranded on two islands in the Madeira archipelago, Portugal (Cox *et al.,* 2006). A fourth animal was reported floating in the Madeiran waters by fisherman but did not come ashore (Woods Hole Oceanographic Institution, 2005). Joint NATO amphibious training peacekeeping exercises involving participants from 17 countries and 80 warships, took place in Portugal during May 2–15, 2000.

The bodies of the three stranded whales were examined post mortem (Woods Hole Oceanographic Institution, 2005), though only one of the stranded whales was fresh enough (24 hours after stranding) to be necropsied (Cox *et al.,* 2006). Results from the necropsy revealed evidence of hemorrhage and congestion in the right lung and both kidneys (Cox *et al.,* 2006). There was also evidence of intercochlear and intracranial hemorrhage similar to that which was observed in the whales that stranded in the Bahamas event (Cox *et al.,* 2006). There were no signs of blunt trauma, and no major fractures (Woods Hole Oceanographic Institution, 2005). The cranial sinuses and airways were found to be clear with little or no fluid deposition, which may indicate good preservation of tissues (Woods Hole Oceanographic Institution, 2005).

Several observations on the Madeira stranded beaked whales, such as the pattern of injury to the auditory system, are the same as those observed in the Bahamas strandings. Blood in and around the eyes, kidney lesions, pleural hemorrhages, and congestion in the lungs are particularly consistent with the pathologies from the whales stranded in the Bahamas, and are consistent with stress and pressure related trauma. The similarities in pathology and stranding patterns between these two events suggest that a similar pressure event may have precipitated or contributed to the strandings at both sites (Woods Hole Oceanographic Institution, 2005).

Even though no definitive causal link can be made between the stranding event and naval exercises, certain conditions may have existed in the exercise area that, in their aggregate, may have contributed to the marine mammal strandings (Freitas, 2004): Exercises were conducted in areas of at least 547 fathoms (1,000 m) depth near a shoreline where there is a rapid change in bathymetry on the order of 547 to 3,281 fathoms (1,000 to 6,000 m) occurring across a relatively short horizontal distance (Freitas, 2004); multiple ships were operating around Madeira, though it is not known if MFAS was used, and the specifics of the sound sources used are unknown (Cox *et al.,* 2006, Freitas, 2004); and exercises took place in an area surrounded by landmasses separated by less than 35 nmi (65 km) and at least 10 nmi (19 km) in length, or in an embayment. Exercises involving multiple ships employing MFAS near land may produce sound directed towards a channel or embayment that may cut off the lines of egress for marine mammals (Freitas, 2004).

Canary Islands, Spain (2002)

The southeastern area within the Canary Islands is well known for aggregations of beaked whales due to its ocean depths of greater than 547 fathoms (1,000 m) within a few hundred meters of the coastline (Fernandez *et al.,* 2005). On September 24, 2002, 14 beaked whales were found stranded on Fuerteventura and Lanzarote Islands in the Canary Islands (International Council for Exploration of the Sea, 2005a). Seven whales died, while the remaining seven live whales were returned to deeper waters (Fernandez *et al.,* 2005). Four beaked whales were found stranded dead over the next three days either on the coast or floating offshore. These strandings occurred within near proximity of an international naval exercise that utilized MFAS and involved numerous surface warships and several submarines. Strandings began about four hours after the onset of MFAS activity (International Council for Exploration of the Sea, 2005a; Fernandez *et al.,* 2005).

Eight Cuvier's beaked whales, one Blainville's beaked whale, and one Gervais' beaked whale were necropsied, 6 of them within 12 hours of stranding (Fernandez *et al.,* 2005). No pathogenic bacteria were isolated from the carcasses (Jepson *et al.,* 2003). The animals displayed severe vascular congestion and hemorrhage especially around the tissues in the jaw, ears, brain, and kidneys, displaying marked disseminated microvascular hemorrhages associated with widespread fat emboli (Jepson *et al.,* 2003; International Council for Exploration of the Sea, 2005a). Several organs contained intravascular bubbles, although definitive evidence of gas embolism in vivo is difficult to determine after death (Jepson *et al.,* 2003). The livers of the necropsied animals were the most consistently affected organ, which contained macroscopic gas-filled cavities and had variable degrees of fibrotic encapsulation. In some animals, cavitary lesions had extensively replaced the normal tissue (Jepson *et al.,* 2003). Stomachs contained a large amount of fresh and undigested contents, suggesting a rapid onset of disease and death (Fernandez *et al.,* 2005). Head and neck lymph nodes were enlarged and congested, and parasites were found in the kidneys of all animals (Fernandez *et al.,* 2005).

The association of NATO MFAS use close in space and time to the beaked whale strandings, and the similarity between this stranding event and previous beaked whale mass strandings coincident with sonar use, suggests that a similar scenario and causative mechanism of stranding may be shared between the events. Beaked whales stranded in this event demonstrated brain and auditory system injuries, hemorrhages, and congestion in multiple organs, similar to the pathological findings of the Bahamas and Madeira stranding events. In addition, the necropsy results of Canary Islands stranding event lead to the hypothesis that the presence of disseminated and widespread gas bubbles and fat emboli were indicative of nitrogen bubble formation, similar to what might be expected in decompression sickness (Jepson *et al.,* 2003; Fernández *et al.,* 2005).

Hanalei Bay (2004)

On July 3 and 4, 2004, approximately 150 to 200 melon-headed whales occupied the shallow waters of the Hanalei Bay, Kauai, Hawaii for over 28 hrs. Attendees of a canoe blessing observed the animals entering the Bay in a single wave formation at 7 a.m. on July 3, 2004. The animals were observed moving back into the shore from the mouth of the Bay at 9 a.m. The usually pelagic animals milled in the shallow bay and were returned to deeper water with human assistance beginning at 9:30 a.m. on July 4, 2004, and were out of sight by 10:30 a.m.

Only one animal, a calf, was known to have died following this event. The animal was noted alive and alone in the Bay on the afternoon of July 4, 2004, and was found dead in the Bay the morning of July 5, 2004. A full necropsy, magnetic resonance imaging, and computerized tomography examination were performed on the calf to determine the manner and cause of death. The combination of imaging, necropsy and histological analyses found no evidence of infectious, internal traumatic, congenital, or toxic factors. Cause of death could not be definitively determined, but it is likely that maternal separation, poor nutritional condition, and dehydration contributed to the final demise of the animal. Although it is not known when the calf was separated from its mother, the animals' movement into the Bay and subsequent milling and re-grouping may have contributed to the separation or lack of nursing, especially if the maternal bond was weak or this was an inexperienced mother with her first calf.

Environmental factors, abiotic and biotic, were analyzed for any anomalous occurrences that would have contributed to the animals entering and remaining in Hanalei Bay. The Bay's bathymetry is similar to many other sites within the Hawaiian Island chain and dissimilar to sites that have been associated with mass strandings in other parts of the U.S. The weather conditions appeared to be normal for that time of year with no fronts or other significant features noted. There was no evidence of unusual distribution, occurrence of predator or prey species, or unusual harmful algal blooms, although Mobley *et al.* (2007) suggested that the full moon cycle that occurred at that time may have influenced a run of squid into the Bay. Weather patterns and bathymetry that have been associated with mass strandings elsewhere were not found to occur in this instance.

The Hanalei event was spatially and temporally correlated with RIMPAC. Official sonar training and tracking exercises in the Pacific Missile Range Facility (PMRF) warning area did not commence until approximately 8 a.m. on July 3 and were thus ruled out as a possible trigger for the initial movement into the Bay. However, six naval surface vessels transiting to the operational area on July 2 intermittently transmitted active sonar (for approximately nine hours total from 1:15 p.m. to 12:30 a.m.) as they approached from the south. The potential for these transmissions to have triggered the whales' movement into Hanalei Bay was investigated. Analyses with the information available indicated that animals to the south and east of Kaua'i could have detected active sonar transmissions on July 2, and reached Hanalei Bay on or before 7 a.m. on July 3. However, data limitations regarding the position of the whales prior to their arrival in the Bay, the magnitude of sonar exposure, behavioral responses of melon-headed whales to acoustic stimuli, and other possible relevant factors preclude a conclusive finding regarding the role of sonar in triggering this event. Propagation modeling suggests that transmissions from sonar use during the July 3 exercise in the

PMRF warning area may have been detectable at the mouth of the Bay. If the animals responded negatively to these signals, it may have contributed to their continued presence in the Bay. The U.S. Navy ceased all active sonar transmissions during exercises in this range on the afternoon of July 3. Subsequent to the cessation of sonar use, the animals were herded out of the Bay.

While causation of this stranding event may never be unequivocally determined, NMFS consider the active sonar transmissions of July 2–3, 2004, a plausible, if not likely, contributing factor in what may have been a confluence of events. This conclusion is based on the following: (1) The evidently anomalous nature of the stranding; (2) its close spatiotemporal correlation with wide-scale, sustained use of sonar systems previously associated with stranding of deep-diving marine mammals; (3) the directed movement of two groups of transmitting vessels toward the southeast and southwest coast of Kauai; (4) the results of acoustic propagation modeling and an analysis of possible animal transit times to the Bay; and (5) the absence of any other compelling causative explanation. The initiation and persistence of this event may have resulted from an interaction of biological and physical factors. The biological factors may have included the presence of an apparently uncommon, deep-diving cetacean species (and possibly an offshore, non-resident group), social interactions among the animals before or after they entered the Bay, and/or unknown predator or prey conditions. The physical factors may have included the presence of nearby deep water, multiple vessels transiting in a directed manner while transmitting active sonar over a sustained period, the presence of surface sound ducting conditions, and/or intermittent and random human interactions while the animals were in the Bay.

A separate event involving melon-headed whales and rough-toothed dolphins took place over the same period of time in the Northern Mariana Islands (Jefferson *et al.,* 2006), which is several thousand miles from Hawaii. Some 500 to 700 melon-headed whales came into Sasanhaya Bay on July 4, 2004, near the island of Rota and then left of their own accord after 5.5 hours; no known active sonar transmissions occurred in the vicinity of that event. The Rota incident led to scientific debate regarding what, if any, relationship the event had to the simultaneous events in Hawaii and whether they might be related by some common factor (*e.g.,* there was a full moon on July 2, 2004, as well as during other melon-headed whale strandings and nearshore aggregations (Brownell *et al.,* 2009; Lignon *et al.,* 2007; Mobley *et al.,* 2007). Brownell *et al.* (2009) compared the two incidents, along with one other stranding incident at Nuka Hiva in French Polynesia and normal resting behaviors observed at Palmyra Island, in regard to physical features in the areas, melon-headed whale behavior, and lunar cycles. Brownell *et al.,* (2009) concluded that the rapid entry of the whales into Hanalei Bay, their movement into very shallow water far from the 100-m contour, their milling behavior (typical pre-stranding behavior), and their reluctance to leave the bay constituted an unusual event that was not similar to the events that occurred at Rota (but was similar to the events at Palmyra), which appear to be similar to observations of melon-headed whales resting normally at Palmyra Island. Additionally, there was no correlation between lunar cycle and the types of behaviors observed in the Brownell *et al.* (2009) examples.

Spain (2006)

The Spanish Cetacean Society reported an atypical mass stranding of four beaked whales that occurred January 26, 2006, on the southeast coast of Spain, near Mojacar (Gulf of Vera) in the Western Mediterranean Sea. According to the report, two of the whales were discovered the evening of January 26 and were found to be still alive. Two other whales were discovered during the day on January 27, but had already died. The first three animals were located near the town of Mojacar and the fourth animal was found dead, a few kilometers north of the first three animals. From January 25–26, 2006, Standing NATO Response Force Maritime Group Two (five of seven ships including one U.S. ship under NATO Operational Control) had conducted active sonar training against a Spanish submarine within 50 nmi (93 km) of the stranding site.

Veterinary pathologists necropsied the two male and two female Cuvier's beaked whales. According to the pathologists, the most likely primary cause of this type of beaked whale mass stranding event was anthropogenic acoustic activities, most probably anti-submarine MFAS used during the military naval exercises. However, no positive acoustic link was established as a direct cause of the stranding. Even though no causal link can be made between the stranding event and naval exercises, certain conditions may have existed in the exercise area that, in their aggregate, may have contributed to the marine mammal strandings (Freitas, 2004): Exercises were conducted in areas of at least 547 fathoms (1,000 m) depth near a shoreline where there is a rapid change in bathymetry on the order of 547 to 3,281 fathoms (1,000 to 6,000 m) occurring across a relatively short horizontal distance (Freitas, 2004); multiple ships (in this instance, five) were operating MFAS in the same area over extended periods of time (in this case, 20 hours) in close proximity; and exercises took place in an area surrounded by landmasses, or in an embayment. Exercises involving multiple ships employing MFAS near land may have produced sound directed towards a channel or embayment that may have cut off the lines of egress for the affected marine mammals (Freitas, 2004).

Behaviorally Mediated Responses to MFAS That May Lead to Stranding

Although the confluence of Navy MFAS with the other contributory factors noted in the report was identified as the cause of the 2000 Bahamas stranding event, the specific mechanisms that led to that stranding (or the others) are not understood, and there is uncertainty regarding the ordering of effects that led to the stranding. It is unclear whether beaked whales were directly injured by sound (*e.g.,* acoustically mediated bubble growth, as addressed above) prior to stranding or whether a behavioral response to sound occurred that ultimately caused the beaked whales to be injured and strand.

Although causal relationships between beaked whale stranding events and active sonar remain unknown, several authors have hypothesized that stranding events involving these species in the Bahamas and Canary Islands may have been triggered when the whales changed their dive behavior in a startled response to exposure to active sonar or to further avoid exposure (Cox *et al.,* 2006; Rommel *et al.,* 2006). These authors proposed three mechanisms by which the behavioral responses of beaked whales upon being exposed to active sonar might result in a stranding event. These include the following: Gas bubble formation caused by excessively fast surfacing; remaining at the surface too long when tissues are supersaturated with nitrogen; or diving prematurely when extended time at the surface is necessary to eliminate excess nitrogen. More specifically, beaked whales that occur in deep waters that are in close proximity to shallow waters (for example, the ''canyon areas'' that are cited in the Bahamas stranding event;

see D'Spain and D'Amico, 2006), may respond to active sonar by swimming into shallow waters to avoid further exposures and strand if they were not able to swim back to deeper waters. Second, beaked whales exposed to active sonar might alter their dive behavior. Changes in their dive behavior might cause them to remain at the surface or at depth for extended periods of time which could lead to hypoxia directly by increasing their oxygen demands or indirectly by increasing their energy expenditures (to remain at depth) and increase their oxygen demands as a result. If beaked whales are at depth when they detect a ping from an active sonar transmission and change their dive profile, this could lead to the formation of significant gas bubbles, which could damage multiple organs or interfere with normal physiological function (Cox *et al.,* 2006; Rommel *et al.,* 2006; Zimmer and Tyack, 2007). Baird *et al.* (2005) found that slow ascent rates from deep dives and long periods of time spent within 50 m of the surface were typical for both Cuvier's and Blainville's beaked whales, the two species involved in mass strandings related to naval sonar. These two behavioral mechanisms may be necessary to purge excessive dissolved nitrogen concentrated in their tissues during their frequent long dives (Baird *et al.,* 2005). Baird *et al.* (2005) further suggests that abnormally rapid ascents or premature dives in response to high-intensity sonar could indirectly result in physical harm to the beaked whales, through the mechanisms described above (gas bubble formation or non-elimination of excess nitrogen).

Because many species of marine mammals make repetitive and prolonged dives to great depths, it has long been assumed that marine mammals have evolved physiological mechanisms to protect against the effects of rapid and repeated decompressions. Although several investigators have identified physiological adaptations that may protect marine mammals against nitrogen gas supersaturation (alveolar collapse and elective circulation; Kooyman *et al.,* 1972; Ridgway and Howard, 1979), Ridgway and Howard (1979) reported that bottlenose dolphins that were trained to dive repeatedly had muscle tissues that were substantially supersaturated with nitrogen gas. Houser *et al.* (2001) used these data to model the accumulation of nitrogen gas within the muscle tissue of other marine mammal species and concluded that cetaceans that dive deep and have slow ascent or descent speeds would have tissues that are more supersaturated with nitrogen gas than other marine mammals. Based on these data, Cox *et al.* (2006) hypothesized that a critical dive sequence might make beaked whales more prone to stranding in response to acoustic exposures. The sequence began with (1) very deep (to depths as deep as 2 km) and long (as long as 90 minutes) foraging dives; (2) relatively slow, controlled ascents; and (3) a series of ''bounce'' dives between 100 and 400 m in depth (also see Zimmer and Tyack, 2007). They concluded that acoustic exposures that disrupted any part of this dive sequence (for example, causing beaked whales to spend more time at surface without the bounce dives that are necessary to recover from the deep dive) could produce excessive levels of nitrogen supersaturation in their tissues, leading to gas bubble and emboli formation that produces pathologies similar to decompression sickness.

Zimmer and Tyack (2007) modeled nitrogen tension and bubble growth in several tissue compartments for several hypothetical dive profiles and concluded that repetitive shallow dives (defined as a dive where depth does not exceed the depth of alveolar collapse, approximately 72 m for Ziphius), perhaps as a consequence of an extended avoidance reaction to sonar sound, could pose a risk for decompression sickness and that this risk should increase with the duration of the response. Their models also suggested that unrealistically rapid rates of ascent from normal dive behaviors are unlikely to result in supersaturation to the extent that bubble formation would be expected. Tyack *et al.* (2006) suggested that emboli observed in animals exposed to mid-frequency range sonar (Jepson *et al.,* 2003; Fernandez *et al.,* 2005; Fernández *et al.,* 2012) could stem from a behavioral response that involves repeated dives shallower than the depth of lung collapse. Given that nitrogen gas accumulation is a passive process (*i.e.,* nitrogen is metabolically inert), a bottlenose dolphin was trained to repetitively dive a profile predicted to elevate nitrogen saturation to the point that nitrogen bubble formation was predicted to occur. However, inspection of the vascular system of the dolphin via ultrasound did not demonstrate the formation of asymptomatic nitrogen gas bubbles (Houser *et al.,* 2007). Baird *et al.* (2008), in a beaked whale tagging study off Hawaii, showed that deep dives are equally common during day or night, but ''bounce dives'' are typically a daytime behavior, possibly associated with visual predator avoidance. This may indicate that ''bounce dives'' are associated with something other than behavioral regulation of dissolved nitrogen levels, which would be necessary day and night.

If marine mammals respond to a Navy vessel that is transmitting active sonar in the same way that they might respond to a predator, their probability of flight responses could 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). The probability of flight responses could also increase as received levels of active sonar increase (and the ship is, therefore, closer) and as ship speeds increase (that is, as approach speeds increase). For example, the probability of flight responses in Dall's sheep (*Ovis dalli dalli*) (Frid 2001a, b), ringed seals (*Phoca hispida*) (Born *et al.,* 1999), Pacific brant (*Branta bernic nigricans*) and Canada geese (*B. canadensis*) increased as a helicopter or fixed-wing aircraft approached groups of these animals more directly (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).

Despite the many theories involving bubble formation (both as a direct cause of injury (see Acoustically Mediated Bubble Growth Section) and an indirect cause of stranding (See Behaviorally Mediated Bubble Growth Section), Southall *et al.* (2007) summarizes that there is either scientific disagreement or a lack of information regarding each of the following important points: (1) Received acoustical exposure conditions for animals involved in stranding events; (2) pathological interpretation of observed lesions in stranded marine mammals; (3) acoustic exposure conditions required to induce such physical trauma directly; (4) whether noise exposure may cause behavioral reactions (such as atypical diving behavior) that secondarily cause bubble formation and tissue damage; and (5) the extent the post mortem artifacts introduced by decomposition before sampling, handling, freezing, or necropsy procedures affect interpretation of observed lesions.

Strandings Along Southern California and Hawaii

Stranding events, specifically UMEs that occurred along Southern California or Hawaii (inclusive of the HSTT Study

Area) were previously discussed in the Description of Marine Mammals section.

Data were gathered from stranding networks that operate within and adjacent to the HSTT Study Area and reviewed in an attempt to better understand the frequency that marine mammal strandings occur and what major causes of strandings (both human-related and natural) exist in areas around the HSTT Study Area (NMFS, 2015a). From 2010 through 2014, there were 314 cetacean and phocid strandings reported in Hawaii, an annual average of 63 strandings per year. Twenty-seven species stranded in this region. The most common species reported include the Hawaiian monk seal, humpback whale, sperm whale, striped and spinner dolphin. Although many marine mammals likely strand due to natural or anthropogenic causes, the majority of reported type of occurrences in marine mammal strandings in the HSTT Study Area include fisheries interactions, entanglement, vessel strike and predation. Bradford and Lyman (2015) address overall threats from human activities and industries on stocks in Hawaii.

In 2004, a mass out-of-habitat aggregation of melon-headed whales occurred in Hanalei Bay (see discussion above under ''Strandings Associated with Active Sonar''). It is speculated that sonar operated during a major training exercise may be related to the incident. Upon further investigation, sonar was only considered as a plausible, but not sole, contributing factor among many factors in the event. The Hanalei Bay incident does not share the characteristics observed with other mass strandings of whales coincident with sonar activity (*e.g.,* specific traumas, species composition, etc.) (Southall *et al.,* 2006; U.S. Navy Marine Mammal Program & Space and Naval Warfare Systems Command Center Pacific, 2017). Additional information on this event is available in the Navy's Technical Report on Marine Mammal Strandings Associated with U.S. Navy Sonar Activities (U.S. Navy Marine Mammal Program & Space and Naval Warfare Systems Command Center Pacific, 2017). In addition, on October 31, 2017, at least five pilot whales live-stranded in Nawiliwili Harbor on Kauai. NMFS has yet to determine a cause for that stranding, but Navy activities can be dismissed from consideration given there were no Navy training or testing stressors present in the area before or during the stranding (National Marine Fisheries Service, 2017b).

Records for strandings in San Diego County (covering the shoreline for the Southern California portion of the HSTT Study Area) indicate that there were 143 cetacean and 1,235 pinniped strandings between 2010 and 2014, an annual average of about 29 and 247 per year, respectively. A total of 16 different species have been reported as stranded within this time frame. The majority of species reported include long-beaked common dolphins and California sea lions, but there were also reports of pacific white-sided, bottlenose and Risso's dolphins, gray, humpback, and fin whales, harbor seals and Northern elephant seals (National Marine Fisheries Service, 2015b, 2016a). However, stranded marine mammals are reported along the entire western coast of the United States each year. Within the same timeframe, there were 714 cetacean and 11,132 pinniped strandings reported outside of the Study Area, an annual average of about 142 and 2,226 respectively. Species that strand along the entire west coast are similar to those that typically strand within the Study Area with additional reports of harbor porpoise, Dall's porpoise, Steller sea lions, and various fur seals. The most common reported type of occurrence in stranded marine mammals in this region include fishery interactions, illness, predation, and vessel strikes (NMFS, 2016a). It is important to note that the mass stranding of pinnipeds along the west coast considered part of a NMFS declared UME are still being evaluated. The likely cause of this event is the lack of available prey near rookeries due to warming ocean temperatures (NOAA, 2016a). Carretta *et al.* (2013b; 2016b) provide additional information and data on the threats from human-related activities and the potential causes of strandings for the U.S. Pacific coast marine mammal stocks.

Potential Effects of Vessel Strike

Vessel collisions with marine mammals, also referred to as vessel strikes or ship strikes, can result in death or serious injury of the animal. Wounds resulting from ship strike may include massive trauma, hemorrhaging, broken bones, or propeller lacerations (Knowlton and Kraus, 2001). 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. Superficial strikes may not kill or result in the death of the animal. Lethal interactions are typically associated with large whales, which are occasionally found draped across the bulbous bow of large commercial ships upon arrival in port. Although smaller cetaceans are more maneuverable in relation to large vessels than are large whales, they may also be susceptible to strike. 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; Conn and Silber, 2013). Impact forces increase with speed, as does the probability of a strike at a given distance (Silber *et al.,* 2010; Gende *et al.,* 2011).

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, 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. 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 or serious injury (Knowlton and Kraus, 2001; Laist *et al.,* 2001; Jensen and Silber, 2003; Pace and Silber, 2005; 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 13 kn.

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 58 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 kn. The majority (79 percent) of these strikes occurred at speeds of 13 kn or greater. The average speed that resulted in serious injury or death was 18.6 kn. 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 to 75 percent as vessel speed increased from 10 to 14 kn, and exceeded 90 percent at 17 kn. Higher speeds during collisions result in greater force of impact and also appear to increase the chance of severe injuries or death. While modeling studies have suggested that hydrodynamic forces pulling whales toward the vessel hull increase with increasing speed (Clyne, 1999; Knowlton *et al.,* 1995), this is inconsistent with Silber *et al.* (2010), which demonstrated that there is no such relationship (*i.e.,* hydrodynamic forces are independent of speed).

In a separate study, Vanderlaan and Taggart (2007) analyzed the probability of lethal mortality of large whales at a given speed, showing that the greatest rate of change in the probability of a lethal injury to a large whale as a function of vessel speed occurs between 8.6 and 15 kn. The chances of a lethal injury decline from approximately 80 percent at 15 kn to approximately 20 percent at 8.6 kn. At speeds below 11.8 kn, the chances of lethal injury drop below 50 percent, while the probability asymptotically increases toward 100 percent above 15 kn.

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 because of the required personnel training and lookouts (as described in the Proposed Mitigation Measures section), and they are required to report all ship strikes involving marine mammals. Overall, the percentage of Navy traffic relative to overall large shipping traffic are very small (on the order of two percent) and therefore represent a correspondingly smaller threat of potential ship strikes when compared to commercial shipping.

In the SOCAL portion of the HSTT Study Area, the Navy has struck a total of 16 marine mammals in the 20-year period from 1991 through 2010 for an average of one per year. Of the 16 Navy vessel strikes over the 20-year period in SOCAL, there were seven mortalities and nine injuries reported. The vessel struck species include: Two mortalities and eight injuries of unknown species, three mortalities of gray whales (one in 1993 and two in 1998), one mortality of a blue whale in 2004, and one morality and one injury of fin whales in 2009.

In the HRC portion of the HSTT Study Area, the Navy struck a total of five marine mammals in the 20-year period from 1991 through 2010, for an average of zero to one per year. Of the five Navy vessel strikes over the 20-year period in the HRC, all were reported as injuries. The vessel struck species include: one humpback whale in 1998, one unknown species and one humpback whale in 2003, one sperm whale in 2007, and an unknown species in 2008. No more than two whales were struck by Navy vessels in any given year in the HRC portion of the HSTT within the last 20 years. There was only one 12-month period in 20 years in the HRC when two whales were struck in a single year (2003).

Overall, there have been zero documented vessel strikes associated with training and testing in the SOCAL and HRC portions of the HSTT Study Area since 2010 and 2008, respectively.

Between 2007 and 2009, the Navy developed and distributed additional training, mitigation, and reporting tools to Navy operators to improve marine mammal protection and to ensure compliance with permit requirements. In 2009, the Navy implemented Marine Species Awareness Training designed to improve effectiveness of visual observation for marine resources including marine mammals. In subsequent years, the Navy issued refined policy guidance on ship strikes in order to collect the most accurate and detailed data possible in response to a possible incident (also see the Notification and Reporting Plan for this proposed rule). For over a decade, the Navy has implemented the Protective Measures Assessment Protocol software tool, which provides operators with notification of the required mitigation and a visual display of the planned training or testing activity location overlaid with relevant environmental data.

Marine Mammal Habitat

The Navy's proposed training and testing activities could potentially affect marine mammal habitat through the introduction of impacts to the prey species of marine mammals, acoustic habitat (sound in the water column), water quality, and important habitat for marine mammals. Each of these components was considered in the HSTT DEIS/OEIS and was determined by the Navy to have no effect on marine mammal habitat. Based on the information below and the supporting information included in the HSTT DEIS/OEIS, NMFS has determined that the proposed training and training activities would not have adverse or long-term impacts on marine mammal habitat.

Effects to Prey

Sound may affect marine mammals through impacts on the abundance, behavior, or distribution of prey species (*e.g.,* crustaceans, cephalopods, fish, zooplankton). Marine mammal prey varies by species, season, and location and, for some, is not well documented. Here, we describe studies regarding the effects of noise on known marine mammal prey. Fish utilize the soundscape and components of sound in their environment to perform important functions such as foraging, predator avoidance, mating, and spawning (*e.g.,* Zelick *et al*., 1999; Fay, 2009). The most likely effects on fishes exposed to loud, intermittent, low-frequency sounds are behavioral responses (*i.e.,* flight or avoidance). Short duration, sharp sounds (such as pile driving or air guns) can cause overt or subtle changes in fish behavior and local distribution. The reaction of fish to acoustic sources depends on the physiological state of the fish, past exposures, motivation (*e.g.,* feeding, spawning, migration), and other environmental factors. Key impacts to fishes may include behavioral responses, hearing damage, barotrauma (pressure-related injuries), and mortality.

Fishes, like other vertebrates, have variety of different sensory systems to glean information from ocean around them (Astrup and Mohl, 1993; Astrup, 1999; Braun and Grande, 2008; Carroll *et al.,* 2017; Hawkins and Johnstone, 1978; Ladich and Popper, 2004; Ladich and Schulz-Mirbach, 2016; Mann, 2016; Nedwell *et al.,* 2004; Popper *et al.,* 2003; Popper *et al.,* 2005). Depending on their hearing anatomy and peripheral sensory structures, which vary among species, fishes hear sounds using pressure and particle motion sensitivity capabilities and detect the motion of surrounding water (Fay *et al.,* 2008) (terrestrial vertebrates generally only detect pressure). Most marine fishes primarily detect particle motion using the inner ear and lateral line system, while some fishes possess additional morphological adaptations or specializations that can enhance their sensitivity to sound pressure, such as a gas-filled swim bladder (Braun and Grande, 2008; Popper and Fay, 2011).

Hearing capabilities vary considerably between different fish species with data only available for just over 100 species out of the 34,000 marine and freshwater fish species (Eschmeyer and Fong 2016). In order to better understand acoustic impacts on fishes, fish hearing groups are defined by species that possess a similar continuum of anatomical features which result in varying degrees of hearing sensitivity (Popper and Hastings, 2009a). There are four hearing groups defined for all fish species (modified from Popper *et al.,* 2014) within this analysis and they include: Fishes without a swim bladder (*e.g.,* flatfish, sharks, rays, etc.); fishes with a swim bladder not involved in hearing (*e.g.,* salmon, cod, pollock, etc.); fishes with a swim bladder involved in hearing (*e.g.,* sardines, anchovy, herring, etc.); and fishes with a swim bladder involved in hearing and high-frequency hearing (*e.g.,* shad and menhaden). Most marine mammal fish prey species would not be likely to perceive or hear Navy mid- or high-frequency sonars (see Figure 9–1 of the Navy's rulemaking/LOA application). Within Southern California, the Clupeiformes order of fish include the Pacific sardine (Clupeidae), and northern anchovy (Engraulidae), key forage fish in Southern California. While hearing studies have not been done on sardines and northern anchovies, it would not be unexpected for them to have hearing similarities to Pacific herring (up to 2–5 kHz) (Mann *et al.,* 2005). Currently, less data are available to estimate the range of best sensitivity for fishes without a swim bladder. In terms of physiology, multiple scientific studies have documented a lack of mortality or physiological effects to fish from exposure to low- and mid-frequency sonar and other sounds (Halvorsen *et al.,* 2012; Jørgensen *et al.,* 2005; Juanes *et al.,* 2017; Kane *et al.,* 2010; Kvadsheim and Sevaldsen, 2005; Popper *et al.,* 2007; Popper *et al.,* 2016; Watwood *et al.,* 2016). Techer *et al.* (2017) exposed carp in floating cages for up to 30 days to low-power 23 and 46 kHz source without any significant physiological response. Other studies have documented either a lack of TTS in species whose hearing range cannot perceive Navy sonar, or for those species that could perceive sonar-like signals, any TTS experienced would be recoverable (Halvorsen *et al.,* 2012; Ladich and Fay, 2013; Popper and Hastings, 2009a, 2009b; Popper *et al.,* 2014; Smith, 2016). Only fishes that have specializations that enable them to hear sounds above about 2,500 Hz (2.5 kHz) such as herring (Halvorsen *et al.,* 2012; Mann *et al.,* 2005; Mann, 2016; Popper *et al.,* 2014) would have the potential to receive TTS or exhibit behavioral responses from exposure to mid-frequency sonar. In addition, any sonar induced TTS to fish whose hearing range could perceive sonar would only occur in the narrow spectrum of the source (*e.g.,* 3.5 kHz) compared to the fish's total hearing range (*e.g.,* 0.01 kHz to 5 kHz). Overall, Navy sonar sources are much narrower in terms of source frequency compared to a given fish species full hearing range (see examples in Figure 9–1 of the Navy's rulemaking/LOA application).

In terms of behavioral responses, Juanes *et al.* (2017) discuss the potential for negative impacts from anthropogenic soundscapes on fish, but the author's focus was on broader based sounds such as ship and boat noise sources. Watwood *et al.* (2016) also documented no behavioral responses by reef fish after exposure to mid-frequency active sonar. Doksaeter *et al.* (2009; 2012) reported no behavioral responses to mid-frequency naval sonar by Atlantic herring, specifically, no escape reactions (vertically or horizontally) observed in free swimming herring exposed to mid-frequency sonar transmissions. Based on these results (Doksaeter *et al.,* 2009; Doksaeter *et al.,* 2012; Sivle *et al.,* 2012), Sivle *et al.* (2014) created a model in order to report on the possible population-level effects on Atlantic herring from active naval sonar. The authors concluded that the use of naval sonar poses little risk to populations of herring regardless of season, even when the herring populations are aggregated and directly exposed to sonar. Finally, Bruintjes *et al.* (2016) commented that fish exposed to any short-term noise within their hearing range might initially startle, but would quickly return to normal behavior.

The potential effects of air gun noise on fishes depends on the overlapping frequency range, distance from the sound source, water depth of exposure, and species-specific hearing sensitivity, anatomy, and physiology. Some studies have shown no or slight reaction to air gun sounds (*e.g.,* Pena *et al.,* 2013; Wardle *et al.,* 2001; Jorgenson and Gyselman, 2009; Cott *et al.,* 2012). More commonly, though, the impacts of noise on fish are temporary. Investigators reported significant, short-term declines in commercial fishing catch rate of gadid fishes during and for up to five days after survey operations, but the catch rate subsequently returned to normal (Engas *et al.,* 1996; Engas and Lokkeborg, 2002); other studies have reported similar findings (Hassel *et al.,* 2004). However, even temporary effects to fish distribution patterns can impact their ability to carry out important life-history functions (Paxton *et al.,* 2017). SPLs of sufficient strength have been known to cause injury to fish and fish mortality and, in some studies, fish auditory systems have been damaged by air gun noise (McCauley *et al.,* 2003; Popper *et al.,* 2005; Song *et al.,* 2008). However, in most fish species, hair cells in the ear continuously regenerate and loss of auditory function likely is restored when damaged cells are replaced with new cells. Halvorsen *et al.* (2012a) showed that a TTS of 4–6 dB was recoverable within 24 hrs for one species. Impacts would be most severe when the individual fish is close to the source and when the duration of exposure is long. No mortality occurred to fish in any of these studies.

Occasional behavioral reactions to intermittent explosions and impulsive sound sources are unlikely to cause long-term consequences for individual fish or populations. Fish that experience hearing loss as a result of exposure to explosions and impulsive sound sources may have a reduced ability to detect relevant sounds such as predators, prey, or social vocalizations. However, PTS has not been known to occur in fishes and any hearing loss in fish may be as temporary as the timeframe required to repair or replace the sensory cells that were damaged or destroyed (Popper *et al.,* 2005; Popper *et al.,* 2014; Smith *et al.,* 2006). It is not known if damage to auditory nerve fibers could occur, and if so, whether fibers would recover during this process. It is also possible for fish to be injured or killed by an explosion in the immediate vicinity of the surface from dropped or fired ordnance, or near the bottom from shallow water bottom-placed underwater mine warfare detonations. Physical effects from pressure waves generated by underwater sounds *(e.g.,* underwater explosions) could potentially affect fish within proximity of training or testing activities. The shock wave from an underwater explosion is lethal to fish at close range, causing massive organ and tissue damage and internal bleeding (Keevin and Hempen, 1997). At greater distance from the detonation point, the extent of mortality or injury depends on a number of factors including fish size, body shape, orientation, and species (Keevin and Hempen, 1997; Wright, 1982). At the same distance from the source, larger fish are generally less susceptible to death or injury, elongated forms that are round in cross-section are less at risk than deep-bodied forms, and fish oriented sideways to the blast suffer the greatest impact (Edds-Walton and Finneran, 2006; O'Keeffe, 1984; O'Keeffe and Young, 1984; Wiley *et al.,* 1981; Yelverton *et al.,* 1975). Species with gas-filled organs are more susceptible to injury and mortality than those without them (Gaspin, 1975; Gaspin *et al.,* 1976; Goertner *et al.,* 1994). Barotrauma injuries have been documented during controlled exposure to impact pile driving (an impulsive noise source, as are explosives and air guns) (Halvorsen *et al.,* 2012b; Casper *et al.,* 2013). For seismic surveys, the sound source is constantly moving, and most fish would likely avoid the sound source prior to receiving sound of sufficient intensity to cause physiological or anatomical damage.

Fish not killed or driven from a location by an explosion might change their behavior, feeding pattern, or distribution. Changes in behavior of fish have been observed as a result of sound produced by explosives, with effect intensified in areas of hard substrate (Wright, 1982). However, Navy explosive use avoids hard substrate to the best extent practical during underwater detonations, or deep-water surface detonations (distance from bottom). Stunning from pressure waves could also temporarily immobilize fish, making them more susceptible to predation. The abundances of various fish (and invertebrates) near the detonation point for explosives could be altered for a few hours before animals from surrounding areas repopulate the area. However, these populations would likely be replenished as waters near the detonation point are mixed with adjacent waters. Repeated exposure of individual fish to sounds from underwater explosions is not likely and are expected to be short-term and localized. Long-term consequences for fish populations would not be expected. Several studies have demonstrated that air gun sounds might affect the distribution and behavior of some fishes, potentially impacting foraging opportunities or increasing energetic costs (*e.g.,* Fewtrell and McCauley, 2012; Pearson *et al.,* 1992; Skalski *et al.,* 1992; Santulli *et al.,* 1999; Paxton *et al.,* 2017).

In conclusion, for fishes exposed to Navy sonar, there would be limited sonar use spread out in time and space across large offshore areas such that only small areas are actually ensonified (10's of miles) compared to the total life history distribution of fish prey species. There would be no probability for mortality and physical injury from sonar, and for most species, no or little potential for hearing or behavioral effects, except to a few select fishes with hearing specializations (*e.g.,* herring) that could perceive mid-frequency sonar. Training and testing exercises involving explosions are dispersed in space and time; therefore, repeated exposure of individual fishes are unlikely. Morality and injury effects to fishes from explosives would be localized around the area of a given in-water explosion, but only if individual fish and the explosive (and immediate pressure field) were co-located at the same time. Fishes deeper in the water column or on the bottom would not be affected by water surface explosions. Repeated exposure of individual fish to sound and energy from underwater explosions is not likely given fish movement patterns, especially schooling prey species. Most acoustic effects, if any, are expected to be short-term and localized. Long-term consequences for fish populations including key prey species within the HSTT Study Area would not be expected.

Invertebrates appear to be able to detect sounds (Pumphrey, 1950; Frings and Frings, 1967) and are most sensitive to low-frequency sounds (Packard *et al.,* 1990; Budelmann and Williamson, 1994; Lovell *et al.,* 2005; Mooney *et al.,* 2010). Data on response of invertebrates such as squid, another marine mammal prey species, to anthropogenic sound is more limited (de Soto, 2016; Sole *et al.,* 2017b). Data suggest that cephalopods are capable of sensing the particle motion of sounds and detect low frequencies up to 1–1.5 kHz, depending on the species, and so are likely to detect air gun noise (Kaifu *et al.,* 2008; Hu *et al.,* 2009; Mooney *et al.,* 2010; Samson *et al.,* 2014). Sole *et al.* (2017b) reported physiological injuries to cuttlefish in cages placed at-sea when exposed during a controlled exposure experiment to low-frequency sources (315 Hz, 139 to 142 dB re 1 μPa^2 and 400 Hz, 139 to 141 dB re 1 μPa^2). Fewtrell and McCauley (2012) reported squids maintained in cages displayed startle responses and behavioral changes when exposed to seismic air gun sonar (136–162 re 1 $\mu Pa^2 \cdot s$). However, the sources Sole *et al.* (2017a) and Fewtrell and McCauley (2012) used are not similar and much lower than typical Navy sources within the HSTT Study Area. Nor do the studies address the issue of individual displacement outside of a zone of impact when exposed to sound. Cephalopods have a specialized sensory organ inside the head called a statocyst that may help an animal determine its position in space (orientation) and maintain balance (Budelmann, 1992). Packard *et al.* (1990) showed that cephalopods were sensitive to particle motion, not sound pressure, and Mooney et al. (2010) demonstrated that squid statocysts act as an accelerometer through which particle motion of the sound field can be detected. Auditory injuries (lesions occurring on the statocyst sensory hair cells) have been reported upon controlled exposure to low-frequency sounds, suggesting that cephalopods are particularly sensitive to low-frequency sound (Andre *et al.,* 2011; Sole *et al.,* 2013). Behavioral responses, such as inking and jetting, have also been reported upon exposure to low-frequency sound (McCauley *et al.,* 2000b; Samson *et al.,* 2014). Squids, like most fish species, are likely more sensitive to low frequency sounds, and may not perceive mid- and high-frequency sonars such as Navy sonars. Cumulatively for squid as a prey species, individual and population impacts from exposure to Navy sonar and explosives, like fish, are not likely to be significant, and explosive impacts would be short-term and localized.

Vessels and in-water devices do not normally collide with adult fish, most of which can detect and avoid them. Exposure of fishes to vessel strike stressors is limited to those fish groups that are large, slow-moving, and may occur near the surface, such as ocean sunfish, whale sharks, basking sharks, and manta rays. These species are distributed widely in offshore portions of the Study Area. Any isolated cases of a Navy vessel striking an individual could injure that individual, impacting the fitness of an individual fish. Vessel strikes would not pose a risk to most of the other marine fish groups, because many fish can detect and avoid vessel movements, making strikes rare and allowing the fish to return to their normal behavior after the ship or device passes. As a vessel approaches a fish, they could have a detectable behavioral or physiological response (*e.g.,* swimming away and increased heart rate) as the passing vessel displaces them. However, such reactions are not expected to have lasting effects on the survival, growth, recruitment, or reproduction of these marine fish groups at the population level and therefore would not have an impact on marine mammals species as prey items.

In addition to fish, prey sources such as marine invertebrates could potentially be impacted by sound stressors as a result of the proposed activities. However, most marine invertebrates' ability to sense sounds is very limited. In most cases, marine invertebrates would not respond to impulsive and non-impulsive sounds, although they may detect and briefly respond to nearby low-frequency sounds. These short-term responses would likely be inconsequential to invertebrate populations. Impacts to benthic communities from impulsive sound generated by active acoustic sound sources are not well documented. (*e.g.,* Andriguetto-Filho *et al.,* 2005; Payne *et al.,* 2007; 2008; Boudreau *et al.,* 2009). There are no published data that indicate whether temporary or permanent threshold shifts, auditory masking, or behavioral effects occur in benthic invertebrates (Hawkins *et al.,* 2014) and some studies showed no short-term or long-term effects of air gun exposure (*e.g.,* Andriguetto-Filho *et al.,* 2005; Payne *et al.,* 2007; 2008; Boudreau *et al.,* 2009). Exposure to air gun signals was found to significantly increase mortality in scallops, in addition to causing significant changes in behavioral patterns during exposure (Day *et al.,* 2017). However, the authors state that the observed levels of mortality were not beyond naturally occurring rates. Explosions and pile driving could potentially kill or injure nearby marine invertebrates; however, mortality or long-term consequences for a few animals is unlikely to have measurable effects on overall stocks or populations.

Vessels also have the potential to impact marine invertebrates by disturbing the water column or sediments, or directly striking organisms (Bishop, 2008). The propeller wash (water displaced by propellers used for propulsion) from vessel movement and water displaced from vessel hulls can potentially disturb marine invertebrates in the water column and is a likely cause of zooplankton mortality (Bickel *et al.,* 2011). The localized and short-term exposure to explosions or vessels could displace, injure, or kill zooplankton, invertebrate eggs or larvae, and macro-invertebrates. However, mortality or long-term consequences for a few animals is unlikely to have measurable effects on overall stocks or populations.

There is little information concerning potential impacts of noise on zooplankton populations. However, one recent study (McCauley *et al.,* 2017) investigated zooplankton abundance, diversity, and mortality before and after exposure to air gun noise, finding that the exposure resulted in significant depletion for more than half the taxa present and that there were two to three times more dead zooplankton after air gun exposure compared with controls for all taxa. The majority of taxa present were copepods and cladocerans; for these taxa, the range within which effects on abundance were detected was up to approximately 1.2 km. In order to have significant impacts on *r*-selected species such as plankton, the spatial or temporal scale of impact must be large in comparison with the ecosystem concerned (McCauley *et al.,* 2017). Therefore, the large scale of effect observed here is of concern—particularly where repeated noise exposure is expected—and further study is warranted.

Overall, the combined impacts of sound exposure, explosions, vessel strikes, and military expended materials resulting from the proposed activities would not be expected to have measurable effects on populations of marine mammal prey species. Prey species exposed to sound might move away from the sound source, experience TTS, experience masking of biologically relevant sounds, or show no obvious direct effects. Mortality from decompression injuries is possible in close proximity to a sound, but only limited data on mortality in response to air gun noise exposure are available (Hawkins *et al.,* 2014). The most likely impacts for most prey species in a given area would be temporary avoidance of the area. Surveys using towed air gun arrays move through an area relatively quickly, limiting exposure to multiple impulsive sounds. In all cases, sound levels would return to ambient once a survey ends and the noise source is shut down and, when exposure to sound ends, behavioral and/or physiological responses are expected to end relatively quickly (McCauley *et al.,* 2000b). The duration of fish avoidance of a given area after survey effort stops is unknown, but a rapid return to normal recruitment, distribution, and behavior is anticipated. While the potential for disruption of spawning aggregations or schools of important prey species can be meaningful on a local scale, the mobile and temporary nature of most surveys and the likelihood of temporary avoidance behavior suggest that impacts would be minor. Long-term consequences to marine invertebrate populations would not be expected as a result of exposure to sounds or vessels in the Study Area. Military expended materials resulting from training and testing activities could potentially result in minor long-term changes to benthic habitat. Military expended materials may be colonized over time by benthic organisms that prefer hard substrate and would provide structure that could attract some species of fish or invertebrates.

Acoustic Habitat

Acoustic habitat is the soundscape which encompasses all of the sound present in a particular location and time, as a whole when considered from the perspective of the animals experiencing it. Animals produce sound for, or listen for sounds produced by, conspecifics (communication during feeding, mating, and other social activities), other animals (finding prey or avoiding predators), and the physical environment (finding suitable habitats, navigating). Together, sounds made by animals and the geophysical environment (*e.g.,* produced by earthquakes, lightning, wind, rain, waves) make up the natural contributions to the total acoustics of a place. These acoustic conditions, termed acoustic habitat, are one attribute of an animal's total habitat.

Soundscapes are also defined by, and acoustic habitat influenced by, the total contribution of anthropogenic sound. This may include incidental emissions from sources such as vessel traffic, may be intentionally introduced to the marine environment for data acquisition purposes (as in the use of air gun arrays), or for Navy training and testing purposes (as in the use of sonar and explosives and other acoustic sources). Anthropogenic noise varies widely in its frequency, content, duration, and loudness and these characteristics greatly influence the potential habitat-mediated effects to marine mammals (please also see the previous discussion on ''Masking''), which may range from local effects for brief periods of time to chronic effects over large areas and for long durations. Depending on the extent of effects to habitat, animals may alter their communications signals (thereby potentially expending additional energy) or miss acoustic cues (either conspecific or adventitious). Problems arising from a failure to detect cues are more likely to occur when noise stimuli are chronic and overlap with biologically relevant cues used for communication, orientation, and predator/prey detection (Francis and Barber, 2013). For more detail on these concepts see, *e.g.,* Barber *et al.,* 2009; Pijanowski *et al.,* 2011; Francis and Barber, 2013; Lillis *et al.,* 2014.

The term ''listening area'' refers to the region of ocean over which sources of sound can be detected by an animal at the center of the space. Loss of communication space concerns the area over which a specific animal signal, used to communicate with conspecifics in biologically-important contexts (*e.g.,* foraging, mating), can be heard, in noisier relative to quieter conditions (Clark *et al.,* 2009). Lost listening area concerns the more generalized contraction of the range over which animals would be able to detect a variety of signals of biological importance, including eavesdropping on predators and prey (Barber *et al.,* 2009). Such metrics do not, in and of themselves, document fitness consequences for the marine animals that live in chronically noisy environments. Long-term population-level consequences mediated through changes in the ultimate survival and reproductive success of individuals are difficult to study, and particularly so underwater. However, it is increasingly well documented that aquatic species rely on qualities of natural acoustic habitats, with researchers quantifying reduced detection of important ecological cues (*e.g.,* Francis and Barber, 2013; Slabbekoorn *et al.,* 2010) as well as survivorship consequences in several species (*e.g.,* Simpson *et al.,* 2014; Nedelec *et al.,* 2015).

Sound produced from training and testing activities in the HSTT Study Area is temporary and transitory. The sounds produced during training and testing activities can be widely dispersed or concentrated in small areas for varying periods. Any anthropogenic noise attributed to training and testing activities in the HSTT Study Area would be temporary and the affected area would be expected to immediately return to the original state when these activities cease.

Water Quality

The HSTT DEIS/OEIS analyzed the potential effects on water quality from military expended materials. Training and testing activities may introduce water quality constituents into the water column. Based on the analysis of the HSTT DEIS/OEIS, military expended materials (*e.g.,* undetonated explosive materials) would be released in quantities and at rates that would not result in a violation of any water quality standard or criteria. High-order explosions consume most of the explosive material, creating typical combustion products. For example, in the case of Royal Demolition Explosive, 98 percent of the products are common seawater constituents and the remainder is rapidly diluted below threshold effect level. Explosion by-products associated with high order detonations present no secondary stressors to marine mammals through sediment or water. However, low order detonations and unexploded ordnance present elevated likelihood of impacts on marine mammals.

Indirect effects of explosives and unexploded ordnance to marine mammals via sediment is possible in the immediate vicinity of the ordnance. Degradation products of Royal Demolition Explosive are not toxic to marine organisms at realistic exposure levels (Rosen and Lotufo, 2010). Relatively low solubility of most explosives and their degradation products means that concentrations of these contaminants in the marine environment are relatively low and readily diluted. Furthermore, while explosives and their degradation products were detectable in marine sediment approximately 6–12 in (0.15–0.3 m) away from degrading ordnance, the concentrations of these compounds were not statistically distinguishable from background beyond 3–6 ft (1–2 m) from the degrading ordnance. Taken together, it is possible that marine mammals could be exposed to degrading explosives, but it would be within a very small radius of the explosive (1–6 ft (0.3–2 m)).

Equipment used by the Navy within the HSTT Study Area, including ships and other marine vessels, aircraft, and other equipment, are also potential sources of by-products. All equipment is properly maintained in accordance with applicable Navy or legal requirements. All such operating equipment meets Federal water quality standards, where applicable.

Estimated Take of Marine Mammals

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

Takes are predominantly in the form of harassment, but a small number of mortalities are also estimated. For a military readiness activity, 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).

Authorized takes would primarily be in the form of Level B harassment, as use of the acoustic and explosive sources (*i.e.,* sonar, air guns, pile driving, explosives) is likely to result in the disruption of natural behavioral patterns to a point where they are abandoned or significantly altered (as defined specifically at the beginning of this section, but referred to generally as behavioral disruption) or TTS for marine mammals. There is also the potential for Level A harassment, in the form of auditory injury and/or tissue damage (latter for explosives only) to result from exposure to the sound sources utilized in training and testing activities. Lastly, a limited number of serious injuries or mortalities could occur for California sea lion and short-beaked common dolphin (10 mortalities total between the two species over the 5-year period) from explosives, and no more than three serious injuries or mortalities total (over the five-year period) of large whales through vessel collisions. Although we analyze the impacts of these potential serious injuries or mortalities that are proposed for authorization, the proposed mitigation and monitoring measures are expected to minimize the likelihood (*i.e.,* further lower the already low probability) that ship strike or these explosive exposures (and the associated serious injury or mortality) occur.

Described in the most basic way, we estimate the amount and type of harassment by considering: (1) Acoustic thresholds above which NMFS believes the best available science indicates marine mammals will be behaviorally harassed (in this case, as defined in the military readiness definition included above) or incur some degree of temporary or permanent hearing impairment; (2) the area or volume of water that will be ensonified above these levels in a day; (3) the density or occurrence of marine mammals within these ensonified areas; and, (4) and the number of days during which activities might occur. Below, we describe these components in more detail and present the proposed take estimate.

Acoustic Thresholds

Using the best available science, and in coordination with the Navy, NMFS has established acoustic thresholds above which exposed marine mammals would reasonably be expected to experience a disruption in behavioral patterns to a point where they are abandoned or significantly altered, or to incur TTS (equated to Level B harassment) or PTS of some degree (equated to Level A harassment). Thresholds have also been developed to identify the pressure levels above which animals may incur different types of tissue damage from exposure to pressure waves from explosive detonation.

Hearing Impairment (TTS/PTS and Tissue Damage and Mortality)

Non-Impulsive and Impulsive

NMFS's Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Technical Guidance, 2016) identifies dual criteria to assess auditory injury (Level A harassment) to five different marine mammal groups (based on hearing sensitivity) as a result of exposure to noise from two different types of sources (impulsive or non-impulsive). The Technical Guidance also identifies criteria to predict TTS, which is not considered injury and falls into the Level B Harassment category. The Navy's Specified Activities includes the use of non-impulsive (sonar, vibratory pile driving/removal) sources and impulsive (explosives, air guns, impact pile driving) sources.

These thresholds (Tables 14–15) were developed by compiling and synthesizing the best available science and soliciting input multiple times from both the public and peer reviewers to inform the final product, and are provided in the table below. The references, analysis, and methodology used in the development of the thresholds are described in NMFS 2016 Technical Guidance, which may be accessed at: *http://www.nmfs.noaa.gov/pr/acoustics/guidelines.htm.*

TABLE 14—ACOUSTIC THRESHOLDS IDENTIFYING THE ONSET OF TTS AND PTS FOR NON-IMPULSIVE SOUND SOURCES BY FUNCTIONAL HEARING GROUPS

Functional hearing group	Non-impulsive	
	TTS threshold SEL (weighted)	PTS threshold SEL (weighted)
Low-Frequency Cetaceans	179	199
Mid-Frequency Cetaceans	178	198
High-Frequency Cetaceans	153	173
Phocid Pinnipeds (Underwater)	181	201
Ottarid Pinnipeds (Underwater)	199	219

Note: SEL thresholds in dB re 1 μPa²s.

Based on the best available science, the Navy (in coordination with NMFS) used the acoustic and pressure thresholds indicated in Table 15 to predict the onset of TTS, PTS, tissue damage, and mortality for explosives (impulsive) and other impulsive sound sources.

TABLE 15—ONSET OF TTS, PTS, TISSUE DAMAGE, AND MORTALITY THRESHOLDS FOR MARINE MAMMALS FOR EXPLOSIVES AND OTHER IMPULSIVE SOURCES

Functional hearing group	Species	Weighted onset TTS	Weighted onset PTS	Mean onset slight GI tract injury	Mean onset slight lung injury	Mean onset mortality
Low-frequency cetaceans	All mysticetes	168 dB SEL or 213 dB Peak SPL.	183 dB SEL or 219 dB Peak SPL.	237 dB Peak SPL	Equation 1	Equation 2.
Mid-frequency cetaceans	Most delphinids, medium and large toothed whales.	170 dB SEL or 224 dB Peak SPL.	185 dB SEL or 230 dB Peak SPL.	237 dB Peak SPL.		
High-frequency cetaceans	Porpoises and *Kogia spp*	140 dB SEL or 196 dB Peak SPL.	155 dB SEL or 202 dB Peak SPL.	237 dB Peak SPL.		
Phocidae	Harbor seal, Hawaiian monk seal, Northern elephant seal.	170 dB SEL or 212 dB Peak SPL.	185 dB SEL or 218 dB Peak SPL.	237 dB Peak SPL.		
Otariidae	California sea lion, Guadalupe fur seal, Northern fur seal.	188 dB SEL or 226 dB Peak SPL.	203 dB SEL or 232 dB Peak SPL.	237 dB Peak SPL.		

Notes:
Equation 1: $47.5M^{1/3} (1 + [D_{Rm} / 10.1])^{1/6}$ Pa-sec.
Equation 2: $103M^{1/3} (1 + [D_{Rm} / 10.1])^{1/6}$ Pa-sec.
M = mass of the animals in kg.
D_{Rm} = depth of the receiver (animal) in meters.
SPL = sound pressure level.

Impulsive—Air Guns and Impact Pile Driving

Impact pile driving produces impulsive noise; therefore, the criteria used to assess the onset of TTS and PTS are identical to those used for air guns, as well as explosives (see Table 15 above) (see Hearing Loss from air guns in Section 6.4.3.1, Methods for Analyzing Impacts from air guns in the Navy's rulemaking/LOA application). Refer to the *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)* report (U.S. Department of the Navy, 2017c) for detailed information on how the criteria and thresholds were derived.

Non-Impulsive—Sonar and Vibratory Pile Driving/Removal

Vibratory pile removal (that will be used during the ELCAS) creates continuous non-impulsive noise at low source levels for a short duration. Therefore, the criteria used to assess the onset of TTS and PTS due to exposure to sonars (non-impulsive, see Table 14 above) are also used to assess auditory impacts to marine mammals from vibratory pile driving (see Hearing Loss from Sonar and Other Transducers in Section 6.4.2.1, Methods for Analyzing Impacts from Sonars and Other Transducers in the Navy's rulemaking/LOA application). Refer to the *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)* report (U.S. Department of the Navy, 2017c) for detailed information on how the criteria and thresholds were derived. Non-auditory injury (*i.e.,* other than PTS) and mortality from sonar and other transducers is so unlikely as to be discountable under normal conditions for the reasons explained in the Potential Effects of Specified Activities on Marine Mammals and Their Habitat section under ''*Acoustically Mediated Bubble Growth and other Pressure-related Injury*'' and is therefore not considered further in this analysis.

Behavioral Harassment

Marine mammal responses (some of which are considered disturbances that rise to the level of a take) to sound are highly variable and context specific (affected by differences in acoustic conditions, differences between species and populations; differences in gender, age, reproductive status, or social behavior; or other prior experience of the individuals), which means that there is support for alternative approaches for estimating behavioral harassment. Although the statutory definition of Level B harassment for military readiness activities requires that the natural behavior patterns of a marine mammal be significantly altered or abandoned in order to qualify as a take, the current state of science for determining those thresholds is still evolving and indefinite. In its analysis of impacts associated with sonar acoustic sources (which was coordinated with NMFS), the Navy proposes, and NMFS supports, an updated conservative approach that likely overestimates the number of takes by Level B harassment due to behavioral disturbance and response. Many of the responses estimated using the Navy's quantitative analysis are most likely to be moderate severity (see Southall *et al.,* 2007 for behavior response severity scale). Moderate severity responses would be considered significant if they were sustained for a duration long enough that it caused an animal to be outside of normal variation in daily behavioral patterns in feeding, reproduction, resting, migration/movement, or social cohesion. Many of the behavioral reactions predicted by the Navy's quantitative analysis are only expected to exceed an animal's behavioral threshold for a single exposure lasting several minutes. It is therefore likely that some of the exposures that are included in the estimated behavioral harassment takes would not actually constitute significant alterations or abandonment of natural behavior patterns. The Navy and NMFS have used the best available science to address the challenge of differentiating between behavioral reactions that rise to the level of a take and those that do not, but have erred on the side of caution where uncertainty exists (*e.g.,* counting these lower duration reactions as take). This conservative choice likely results in some degree of overestimation of behavioral harassment take. Therefore, this analysis includes the maximum number of behavioral disturbances and responses that are reasonably possible to occur.

Air Guns and Pile Driving

Though significantly driven by received level, the onset of behavioral disturbance from anthropogenic noise exposure is also informed to varying degrees by other factors related to the source (*e.g.,* frequency, predictability, duty cycle), the environment (*e.g.,* bathymetry), and the receiving animals (hearing, motivation, experience, demography, behavioral context) and can be difficult to predict (Southall *et al.,* 2007, Ellison *et al.,* 2011). Based on what the available science indicates and the practical need to use a threshold based on a factor that is both predictable and measurable for most activities, NMFS uses a generalized acoustic threshold based on received level to estimate the onset of behavioral harassment. NMFS predicts that marine mammals are likely to be behaviorally harassed in a manner we consider Level B harassment when exposed to underwater anthropogenic noise above received levels of 120 dB re 1 μPa (rms) for continuous (*e.g.,* vibratory pile-driving, drilling) and above 160 dB re 1 μPa (rms) for non-explosive impulsive (*e.g.,* seismic air guns) or intermittent (*e.g.,* scientific sonar) sources. To estimate behavioral effects from air guns, the existing NMFS Level B harassment threshold of 160 dB re 1 μPa (rms) is used. The root mean square calculation for air guns is based on the duration defined by 90 percent of the cumulative energy in the impulse.

The existing NMFS Level B harassment thresholds were also applied to estimate behavioral effects from impact and vibratory pile driving (Table 16).

TABLE 16—PILE DRIVING LEVEL B THRESHOLDS USED IN THIS ANALYSIS TO PREDICT BEHAVIORAL RESPONSES FROM MARINE MAMMALS

Pile driving criteria (SPL, dB re 1 μPa) Level B disturbance threshold	
Underwater vibratory	Underwater impact
120 dB rms	160 dB rms.

Notes: Root mean square calculation for impact pile driving is based on the duration defined by 90 percent of the cumulative energy in the impulse. Root mean square for vibratory pile driving is calculated based on a representative time series long enough to capture the variation in levels, usually on the order of a few seconds.

dB: decibel; dB re 1 μPa: decibel referenced to 1 micropascal; rms: root mean square.

Sonar

As noted, the Navy coordinated with NMFS to propose behavioral harassment thresholds specific to their military readiness activities utilizing active sonar. Behavioral response criteria are used to estimate the number of animals that may exhibit a behavioral response to sonar and other transducers. The way the criteria were derived is discussed in detail in the *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)* report (U.S. Department of the Navy, 2017c). Developing the new behavioral criteria involved multiple steps. All peer-reviewed published behavioral response studies conducted both in the field and on captive animals were examined in order to understand the breadth of behavioral responses of marine mammals to sonar and other transducers. NMFS supported the development of this methodology and considered it appropriate to calculate take and support the preliminary determinations made in the proposed rule.

In the Navy acoustic impact analyses during Phase II, the likelihood of behavioral effects to sonar and other transducers was based on a probabilistic function (termed a behavioral response function—BRF), that related the likelihood (*i.e.,* probability) of a behavioral response to the received SPL. The BRF was used to estimate the percentage of an exposed population that is likely to exhibit altered behaviors or behavioral disturbance at a given received SPL. This BRF relied on the assumption that sound poses a negligible risk to marine mammals if they are exposed to SPL below a certain ''basement'' value. Above the basement exposure SPL, the probability of a response increased with increasing SPL. Two BRFs were used in Navy acoustic impact analyses: BRF1 for mysticetes and BRF2 for other species. BRFs were not used for beaked whales during Phase II analyses. Instead, step functions at SPLs of 120 dB re 1 μPa and 140 dB re 1 μPa were used for harbor porpoises and beaked whales, respectively, as thresholds to predict behavioral disturbance. It should be noted that in the HSTT Study Area there are no harbor porpoise.

Developing the new behavioral criteria for Phase III involved multiple steps: All available behavioral response studies conducted both in the field and on captive animals were examined in order to better understand the breadth of behavioral responses of marine mammals to sonar and other transducers. Marine mammal species were placed into behavioral criteria groups based on their known or suspected behavioral sensitivities to sound. In most cases these divisions were driven by taxonomic classifications (*e.g.,* mysticetes, pinnipeds). The data from the behavioral studies were analyzed by looking for significant responses, or lack thereof, for each experimental session.

The Navy used cutoff distances beyond which the potential of significant behavioral responses (and therefore Level B harassment) is considered to be unlikely (see Table 16 below). For animals within the cutoff distance, a behavioral response function based on a received SPL as presented in Section 3.1.0 of the Navy's rulemaking/LOA application was used to predict the probability of a potential significant behavioral response. For training and testing events that contain multiple platforms or tactical sonar sources that exceed 215 dB re 1 μPa @1 1 m, this cutoff distance is substantially increased (*i.e.,* doubled) from values derived from the literature. The use of multiple platforms and intense sound sources are factors that probably increase responsiveness in marine mammals overall. There are currently few behavioral observations under these circumstances; therefore, the Navy conservatively predicted significant behavioral responses at farther ranges as shown in Table 17, versus less intense events.

TABLE 17—CUTOFF DISTANCES FOR MODERATE SOURCE LEVEL, SINGLE PLATFORM TRAINING AND TESTING EVENTS AND FOR ALL OTHER EVENTS WITH MULTIPLE PLATFORMS OR SONAR WITH SOURCE LEVELS AT OR EXCEEDING 215 dB re 1 μPa @1 m

Criteria group	Moderate SL/ single platform cutoff distance (km)	High SL/ multi-platform cutoff distance (km)
Odontocetes	10	20
Pinnipeds	5	10
Mysticetes	10	20
Beaked Whales	25	50
Harbor Porpoise	20	40

Notes: dB re 1 μPa @1 m: Decibels referenced to 1 micropascal at 1 meter; km: kilometer; SL: source level.
There are no harbor porpoise in the HSTT Study Area, but are included in Table 16 for consistency with other Navy Proposed Rules.

Tables 18–22 show the range to received sound levels in 6-dB steps from 5 representative sonar bins and the percentage of animals that may be taken under each behavioral response function. Cells are shaded if the mean range value for the specified received level exceeds the distance cutoff range for a particular hearing group and therefore are not included in the estimated take. See Section 6.4.2.1.1 (Methods for Analyzing Impacts from Sonars and Other Transducers) of the Navy's application for further details on the derivation and use of the behavioral response functions, thresholds, and the cutoff distances, which were coordinated with NMFS. Table 18 illustrates the potentially significant behavioral response for LFAS.

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Table 18. Ranges to a Potentially Significant Behavioral Response for Sonar Bin LF5 over a Representative Range of Environments within the HSTT Study Area.

Received Level (dB re 1 µPa-s)	*Average Range (m) (Minimum – Maximum)*	*Probability of Behavioral Response for Sonar Bin LF5M*			
		Odontocetes	*Mysticetes*	*Pinnipeds*	*Beaked Whales*
178	1 (1–1)	97%	59%	92%	100%
172	2 (1–2)	91%	30%	76%	99%
166	3 (1–5)	78%	20%	48%	97%
160	7 (1–13)	58%	18%	27%	93%
154	16 (1–30)	40%	17%	18%	83%
148	35 (1–85)	29%	16%	16%	66%
142	81 (1–230)	25%	13%	15%	45%
136	183 (1–725)	23%	9%	15%	28%
130	404 (1–1,525)	20%	5%	15%	18%
124	886 (1–3,025)	17%	2%	14%	14%
118	1,973 (725–5,775)	12%	1%	13%	12%
112	4,472 (900–18,275)	6%	0%	9%	11%
106	8,936 (900–54,525)	3%	0%	5%	11%
100	27,580 (900–88,775)	1%	0%	2%	8%

Note: Cells are shaded if the mean range value for the specified received level exceeds the distance cutoff range for a particular hearing group. Any impacts within the cutoff range for a criteria group are included in the estimated impacts. dB re 1 µPa2 - s: decibels referenced to 1 micropascal squared second; m: meters

Tables 19 through Table 21 illustrates the potentially significant behavioral response for MFAS.

Table 19. Ranges to a Potentially Significant Behavioral Response for Sonar Bin MF1 over a Representative Range of Environments within the HSTT Study Area.

Received Level (dB re 1 µPa-s)	*Average Range (m) (Minimum – Maximum)*	*Probability of Behavioral Response for Sonar Bin MF1*			
		Odontocetes	*Mysticetes*	*Pinnipeds*	*Beaked Whales*
196	109 (100–110)	100%	100%	100%	100%
190	239 (190–250)	100%	98%	99%	100%
184	502 (310–575)	99%	88%	98%	100%
178	1,024 (550–2,025)	97%	59%	92%	100%
172	2,948 (625–5,775)	91%	30%	76%	99%
166	6,247 (625–10,025)	78%	20%	48%	97%
160	11,919 (650–20,525)	58%	18%	27%	93%
154	20,470 (650–62,025)	40%	17%	18%	83%
148	33,048 (725–63,525)	29%	16%	16%	66%
142	43,297 (2,025–71,775)	25%	13%	15%	45%
136	52,912 (2,275–91,525)	23%	9%	15%	28%
130	61,974 (2,275–100,000*)	20%	5%	15%	18%
124	66,546 (2,275–100,000*)	17%	2%	14%	14%
118	69,637 (2,525–100,000*)	12%	1%	13%	12%
112	73,010 (2,525–100,000*)	6%	0%	9%	11%
106	75,928 (2,525–100,000*)	3%	0%	5%	11%
100	78,899 (2,525–100,000*)	1%	0%	2%	8%

Note: Cells are shaded if the mean range value for the specified received level exceeds the distance cutoff range for a particular hearing group. Any impacts within the cutoff range for a criteria group are included in the estimated impacts. dB re 1 µPa2 - s: decibels referenced to 1 micropascal squared second; m: meters

* Indicates maximum range to which acoustic model was run, a distance of approximately 100 kilometers from the sound source.

Table 20. Ranges to a Potentially Significant Behavioral Response for Sonar Bin MF4 over a Representative Range of Environments within the HSTT Study Area.

Received Level (dB re 1 µPa-s)	*Average Range (m) (Minimum – Maximum)*	*Probability of Behavioral Response for Sonar Bin MF4*			
		Odontocetes	*Mysticetes*	*Pinnipeds*	*Beaked Whales*
196	8 (1–8)	100%	100%	100%	100%
190	17 (1–17)	100%	98%	99%	100%
184	34 (1–35)	99%	88%	98%	100%
178	68 (1–75)	97%	59%	92%	100%
172	145 (130–300)	91%	30%	76%	99%
166	388 (270–875)	78%	20%	48%	97%
160	841 (470–1,775)	58%	18%	27%	93%
154	1,748 (700–6,025)	40%	17%	18%	83%
148	3,163 (1,025–13,775)	29%	16%	16%	66%
142	5,564 (1,275–27,025)	25%	13%	15%	45%
136	8,043 (1,525–54,275)	23%	9%	15%	28%
130	17,486 (1,525–65,525)	20%	5%	15%	18%
124	27,276 (1,525–84,775)	17%	2%	14%	14%
118	33,138 (2,775–85,275)	12%	1%	13%	12%
112	39,864 (3,775–100,000*)	6%	0%	9%	11%
106	45,477 (5,275–100,000*)	3%	0%	5%	11%
100	48,712 (5,275–100,000*)	1%	0%	2%	8%

Note: Cells are shaded if the mean range value for the specified received level exceeds the distance cutoff range for a particular hearing group. Any impacts within the cutoff range for a criteria group are included in the estimated impacts. dB re 1 µPa2 - s: decibels referenced to 1 micropascal squared second; m: meters

* Indicates maximum range to which acoustic model was run, a distance of approximately 100 kilometers from the sound source.

Table 21. Ranges to a Potentially Significant Behavioral Response for Sonar Bin MF5 over a Representative Range of Environments within the HSTT Study Area.

Received Level (dB re 1 µPa-s)	*Average Range (m) (Minimum – Maximum)*	*Probability of Behavioral Response for Sonar Bin MF5*			
		Odontocetes	*Mysticetes*	*Pinnipeds*	*Beaked Whales*
196	0 (0–0)	100%	100%	100%	100%
190	2 (1–3)	100%	98%	99%	100%
184	4 (1–7)	99%	88%	98%	100%
178	14 (1–15)	97%	59%	92%	100%
172	29 (1–30)	91%	30%	76%	99%
166	59 (1–70)	78%	20%	48%	97%
160	133 (1–340)	58%	18%	27%	93%
154	309 (1–950)	40%	17%	18%	83%
148	688 (430–2,275)	29%	16%	16%	66%
142	1,471 (650–4,025)	25%	13%	15%	45%
136	2,946 (700–7,525)	23%	9%	15%	28%
130	5,078 (725–11,775)	20%	5%	15%	18%
124	7,556 (725–19,525)	17%	2%	14%	14%
118	10,183 (725–27,775)	12%	1%	13%	12%
112	13,053 (725–63,025)	6%	0%	9%	11%
106	16,283 (1,025–64,525)	3%	0%	5%	11%
100	20,174 (1,025–70,525)	1%	0%	2%	8%

Note: Cells are shaded if the mean range value for the specified received level exceeds the distance cutoff range for a particular hearing group. Any impacts within the cutoff range for a criteria group are included in the estimated impacts. dB re 1 µPa2 - s: decibels referenced to 1 micropascal squared second; m: meters

* Indicates maximum range to which acoustic model was run, a distance of approximately 100 kilometers from the sound source.

Table 22 illustrates the potentially significant behavioral response for HFAS.

Table 22. Ranges to a Potentially Significant Behavioral Response for Sonar Bin HF4 over a Representative Range of Environments within the HSTT Study Area.

Received Level (dB re 1 µPa-s)	*Average Range (m) (Minimum – Maximum)*	*Probability of Behavioral Response for Sonar Bin HF4*			
		Odontocetes	*Mysticetes*	*Pinnipeds*	*Beaked Whales*
196	3 (1–6)	100%	100%	100%	100%
190	8 (1–16)	100%	98%	99%	100%
184	17 (1–35)	99%	88%	98%	100%
178	34 (1–90)	97%	59%	92%	100%
172	68 (1–180)	91%	30%	76%	99%
166	133 (12–430)	78%	20%	48%	97%
160	255 (30–750)	58%	18%	27%	93%
154	439 (50–1,525)	40%	17%	18%	83%
148	694 (85–2,275)	29%	16%	16%	66%
142	989 (110–3,525)	25%	13%	15%	45%
136	1,378 (170–4,775)	23%	9%	15%	28%
130	1,792 (270–6,025)	20%	5%	15%	18%
124	2,259 (320–7,525)	17%	2%	14%	14%
118	2,832 (320–8,525)	12%	1%	13%	12%
112	3,365 (320–10,525)	6%	0%	9%	11%
106	3,935 (320–12,275)	3%	0%	5%	11%
100	4,546 (320–16,775)	1%	0%	2%	8%

Note: Cells are shaded if the mean range value for the specified received level exceeds the distance cutoff range for a particular hearing group. Any impacts within the cutoff range for a criteria group are included in the estimated impacts. dB re 1 µPa2 - s: decibels referenced to 1 micropascal squared second; m: meters

* Indicates maximum range to which acoustic model was run, a distance of approximately 100 kilometers from the sound source.

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Explosives

Phase III explosive criteria for behavioral thresholds for marine mammals is the hearing groups' TTS threshold minus 5 dB (see Table 23 below and Table 15 for the TTS thresholds for explosives) for events that contain multiple impulses from explosives underwater. This was the same approach as taken in Phase II for explosive analysis. See the *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)* report (U.S. Department of the Navy, 2017c) for detailed information on how the criteria and thresholds were derived.

TABLE 23—PHASE III BEHAVIORAL THRESHOLDS FOR EXPLOSIVES FOR MARINE MAMMALS

Medium	Functional hearing group	SEL (weighted)
Underwater	LF	163
Underwater	MF	165
Underwater	HF	135
Underwater	PW	165
Underwater	OW	183

Note: Weighted SEL thresholds in dB re 1 μPa^2s underwater.

Navy's Acoustic Effects Model

Sonar and Other Transducers and Explosives

The Navy's Acoustic Effects Model calculates sound energy propagation from sonar and other transducers and explosives during naval activities and the sound received by animat dosimeters. Animat dosimeters are virtual representations of marine mammals distributed in the area around the modeled naval activity that each records its individual sound ''dose.'' The model bases the distribution of animats over the HSTT Study Area on the density values in the *Navy Marine Species Density Database* and distributes animats in the water column proportional to the known time that species spend at varying depths.

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

Assumptions in the Navy model intentionally err on the side of overestimation when there are unknowns. Naval activities are modeled as though they would occur regardless of proximity to marine mammals meaning that no mitigation is considered (*i.e.,* no power down or shut down modeled) and without any avoidance of the activity by the animal. The final step of the quantitative analysis of acoustic effects is to consider the implementation of mitigation and the possibility that marine mammals would avoid continued or repeated sound exposures. For more information on this process, see the discussion in the ''Take Requests'' subsection below. Many explosions from ordnance such as bombs and missiles actually occur upon impact with above-water targets. However, for this analysis, sources such as these were modeled as exploding underwater. This overestimates the amount of explosive and acoustic energy entering the water.

The model estimates the impacts caused by individual training and testing exercises. During any individual modeled event, impacts to individual animats are considered over 24-hour periods. The animats do not represent actual animals, but rather they represent a distribution of animals based on density and abundance data, which allows for a statistical analysis of the number of instances that marine mammals may be exposed to sound levels resulting in an effect. Therefore, the model estimates the number of instances in which an effect threshold was exceeded over the course of a year, but does not estimate the number of individual marine mammals that may be impacted over a year (*i.e.,* some marine mammals could be impacted several times, while others would not experience any impact). A detailed explanation of the Navy's Acoustic Effects Model is provided in the technical report *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing report* (U.S. Department of the Navy, 2017b).

Air Guns and Pile Driving

The Navy's quantitative analysis estimates the sound and energy received by marine mammals distributed in the area around planned Navy activities involving air guns. The analysis for air guns was similar to explosives as an impulsive source, except explosive impulsive sources were placed into bins based on net explosive weights, while each non-explosive impulsive source (air guns) was assigned its own unique bin. The impulsive model used in the Navy's analysis used metrics to describe the sound received by the animats and the SPL_{rms} criteria was only applied to air guns. See the technical report titled *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing report* (U.S. Department of the Navy, 2017b) for additional details.

Underwater noise effects from pile driving and vibratory pile extraction were modeled using actual measures of impact pile driving and vibratory removal during construction of an Elevated Causeway System (Illingworth and Rodkin, 2015, 2016). A conservative estimate of spreading loss of sound in shallow coastal waters (*i.e.,* transmission loss = 16.5 * Log10 (radius)) was applied based on spreading loss observed in actual measurements. Inputs used in the model are provided in Section 1.4.1.3 (Pile Driving) of the Navy's rulemaking/LOA application, including source levels; the number of strikes required to drive a pile and the duration of vibratory removal per pile; the number of piles driven or removed per day; and the number of days of pile driving and removal.

Range to Effects

The following section provides range to effects for sonar and other active acoustic sources as well as explosives to specific acoustic thresholds determined using the Navy Acoustic Effects Model. Marine mammals exposed within these ranges for the shown duration are predicted to experience the associated effect. Range to effects is important information not only for predicting acoustic impacts, but also in verifying the accuracy of model results against real-world situations and determining adequate mitigation ranges to avoid higher level effects, especially physiological effects to marine mammals.

Sonar

The range to received sound levels in 6-dB steps from 5 representative sonar bins and the percentage of the total number of animals that may exhibit a significant behavioral response (and therefore Level B harassment) under each behavioral response function are shown in Table 18 through Table 22 above, respectively. See Section 6.4.2.1.1 (Impact Ranges for Sonar and Other Transducers) of the Navy's rulemaking/LOA application for additional details on the derivation and use of the behavioral response functions, thresholds, and the cutoff distances.

The ranges to the PTS for five representative sonar systems for an exposure of 30 seconds is shown in Table 24 relative to the marine mammal's functional hearing group. This period (30 seconds) was chosen based on examining the maximum amount of time a marine mammal would realistically be exposed to levels that could cause the onset of PTS based on platform (*e.g.,* ship) speed and a nominal animal swim speed of approximately 1.5 m per second. The ranges provided in the table include the average range to PTS, as well as the range from the minimum to the maximum distance at which PTS is possible for each hearing group.

TABLE 24—RANGE TO PERMANENT THRESHOLD SHIFT (METERS) FOR FIVE REPRESENTATIVE SONAR SYSTEMS

Functional hearing group	Approximate range in meters for PTS from 30 seconds exposure				
	Sonar bin LF	Sonar bin MF1	Sonar bin MF4	Sonar bin MF5	Sonar bin HF4
Low-frequency Cetacean	0 (0–0)	65 (65–65)	14 (0–15)	0 (0–0)	0 (0–0)
Mid-frequency Cetacean	0 (0–0)	16 (16–16)	3 (3–3)	0 (0–0)	1 (0–2)
High-frequency Cetacean	0 (0–0)	181 (180–190)	30 (30–30)	9 (8–10)	30 (8–80)
Otariidae	0 (0–0)	6 (6–6)	0 (0–0)	0 (0–0)	0 (0–0)
Phocinae	0 (0–0)	45 (45–45)	11 (11–11)	0 (0–0)	0 (0–0)

[1] PTS ranges extend from the sonar or other active acoustic sound source to the indicated distance. The average range to PTS is provided as well as the range from the estimated minimum to the maximum range to PTS in parenthesis.

The tables below illustrate the range to TTS for 1, 30, 60, and 120 seconds from 5 representative sonar systems (see Table 25 through Table 29).

TABLE 25—RANGES TO TEMPORARY THRESHOLD SHIFT FOR SONAR BIN LF5 OVER A REPRESENTATIVE RANGE OF ENVIRONMENTS WITHIN THE HSTT STUDY AREA

Hearing group	Approximate TTS ranges (meters) [1]			
	Sonar bin LF5M (low frequency sources <180 dB source level)			
	1 second	30 seconds	60 seconds	120 seconds
Low-frequency Cetacean	3 (0–4)	3 (0–4)	3 (0–4)	3 (0–4)
Mid-frequency Cetacean	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)
High-frequency Cetacean	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)
Otariidae	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)
Phocinae	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)

[1] Ranges to TTS represent the model predictions in different areas and seasons within the Study Area. The zone in which animals are expected to suffer TTS extend from onset-PTS to the distance indicated. The average range to TTS is provided as well as the range from the estimated minimum to the maximum range to TTS in parentheses.

TABLE 26—RANGES TO TEMPORARY THRESHOLD SHIFT FOR SONAR BIN MF1 OVER A REPRESENTATIVE RANGE OF ENVIRONMENTS WITHIN THE HSTT STUDY AREA

Hearing group	Approximate TTS ranges (meters) [1]			
	Sonar bin MF1 (*e.g.,* SQS–53 ASW hull-mounted sonar)			
	1 second	30 seconds	60 seconds	120 seconds
Low-frequency Cetacean	903 (850–1,025)	903 (850–1,025)	1,264 (1,025–2,275)	1,839 (1,275–3,025)
Mid-frequency Cetacean	210 (210–210)	210 (210–210)	302 (300–310)	379 (370–390)
High-frequency Cetacean	3,043 (1,525–4,775)	3,043 (1,525–4,775)	4,739 (2,025–6,275)	5,614 (2,025–7,525)
Otariidae	65 (65–65)	65 (65–65)	106 (100–110)	137 (130–140)
Phocinae	669 (650–725)	669 (650–725)	970 (900–1,025)	1,075 (1,025–1,525)

[1] Ranges to TTS represent the model predictions in different areas and seasons within the Study Area. The zone in which animals are expected to suffer TTS extend from onset-PTS to the distance indicated. The average range to TTS is provided as well as the range from the estimated minimum to the maximum range to TTS in parentheses.

TABLE 27—RANGES TO TEMPORARY THRESHOLD SHIFT (METERS) FOR SONAR BIN MF4 OVER A REPRESENTATIVE RANGE OF ENVIRONMENTS WITHIN THE HSTT STUDY AREA

Hearing group	Approximate TTS ranges (meters) [1]			
	Sonar bin MF4 (*e.g.,* AQS–22 ASW dipping sonar)			
	1 second	30 seconds	60 seconds	120 seconds
Low-frequency Cetacean	77 (0–85)	162 (150–180)	235 (220–290)	370 (310–600)
Mid-frequency Cetacean	22 (22–22)	35 (35–35)	49 (45–50)	70 (70–70)
High-frequency Cetacean	240 (220–300)	492 (440–775)	668 (550–1,025)	983 (825–2,025)
Otariidae	8 (8–8)	15 (15–15)	19 (19–19)	25 (25–25)
Phocinae	65 (65–65)	110 (110–110)	156 (150–170)	269 (240–460)

[1] Ranges to TTS represent the model predictions in different areas and seasons within the Study Area. The zone in which animals are expected to suffer TTS extend from onset-PTS to the distance indicated. The average range to TTS is provided as well as the range from the estimated minimum to the maximum range to TTS in parentheses.

TABLE 28—RANGES TO TEMPORARY THRESHOLD SHIFT (METERS) FOR SONAR BIN MF5 OVER A REPRESENTATIVE RANGE OF ENVIRONMENTS WITHIN THE HSTT STUDY AREA

Hearing group	Approximate TTS ranges (meters) [1]			
	Sonar bin MF5 (*e.g.,* SSQ–62 ASW sonobuoy)			
	1 second	30 seconds	60 seconds	120 seconds
Low-frequency Cetacean	10 (0–12)	10 (0–12)	14 (0–18)	21 (0–25)
Mid-frequency Cetacean	6 (0–9)	6 (0–9)	12 (0–13)	17 (0–21)
High-frequency Cetacean	118 (100–170)	118 (100–170)	179 (150–480)	273 (210–700)
Otariidae	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)
Phocinae	9 (8–10)	9 (8–10)	14 (14–16)	21 (21–25)

[1] Ranges to TTS represent the model predictions in different areas and seasons within the Study Area. The zone in which animals are expected to suffer TTS extend from onset-PTS to the distance indicated. The average range to TTS is provided as well as the range from the estimated minimum to the maximum range to TTS in parentheses.

TABLE 29—RANGES TO TEMPORARY THRESHOLD SHIFT (METERS) FOR SONAR BIN HF4 OVER A REPRESENTATIVE RANGE OF ENVIRONMENTS WITHIN THE HSTT STUDY AREA

Hearing group	Approximate TTS ranges (meters) [1]			
	Sonar bin HF4 (*e.g.,* SQS–20 mine hunting sonar)			
	1 second	30 seconds	60 seconds	120 seconds
Low-frequency Cetacean	1 (0–3)	2 (0–5)	4 (0–7)	6 (0–11)
Mid-frequency Cetacean	10 (4–17)	17 (6–35)	24 (7–60)	34 (9–90)
High-frequency Cetacean	168 (25–550)	280 (55–775)	371 (80–1,275)	470 (100–1,525)
Otariidae	0 (0–0)	0 (0–0)	0 (0–0)	1 (0–1)
Phocinae	2 (0–5)	5 (2–8)	8 (3–13)	11 (4–22)

[1] Ranges to TTS represent the model predictions in different areas and seasons within the Study Area. The zone in which animals are expected to suffer TTS extend from onset-PTS to the distance indicated. The average range to TTS is provided as well as the range from the estimated minimum to the maximum range to TTS in parentheses.

Explosives

The following section provides the range (distance) over which specific physiological or behavioral effects are expected to occur based on the explosive criteria (see Chapter 6.5.2.1.1 of the Navy's rulemaking/LOA application and the *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)* report (U.S. Department of the Navy, 2017c) and the explosive propagation calculations from the Navy Acoustic Effects Model (see Chapter 6.5.2.1.3, Navy Acoustic Effects Model of the Navy's rulemaking/LOA application). The range to effects are shown for a range of explosive bins, from E1 (up to 0.25 lb net explosive weight) to E12 (up to 1,000 lb net explosive weight) (Tables 30 through 35). Ranges are determined by modeling the distance that noise from an explosion will need to propagate to reach exposure level thresholds specific to a hearing group that will cause behavioral response (to the degree of a take), TTS, PTS, and non-auditory injury. Ranges are provided for a representative source depth and cluster size for each bin. For events with multiple explosions, sound from successive explosions can be expected to accumulate and increase the range to the onset of an impact based on SEL thresholds. Range to effects is important information in not only predicting impacts from explosives, but also in verifying the accuracy of model results against real-world situations and determining adequate mitigation ranges to avoid higher level effects, especially physiological effects to marine mammals. For additional information on how ranges to impacts from explosions were estimated, see the technical report *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing* (U.S. Navy, 2017b).

Table 30 shows the minimum, average, and maximum ranges to onset of auditory and behavioral effects for high-frequency cetaceans based on the developed thresholds.

TABLE 30—SEL-BASED RANGES (METERS) TO ONSET PTS, ONSET TTS, AND BEHAVIORAL REACTION FOR HIGH-FREQUENCY CETACEANS

Range to effects for explosives: high frequency cetacean [1]					
Bin	Source depth (m)	Cluster size	PTS	TTS	Behavioral
E1	0.1	1	353 (130–825)	1,234 (290–3,025)	2,141 (340–4,775)
		25	1,188 (280–3,025)	3,752 (490–8,525)	5,196 (675–12,275)
E2	0.1	1	425 (140–1,275)	1,456 (300–3,525)	2,563 (390–5,275)
		10	988 (280–2,275)	3,335 (480–7,025)	4,693 (650–10,275)
E3	0.1	1	654 (220–1,525)	2,294 (350–4,775)	3,483 (490–7,775)
		12	1,581 (300–3,525)	4,573 (650–10,275)	6,188 (725–14,775)
	18.25	1	747 (550–1,525)	3,103 (950–6,025)	5,641 (1,000–9,275)
		12	1,809 (875–4,025)	7,807 (1,025–12,775)	10,798 (1,025–17,775)
E4	3	2	2,020 (1,025–3,275)	3,075 (1,025–6,775)	3,339 (1,025–9,775)
	15.25	2	970 (600–1,525)	4,457 (1,025–8,525)	6,087 (1,275–12,025)
	19.8	2	1,023 (1,000–1,025)	4,649 (2,275–8,525)	6,546 (3,025–11,025)
	198	2	959 (875–1,525)	4,386 (3,025–7,525)	5,522 (3,025–9,275)
E5	0.1	25	2,892 (440–6,275)	6,633 (725–16,025)	8,925 (800–22,775)
	15.25	25	4,448 (1,025–7,775)	10,504 (1,525–18,275)	13,605 (1,775–24,775)
E6	0.1	1	1,017 (280–2,525)	3,550 (490–7,775)	4,908 (675–12,275)
	3	1	2,275 (2,025–2,525)	6,025 (4,525–7,275)	7,838 (6,275–9,775)
	15.25	1	1,238 (625–2,775)	5,613 (1,025–10,525)	7,954 (1,275–14,275)
E7	3	1	3,150 (2,525–3,525)	7,171 (5,525–8,775)	8,734 (7,275–10,525)
	18.25	1	2,082 (925–3,525)	6,170 (1,275–10,525)	8,464 (1,525–16,525)
E8	0.1	1	1,646 (775–2,525)	4,322 (1,525–9,775)	5,710 (1,525–14,275)
	45.75	1	1,908 (1,025–4,775)	5,564 (1,525–12,525)	7,197 (1,525–18,775)
E9	0.1	1	2,105 (850–4,025)	4,901 (1,525–12,525)	6,700 (1,525–16,775)
E10	0.1	1	2,629 (875–5,275)	5,905 (1,525–13,775)	7,996 (1,525–20,025)
E11	18.5	1	3,034 (1,025–6,025)	7,636 (1,525–16,525)	9,772 (1,775–21,525)
	45.75	1	2,925 (1,525–6,025)	7,152 (2,275–18,525)	9,011 (2,525–24,525)
E12	0.1	1	2,868 (975–5,525)	6,097 (2,275–14,775)	8,355 (4,275–21,275)
		3	3,762 (1,525–8,275)	7,873 (3,775–20,525)	10,838 (4,275–26,525)

[1] Average distance (m) to PTS, TTS, and behavioral thresholds are depicted above the minimum and maximum distances which are in parentheses. Values depict the range produced by SEL hearing threshold criteria levels.
E13 not modeled due to surf zone use and lack of marine mammal receptors at site-specific location.

Table 31 shows the minimum, average, and maximum ranges to onset of auditory and behavioral effects for mid-frequency cetaceans based on the developed thresholds.

TABLE 31—SEL-BASED RANGES (METERS) TO ONSET PTS, ONSET TTS, AND BEHAVIORAL REACTION FOR MID-FREQUENCY CETACEANS

Range to effects for explosives: mid-frequency cetacean [1]					
Bin	Source depth (m)	Cluster size	PTS	TTS	Behavioral
E1	0.1	1	25 (25–25)	118 (80–210)	178 (100–320)
		25	107 (75–170)	476 (150–1,275)	676 (240–1,525)
E2	0.1	1	30 (30–35)	145 (95–240)	218 (110–400)
		10	88 (65–130)	392 (140–825)	567 (190–1,275)
E3	0.1	1	50 (45–65)	233 (110–430)	345 (130–600)
		12	153 (90–250)	642 (220–1,525)	897 (270–2,025)
	18.25	1	38 (35–40)	217 (190–900)	331 (290–850)
		12	131 (120–250)	754 (550–1,525)	1,055 (600–2,525)
E4	3	2	139 (110–160)	1,069 (525–1,525)	1,450 (875–1,775)
	15.25	2	71 (70–75)	461 (400–725)	613 (470–750)
	19.8	2	69 (65–70)	353 (350–360)	621 (600–650)
	198	2	49 (0–55)	275 (270–280)	434 (430–440)
E5	0.1	25	318 (130–625)	1,138 (280–3,025)	1,556 (310–3,775)
	15.25	25	312 (290–725)	1,321 (675–2,525)	1,980 (850–4,275)

TABLE 31—SEL-BASED RANGES (METERS) TO ONSET PTS, ONSET TTS, AND BEHAVIORAL REACTION FOR MID-FREQUENCY CETACEANS—Continued

Range to effects for explosives: mid-frequency cetacean [1]					
Bin	Source depth (m)	Cluster size	PTS	TTS	Behavioral
E6	0.1	1	98 (70–170)	428 (150–800)	615 (210–1,525)
	3	1	159 (150–160)	754 (650–850)	1,025 (1,025–1,025)
	15.25	1	88 (75–180)	526 (450–875)	719 (500–1,025)
E7	3	1	240 (230–260)	1,025 (1,025–1,025)	1,900 (1,775–2,275)
	18.25	1	166 (120–310)	853 (500–1,525)	1,154 (550–1,775)
E8	0.1	1	160 (150–170)	676 (500–725)	942 (600–1,025)
	45.75	1	128 (120–170)	704 (575–2,025)	1,040 (750–2,525)
E9	0.1	1	215 (200–220)	861 (575–950)	1,147 (650–1,525)
E10	0.1	1	275 (250–480)	1,015 (525–2,275)	1,424 (675–3,275)
E11	18.5	1	335 (260–500)	1,153 (650–1,775)	1,692 (775–3,275)
	45.75	1	272 (230–825)	1,179 (825–3,025)	1,784 (1,000–4,275)
E12	0.1	1	334 (310–350)	1,151 (700–1,275)	1,541 (800–3,525)
	0.1	3	520 (450–550)	1,664 (800–3,525)	2,195 (925–4,775)

[1] Average distance (m) to PTS, TTS, and behavioral thresholds are depicted above the minimum and maximum distances which are in parentheses. Values depict the range produced by SEL hearing threshold criteria levels.
E13 not modeled due to surf zone use and lack of marine mammal receptors at site-specific location.

Table 32 shows the minimum, average, and maximum ranges to onset of auditory and behavioral effects for low-frequency cetaceans based on the developed thresholds.

TABLE 32—SEL-BASED RANGES (METERS) TO ONSET PTS, ONSET TTS, AND BEHAVIORAL REACTION FOR LOW-FREQUENCY CETACEANS

Range to effects for explosives: low frequency cetacean [1]					
Bin	Source depth (m)	Cluster size	PTS	TTS	Behavioral
E1	0.1	1	51 (40–70)	227 (100–320)	124 (70–160)
		25	205 (95–270)	772 (270–1,275)	476 (190–725)
E2	0.1	1	65 (45–95)	287 (120–400)	159 (80–210)
		10	176 (85–240)	696 (240–1,275)	419 (160–625)
E3	0.1	1	109 (65–150)	503 (190–1,000)	284 (120–430)
		12	338 (130–525)	1,122 (320–7,775)	761 (240–6,025)
	18.25	1	205 (170–340)	996 (410–2,275)	539 (330–1,275)
		12	651 (340–1,275)	3,503 (600–8,275)	1,529 (470–3,275)
E4	3	2	493 (440–1,000)	2,611 (1,025–4,025)	1,865 (950–2,775)
	15.25	2	583 (350–850)	3,115 (1,275–5,775)	1,554 (1,000–2,775)
	19.8	2	378 (370–380)	1,568 (1,275–1,775)	926 (825–950)
	198	2	299 (290–300)	2,661 (1,275–3,775)	934 (900–950)
E5	0.1	25	740 (220–6,025)	2,731 (460–22,275)	1,414 (350–14,275)
	15.25	25	1,978 (1,025–5,275)	8,188 (3,025–19,775)	4,727 (1,775–11,525)
E6	0.1	1	250 (100–420)	963 (260–7,275)	617 (200–1,275)
	3	1	711 (525–825)	3,698 (1,525–4,275)	2,049 (1,025–2,525)
	15.25	1	718 (390–2,025)	3,248 (1,275–8,525)	1,806 (950–4,525)
E7	3	1	1,121 (850–1,275)	5,293 (2,025–6,025)	3,305 (1,275–4,025)
	18.25	1	1,889 (1,025–2,775)	6,157 (2,775–11,275)	4,103 (2,275–7,275)
E8	0.1	1	460 (170–950)	1,146 (380–7,025)	873 (280–3,025)
	45.75	1	1,049 (550–2,775)	4,100 (1,025–14,275)	2,333 (800–7,025)
E9	0.1	1	616 (200–1,275)	1,560 (450–12,025)	1,014 (330–5,025)
E10	0.1	1	787 (210–2,525)	2,608 (440–18,275)	1,330 (330–9,025)
E11	18.5	1	4,315 (2,025–8,025)	10,667 (4,775–26,775)	7,926 (3,275–21,025)
	45.75	1	1,969 (775–5,025)	9,221 (2,525–29,025)	4,594 (1,275–16,025)
E12	0.1	1	815 (250–3,025)	2,676 (775–18,025)	1,383 (410–8,525)
	0.1	3	1,040 (330–6,025)	4,657 (1,275–31,275)	2,377 (700–16,275)

[1] Average distance (m) to PTS, TTS, and behavioral thresholds are depicted above the minimum and maximum distances which are in parentheses. Values depict the range produced by SEL hearing threshold criteria levels.
E13 not modeled due to surf zone use and lack of marine mammal receptors at site-specific location.

Table 33 shows the minimum, average, and maximum ranges to onset of auditory and behavioral effects for phocids based on the developed thresholds.

TABLE 33—SEL-BASED RANGES (METERS) TO ONSET PTS, ONSET TTS, AND BEHAVIORAL REACTION FOR PHOCIDS

Range to effects for explosives: phocids[1]					
Bin	Source depth (m)	Cluster size	PTS	TTS	Behavioral
E1	0.1	1	45 (40–65)	210 (100–290)	312 (130–430)
		25	190 (95–260)	798 (280–1,275)	1,050 (360–2,275)
E2	0.1	1	58 (45–75)	258 (110–360)	383 (150–550)
		10	157 (85–240)	672 (240–1,275)	934 (310–1,525)
E3	0.1	1	96 (60–120)	419 (160–625)	607 (220–900)
		12	277 (120–390)	1,040 (370–2,025)	1,509 (525–6,275)
	18.25	1	118 (110–130)	621 (500–1,275)	948 (700–2,025)
		12	406 (330–875)	1,756 (1,025–4,775)	3,302 (1,025–6,275)
E4	3	2	405 (300–430)	1,761 (1,025–2,775)	2,179 (1,025–3,275)
	15.25	2	265 (220–430)	1,225 (975–1,775)	1,870 (1,025–3,275)
	19.8	2	220 (220–220)	991 (950–1,025)	1,417 (1,275–1,525)
	198	2	150 (150–150)	973 (925–1,025)	2,636 (2,025–3,525)
E5	0.1	25	569 (200–850)	2,104 (725–9,275)	2,895 (825–11,025)
	15.25	25	920 (825–1,525)	5,250 (2,025–10,275)	7,336 (2,275–16,025)
E6	0.1	1	182 (90–250)	767 (270–1,275)	1,011 (370–1,775)
	3	1	392 (340–440)	1,567 (1,275–1,775)	2,192 (2,025–2,275)
	15.25	1	288 (250–600)	1,302 (1,025–3,275)	2,169 (1,275–5,775)
E7	3	1	538 (450–625)	2,109 (1,775–2,275)	2,859 (2,775–3,275)
	18.25	1	530 (460–750)	2,617 (1,025–4,525)	3,692 (1,525–5,275)
E8	0.1	1	311 (290–330)	1,154 (625–1,275)	1,548 (725–2,275)
	45.75	1	488 (380–975)	2,273 (1,275–5,275)	3,181 (1,525–8,025)
E9	0.1	1	416 (350–470)	1,443 (675–2,025)	1,911 (800–3,525)
E10	0.1	1	507 (340–675)	1,734 (725–3,525)	2,412 (800–5,025)
E11	18.5	1	1,029 (775–1,275)	5,044 (2,025–8,775)	6,603 (2,525–14,525)
	45.75	1	881 (700–2,275)	3,726 (2,025–8,775)	5,082 (2,025–13,775)
E12	0.1	1	631 (450–750)	1,927 (800–4,025)	2,514 (925–5,525)
	0.1	3	971 (550–1,025)	2,668 (1,025–6,275)	3,541 (1,775–9,775)

[1] Average distance (m) to PTS, TTS, and behavioral thresholds are depicted above the minimum and maximum distances which are in parentheses. Values depict the range produced by SEL hearing threshold criteria levels.
E13 not modeled due to surf zone use and lack of marine mammal receptors at site-specific location.

Table 34 shows the minimum, average, and maximum ranges to onset of auditory and behavioral effects for ottariids based on the developed thresholds.

TABLE 34—SEL-BASED RANGES (METERS) TO ONSET PTS, ONSET TTS, AND BEHAVIORAL REACTION FOR OTARIIDS

Range to effects for explosives: otariids[1] range to effects for explosives: mid-frequency cetacean					
Bin	Source depth (m)	Cluster size	PTS	TTS	Behavioral
E1	0.1	1	7 (7–7)	34 (30–40)	56 (45–70)
		25	30 (25–35)	136 (80–180)	225 (100–320)
E2	0.1	1	9 (9–9)	41 (35–55)	70 (50–95)
		10	25 (25–30)	115 (70–150)	189 (95–250)
E3	0.1	1	16 (15–19)	70 (50–95)	115 (70–150)
		12	45 (35–65)	206 (100–290)	333 (130–450)
	18.25	1	15 (15–15)	95 (90–100)	168 (150–310)
		12	55 (50–60)	333 (280–750)	544 (440–1,025)
E4	3	2	64 (40–85)	325 (240–340)	466 (370–490)
	15.25	2	30 (30–35)	205 (170–300)	376 (310–575)
	19.8	2	25 (25–25)	170 (170–170)	290 (290–290)
	198	2	17 (0–25)	117 (110–120)	210 (210–210)
E5	0.1	25	98 (60–120)	418 (160–575)	626 (240–1,000)
	15.25	25	151 (140–260)	750 (650–1,025)	1,156 (975–2,025)
E6	0.1	1	30 (25–35)	134 (75–180)	220 (100–320)
	3	1	53 (50–55)	314 (280–390)	459 (420–525)
	15.25	1	36 (35–40)	219 (200–380)	387 (340–625)
E7	3	1	93 (90–100)	433 (380–500)	642 (550–800)
	18.25	1	73 (70–75)	437 (360–525)	697 (600–850)
E8	0.1	1	50 (50–50)	235 (220–250)	385 (330–450)
	45.75	1	55 (55–60)	412 (310–775)	701 (500–1,525)
E9	0.1	1	68 (65–70)	316 (280–360)	494 (390–625)
E10	0.1	1	86 (80–95)	385 (240–460)	582 (390–800)
E11	18.5	1	158 (150–200)	862 (750–975)	1,431 (1,025–2,025)
	45.75	1	117 (110–130)	756 (575–1,525)	1,287 (950–2,775)
E12	0.1	1	104 (100–110)	473 (370–575)	709 (480–1,025)

TABLE 34—SEL-BASED RANGES (METERS) TO ONSET PTS, ONSET TTS, AND BEHAVIORAL REACTION FOR OTARIIDS—Continued

Range to effects for explosives: otariids [1] range to effects for explosives: mid-frequency cetacean					
Bin	Source depth (m)	Cluster size	PTS	TTS	Behavioral
	0.1	3	172 (170–180)	694 (480–1,025)	924 (575–1,275)

[1] Average distance (m) to PTS, TTS, and behavioral thresholds are depicted above the minimum and maximum distances which are in parentheses. Values depict the range produced by SEL hearing threshold criteria levels.
E13 not modeled due to surf zone use and lack of marine mammal receptors at site-specific location.

Table 35 which show the minimum, average, and maximum ranges due to varying propagation conditions to non-auditory injury as a function of animal mass and explosive bin (*i.e.,* net explosive weight). These ranges represent the larger of the range to slight lung injury or gastrointestinal tract injury for representative animal masses ranging from 10 to 72,000 kg and different explosive bins ranging from 0.25 to 1,000 lb net explosive weight. Animals within these water volumes would be expected to receive minor injuries at the outer ranges, increasing to more substantial injuries, and finally mortality as an animal approaches the detonation point.

TABLE 35—RANGES [1] TO 50 PERCENT NON-AUDITORY INJURY RISK FOR ALL MARINE MAMMAL HEARING GROUPS AS A FUNCTION OF ANIMAL MASS

[10–72,000 kg]

Bin	Range (m) (min-max)
E1	12 (11–13)
E2	15 (15–20)
E3	25 (25–30)
E4	32 (0–75)
E5	40 (35–140)
E6	52 (40–120)
E7	145 (100–500)
E8	117 (75–400)
E9	120 (90–290)
E10	174 (100–480)
E11	443 (350–1,775)
E12	232 (110–775)

Note:
[1] Average distance (m) to mortality is depicted above the minimum and maximum distances which are in parentheses.
E13 not modeled due to surf zone use and lack of marine mammal receptors at site-specific location. Differences between bins E11 and E12 due to different ordnance types and differences in model parameters.

Ranges to mortality, based on animal mass, are show in Table 36 below.

TABLE 36—RANGES [1] TO 50 PERCENT MORTALITY RISK FOR ALL MARINE MAMMAL HEARING GROUPS AS A FUNCTION OF ANIMAL MASS

Bin	Animal mass intervals (kg) [1]					
	10	250	1,000	5,000	25,000	72,000
E1	3 (2–3)	0 (0–3)	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)
E2	4 (3–5)	1 (0–4)	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)
E3	8 (6–10)	4 (2–8)	1 (0–2)	0 (0–0)	0 (0–0)	0 (0–0)
E4	15 (0–35)	9 (0–30)	4 (0–8)	2 (0–6)	0 (0–3)	0 (0–2)
E5	13 (11–45)	7 (4–35)	3 (3–12)	2 (0–8)	0 (0–2)	0 (0–2)
E6	18 (14–55)	10 (5–45)	5 (3–15)	3 (2–10)	0 (0–3)	0 (0–2)
E7	67 (55–180)	35 (18–140)	16 (12–30)	10 (8–20)	5 (4–9)	4 (3–7)
E8	50 (24–110)	27 (9–55)	13 (0–20)	9 (4–13)	4 (0–6)	3 (0–5)
E9	32 (30–35)	20 (13–30)	10 (8–12)	7 (6–9)	4 (3–4)	3 (2–3)
E10	56 (40–190)	25 (16–130)	13 (11–16)	9 (7–11)	5 (4–5)	4 (3–4)
E11	211 (180–500)	109 (60–330)	47 (40–100)	30 (25–65)	15 (0–25)	13 (11–22)
E12	94 (50–300)	35 (20–230)	16 (13–19)	11 (9–13)	6 (5–8)	5 (4–8)

Note:
[1] Average distance (m) to mortality is depicted above the minimum and maximum distances which are in parentheses.
E13 not modeled due to surf zone use and lack of marine mammal receptors at site-specific location.
Differences between bins E11 and E12 due to different ordnance types and differences in model parameters (see Table 6–42 for details).

Air Guns

Table 37 and Table 38 present the approximate ranges in meters to PTS, TTS, and potential behavioral reactions for air guns for 1 and 10 pulses, respectively. Ranges are specific to the HSTT Study Area and also to each marine mammal hearing group, dependent upon their criteria and the specific locations where animals from the hearing groups and the air gun activities could overlap. Small air guns (12–60 in^3) would be used during testing activities in the offshore areas of the Southern California Range Complex and in the Hawaii Range Complex. Generated impulses would have short durations, typically a few hundred milliseconds, with dominant frequencies below 1 kHz. The SPL and SPL peak (at a distance 1 m from the air gun) would be approximately 215 dB re 1 µPa and 227 dB re 1 µPa, respectively, if operated at the full capacity of 60 in^3. The size of the air gun chamber can be adjusted, which would result in lower SPLs and SEL per shot. Single, small air guns lack the peak pressures that could cause non-auditory injury (see Finneran *et al.,* (2015)); therefore, potential impacts could include PTS, TTS, and behavioral reactions.

TABLE 37—RANGE TO EFFECTS (METERS) FROM AIR GUNS FOR 1 PULSE

Range to effects for air guns[1] for 1 pulse (m)					
Hearing group	PTS (SEL)	PTS (peak SPL)	TTS (SEL)	TTS (peak SPL)	Behavioral[2]
High-Frequency Cetacean	0 (0–0)	18 (15–25)	1 (0–2)	33 (25–80)	702 (290–1,525)
Low-Frequency Cetacean	3 (3–4)	2 (2–3)	27 (23–35)	5 (4–7)	651 (200–1,525)
Mid-Frequency Cetacean	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)	689 (290–1,525)
Otariidae	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)	590 (290–1,525)
Phocids	0 (0–0)	2 (2–3)	0 (0–0)	5 (4–8)	668 (290–1,525)

[1] Average distance (m) to PTS, TTS, and behavioral thresholds are depicted above the minimum and maximum distances which are in parentheses. PTS and TTS values depict the range produced by SEL and Peak SPL (as noted) hearing threshold criteria levels.
[2] Behavioral values depict the ranges produced by RMS hearing threshold criteria levels.

TABLE 38—RANGE TO EFFECTS (METERS) FROM AIR GUNS FOR 10 PULSES

Range to effects for air guns[1] for 10 pulses (m)					
Hearing group	PTS (SEL)	PTS (Peak SPL)	TTS (SEL)	TTS (Peak SPL)	Behavioral[2]
High-Frequency Cetacean	0 (0–0)	18 (15–25)	3 (0–9)	33 (25–80)	702 (290–1,525)
Low-Frequency Cetacean	15 (12–20)	2 (2–3)	86 (70–140)	5 (4–7)	651 (200–1,525)
Mid-Frequency Cetacean	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)	689 (290–1,525)
Otariidae	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)	590 (290–1,525)
Phocids	0 (0–0)	2 (2–3)	4 (3–5)	5 (4–8)	668 (290–1,525)

[1] Average distance (m) to PTS, TTS, and behavioral thresholds are depicted above the minimum and maximum distances which are in parentheses. PTS and TTS values depict the range produced by SEL and Peak SPL (as noted) hearing threshold criteria levels.
[2] Behavioral values depict the ranges produced by RMS hearing threshold criteria levels.

Pile Driving

Table 39 and Table 40 present the approximate ranges in meters to PTS, TTS, and potential behavioral reactions for impact pile driving and vibratory pile removal, respectively. Non-auditory injury is not predicted for pile driving activities.

TABLE 39—AVERAGE RANGES TO EFFECTS (METERS) FROM IMPACT PILE DRIVING

Hearing group	PTS (m)	TTS (m)	Behavioral (m)
Low-frequency Cetaceans	65	529	870
Mid-frequency Cetaceans	2	16	870
High-frequency Cetaceans	65	529	870
Phocids	19	151	870
Otariids	2	12	870

Note: PTS: Permanent threshold shift; TTS: Temporary threshold shift.

TABLE 40—AVERAGE RANGES TO EFFECT (METERS) FROM VIBRATORY PILE EXTRACTION

Hearing group	PTS (m)	TTS (m)	Behavioral (m)
Low-frequency Cetaceans	0	3	376
Mid-frequency Cetaceans	0	4	376
High-frequency Cetaceans	7	116	376
Phocids	0	2	376
Otariids	0	0	376

Note: PTS: Permanent threshold shift; TTS: Temporary threshold shift.

Serious Injury or Mortality From Ship Strikes

There have been two recorded Navy vessel strikes of marine mammals (two fin whales off San Diego, CA in 2009) in the HSTT Study Area from 2009 through 2017 (nine years), the period in which Navy began implementing effective mitigation measures to reduce the likelihood of vessel strikes. From unpublished NMFS data, the most commonly struck whales in Hawaii are humpback whales, and the most commonly struck whales in California are gray whales, fin whales, and humpback whales. The majority of these strikes are from non-Navy commercial shipping. For both areas (Hawaii and California), the higher strike rates to these species is largely attributed to higher species abundance in these areas. Prior to 2009, the Navy had struck multiple species of whales off California or Hawaii, but also individuals that were not identified to species. Further, because the overall number of Navy strikes is small, it is appropriate to consider the larger record of known ship strikes (by other types of vessels) in predicting what species may potentially be involved in a Navy ship strike. Based on this information, and as described in more detail in Navy's rulemaking/LOA application and below, the Navy proposes, and NMFS preliminary agrees, to three ship strike takes to select large whale species and stocks over the five years of the authorization, with no more than two takes to several specific stocks with a higher likelihood of being struck and no more than one take of other specific stocks with a lesser likelihood of being struck (described in detail below in the Vessel Strike section).

Marine Mammal Density

A quantitative analysis of impacts on a species requires data on their abundance and distribution that may be affected by anthropogenic activities in the potentially impacted area. The most appropriate metric for this type of analysis is density, which is the number of animals present per unit area. Marine species density estimation requires a significant amount of effort to both collect and analyze data to produce a reasonable estimate. Unlike surveys for terrestrial wildlife, many marine species spend much of their time submerged, and are not easily observed. In order to collect enough sighting data to make reasonable density estimates, multiple observations are required, often in areas that are not easily accessible (*e.g.,* far offshore). Ideally, marine mammal species sighting data would be collected for the specific area and time period (*e.g.,* season) of interest and density estimates derived accordingly. However, in many places, poor weather conditions and high sea states prohibit the completion of comprehensive visual surveys.

For most cetacean species, abundance within U.S. waters is estimated using line-transect surveys or mark-recapture studies (*e.g.,* Barlow, 2010, Barlow and Forney, 2007, Calambokidis *et al.,* 2008). The result provides one single density estimate value for each species across a broad geographic area. This is the general approach applied in estimating cetacean abundance in the NMFS SARS. Although the single value provides a good average estimate of abundance (total number of individuals) for a specified area, it does not provide information on the species distribution or concentrations within that area, and it does not estimate density for other timeframes, areas, or seasons that were not surveyed. More recently, habitat modeling has been used to estimate cetacean densities (*e.g.,* Barlow *et al.,* 2009; Becker *et al.,* 2010; 2012a; 2014; Becker *et al.,* 2016; Ferguson *et al.,* 2006; Forney *et al.,* 2012; 2015; Redfern *et al.,* 2006). These models estimate cetacean density as a continuous function of habitat variables (*e.g.,* sea surface temperature, seafloor depth, etc.) and thus allow predictions of cetacean densities on finer spatial scales than traditional line-transect or mark recapture analyses and for areas that have not been surveyed. Within the geographic area that was modeled, densities can be predicted wherever these habitat variables can be measured or estimated.

To characterize the marine species density for large areas such as the Study Area, the Navy compiled data from several sources. The Navy developed a protocol to select the best available data sources based on species, area, and time (season). The resulting Geographic Information System database called the Navy Marine Species Density Database includes seasonal density values for every marine mammal species present within the HSTT Study Area. This database is described in the technical report titled *U.S. Navy Marine Species Density Database Phase III for the Hawaii-Southern California Training and Testing Study Area* (U.S. Department of the Navy, 2017e), hereafter referred to as the Density Technical Report.

A variety of density data and density models are needed in order to develop a density database that encompasses the entirety of the HSTT Study Area. Because this data is collected using different methods with varying amounts of accuracy and uncertainty, the Navy has developed a model hierarchy to ensure the most accurate data is used when available. The Density Technical Report describes these models in detail and provides detailed explanations of the models applied to each species density estimate. The below list describes models in order of preference.

1. Spatial density models are preferred and used when available because they provide an estimate with the least amount of uncertainty by deriving estimates for divided segments of the sampling area. These models (see Becker *et al.,* 2016; Forney *et al.,* 2015) predict spatial variability of animal presence as a function of habitat variables (*e.g.,* sea surface temperature, seafloor depth, etc.). This model is developed for areas, species, and, when available, specific timeframes (months or seasons) with sufficient survey data.

2. Stratified designed-based density estimates use line-transect survey data with the sampling area divided (stratified) into sub-regions, and a density is predicted for each sub-region (see Barlow, 2016; Becker *et al.,* 2016; Bradford *et al.,* 2017; Campbell *et al.,* 2014; Jefferson *et al.,* 2014). While geographically stratified density estimates provide a better indication of a species' distribution within the study area, the uncertainty is typically high because each sub-region estimate is based on a smaller stratified segment of the overall survey effort.

3. Design-based density estimations use line-transect survey data from land and aerial surveys designed to cover a specific geographic area (see Carretta *et al.,* 2015). These estimates use the same survey data as stratified design-based estimates, but are not segmented into sub-regions and instead provide one estimate for a large surveyed area.

Although relative environmental suitability (RES) models provide estimates for areas of the oceans that have not been surveyed using information on species occurrence and inferred habitat associations and have been used in past density databases, these models were not used in the current quantitative analysis. In the HSTT analysis, due to the availability of other density methods along the hierarchy the use of RES model was not necessary.

When interpreting the results of the quantitative analysis, as described in the Density Technical Report, ''it is important to consider that even the best estimate of marine species density is really a model representation of the values of concentration where these animals might occur. Each model is limited to the variables and assumptions considered by the original data source provider. No mathematical model representation of any biological population is perfect, and with regards to marine mammal biodiversity, any single model method will not completely explain the actual distribution and abundance of marine mammal species. It is expected that there would be anomalies in the results that need to be evaluated, with independent information for each case, to support if we might accept or reject a model or portions of the model (U.S. Department of the Navy, 2017a).''

The Navy's estimate of abundance (based on the density estimates used) in the HSTT Study Area may differ from population abundances estimated in the NMFS's SARS for a variety of reasons.

Mainly because the Pacific SAR overlaps only 35 percent of the Hawaii part of HSTT and only about 14 percent of SOCAL. The Alaska SAR covering humpbacks present in Hawaii is another complicating factor. For some species, the stock assessment for a given species may exceed the Navy's density prediction because those species' home range extends beyond the Study Area boundaries. For other species, the stock assessment abundance may be much less than the number of animals in the Navy's modeling given the HSTT Study Area extends well beyond the U.S waters covered by the SAR abundance estimate. The primary source of density estimates are geographically specific survey data and either peer-reviewed line-transect estimates or habitat-based density models that have been extensively validated to provide the most accurate estimates possible.

These factors and others described in the Density Technical Report should be considered when examining the estimated impact numbers in comparison to current population abundance information for any given species or stock. For a detailed description of the density and assumptions made for each species, see the Density Technical Report.

NMFS coordinated with the Navy in the development of its take estimates and concurs that the Navy's proposed approach for density appropriately utilizes the best available science. Later, in the Negligible Impact Determination Section, we assess how the estimated take numbers compare to stock abundance in order to better understand the potential number of individuals impacted—and the rationale for which abundance estimate is used is included there.

Take Requests

The HSTT DEIS/OEIS considered all training and testing activities proposed to occur in the HSTT Study Area that have the potential to result in the MMPA defined take of marine mammals. The Navy determined that the following three stressors could result in the incidental taking of marine mammals. NMFS has reviewed the Navy's data and analysis and determined that it is complete and accurate and agrees that the following stressors have the potential to result in takes of marine mammals from the Specified Activities.

- Acoustics (sonar and other transducers; air guns; pile driving/extraction).
- Explosives (explosive shock wave and sound (assumed to encompass the risk due to fragmentation).
- Physical Disturbance and Strike (vessel strike).

Acoustic and explosive sources have the potential to result in incidental takes of marine mammals by harassment, injury, or mortality. Vessel strikes have the potential to result in incidental take from injury, serious injury and/or mortality.

The quantitative analysis process used for the HSTT DEIS/OEIS and the Navy's request in the rulemaking/LOA application to estimate potential exposures to marine mammals resulting from acoustic and explosive stressors is detailed in the technical report titled *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing report* (U.S. Department of the Navy, 2017b). The Navy Acoustic Effects Model estimates acoustic and explosive effects without taking mitigation into account; therefore, the model overestimates predicted impacts on marine mammals within mitigation zones. To account for mitigation for marine species in the take estimates, the Navy conducts a quantitative assessment of mitigation. The Navy conservatively quantifies the manner in which mitigation is expected to reduce model-estimated PTS to TTS for exposures to sonar and other transducers, and reduce model-estimated mortality to injury for exposures to explosives. The Navy assessed the effectiveness of its mitigation measures on a per-scenario basis for four factors: (1) Species sightability, (2) a Lookout's ability to observe the range to PTS (for sonar and other transducers) and range to mortality (for explosives), (3) the portion of time when mitigation could potentially be conducted during periods of reduced daytime visibility (to include inclement weather and high sea-state) and the portion of time when mitigation could potentially be conducted at night, and (4) the ability for sound sources to be positively controlled (*e.g.,* powered down).

During the conduct of training and testing activities, there is typically at least one, if not numerous, support personnel involved in the activity (*e.g.,* range support personnel aboard a torpedo retrieval boat or support aircraft). In addition to the Lookout posted for the purpose of mitigation, these additional personnel observe for and disseminate marine species sighting information amongst the units participating in the activity whenever possible as they conduct their primary mission responsibilities. However, as a conservative approach to assigning mitigation effectiveness factors, the Navy elected to only account for the minimum number of required Lookouts used for each activity; therefore, the mitigation effectiveness factors may underestimate the likelihood that some marine mammals may be detected during activities that are supported by additional personnel who may also be observing the mitigation zone.

The Navy used the equations in the below sections to calculate the reduction in model-estimated mortality impacts due to implementing mitigation.

Equation 1:

Mitigation Effectiveness = Species Sightability × Visibility × Observation Area × Positive Control

Whereas, Species Sightability is the ability to detect marine mammals is dependent on the animal's presence at the surface and the characteristics of the animal that influence its sightability. The Navy considered applicable data from the best available science to numerically approximate the sightability of marine mammals and determined that the standard ''detection probability'' referred to as g(0). Also, Visibility = 1 − sum of individual visibility reduction factors; Observation Area = portion of impact range that can be continuously observed during an event; and Positive Control = positive control factor of all sound sources involving mitigation. For further details on these mitigation effectiveness factors please refer to the technical report titled *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing report* (U.S. Department of the Navy, 2017b).

To quantify the number of marine mammals predicted to be sighted by Lookouts during implementation of mitigation in the range to injury (PTS) for sonar and other transducers, the species sightability is multiplied by the mitigation effectiveness scores and number of model-estimated PTS impacts, as shown in the equation below:

Equation 2:

Number of Animals Sighted by Lookouts = Mitigation Effectiveness × Model-Estimated Impacts

The marine mammals sighted by Lookouts during implementation of mitigation in the range to PTS, as calculated by the equation above, would avoid being exposed to these higher level impacts. The Navy corrects the category of predicted impact for the number of animals sighted within the mitigation zone (*e.g.,* shifts PTS to TTS), but does not modify the total number of animals predicted to experience impacts from the scenario.

To quantify the number of marine mammals predicted to be sighted by Lookouts during implementation of mitigation in the range to mortality during events using explosives, the species sightability is multiplied by the mitigation effectiveness scores and number of model-estimated mortality impacts, as shown in equation 1 above. The marine mammals and sea turtles predicted to be sighted by Lookouts during implementation of mitigation in the range to mortality, as calculated by the above equation 2, are predicted to avoid exposure in these ranges. The Navy corrects the category of predicted impact for the number of animals sighted within the mitigation zone, but does not modify the total number of animals predicted to experience impacts from the scenario. For example, the number of animals sighted (*i.e.,* number of animals that will avoid mortality) is first subtracted from the model-predicted mortality impacts, and then added to the model-predicted injurious impacts.

NMFS coordinated with the Navy in the development of this quantitative method to address the effects of mitigation on acoustic exposures and explosive takes, and NMFS concurs with the Navy that it is appropriate to incorporate into the take estimates based on the best available science. For additional information on the quantitative analysis process and mitigation measures, refer to the technical report titled *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing report* (U.S. Department of the Navy, 2017b) and Section 6 (Take Estimates for Marine Mammals) and Section 11 (Mitigation Measures) of the Navy's rulemaking/LOA application.

Summary of Proposed Authorized Take From Training and Testing Activities

Based on the methods outlined in the previous sections and the Navy's model and the quantitative assessment of mitigation, the Navy summarizes the take request for acoustic and explosive sources for training and testing activities both annually (based on the maximum number of activities per 12-month period) and over a 5-year period. NMFS has reviewed the Navy's data and analysis and preliminary determined that it is complete and accurate and that the takes by harassment proposed for authorization are reasonably expected to occur and that the takes by mortality could occur as in the case of vessel strikes. Five-year total impacts may be less than the sum total of each year because although the annual estimates are based on the maximum estimated takes, five-year estimates are based on the sum of two maximum years and three nominal years.

Nonlethal Take Reasonably Expected To Occur From Training Activities

Table 41 summarizes the Navy's take request and the amount and type of take that is reasonably likely to occur (Level A and Level B harassment) by species associated with all training activities. Note that Level B harassment take includes both behavioral disruption and TTS. Figures 6–12 through 6–50 in Section 6 of the Navy's rulemaking/LOA application illustrate the comparative amounts of TTS and behavioral disruption (at the level of a take) for each species, noting that if a ''taken'' animat was exposed to both TTS and behavioral disruption in the model, it was recorded as a TTS.

TABLE 41—SPECIES-SPECIFIC PROPOSED TAKE AUTHORIZATION FOR ACOUSTIC AND EXPLOSIVE EFFECTS FOR ALL TRAINING ACTIVITIES IN THE HSTT STUDY AREA

Species	Stock	Annual		5-Year total **	
		Level B	Level A	Level B	Level A
Suborder Mysticeti (baleen whales)					
Family Balaenopteridae (rorquals)					
Blue whale *	Central North Pacific	34	0	139	0
	Eastern North Pacific	1,155	1	5,036	3
Bryde's whale †	Eastern Tropical Pacific	27	0	118	0
	Hawaiian †	105	0	429	0
Fin whale *	California, Oregon, and Washington	1,245	0	5,482	0
	Hawaiian	33	0	133	0
Humpback whale †	California, Oregon, and Washington †.	1,254	1	5,645	3
	Central North Pacific	5,604	1	23,654	5
Minke whale	California, Oregon, and Washington	649	1	2,920	4
	Hawaiian	3,463	1	13,664	2
Sei whale *	Eastern North Pacific	53	0	236	0
	Hawaiian	118	0	453	0
Family Eschrichtiidae					
Gray whale †	Eastern North Pacific	2,751	5	11,860	19
	Western North Pacific †	4	0	14	0
Suborder Odontoceti (toothed whales)					
Family Physeteridae (sperm whale)					
Sperm whale *	California, Oregon, and Washington	1,397	0	6,257	0
	Hawaiian	1,714	0	7,078	0
Family Kogiidae (sperm whales)					
Dwarf sperm whale	Hawaiian	13,961	35	57,571	148

TABLE 41—SPECIES-SPECIFIC PROPOSED TAKE AUTHORIZATION FOR ACOUSTIC AND EXPLOSIVE EFFECTS FOR ALL TRAINING ACTIVITIES IN THE HSTT STUDY AREA—Continued

Species	Stock	Annual		5-Year total **	
		Level B	Level A	Level B	Level A
Pygmy sperm whale	Hawaiian	5,556	16	22,833	64
Kogia whales	California, Oregon, and Washington	6,012	23	27,366	105
Family Ziphiidae (beaked whales)					
Baird's beaked whale	California, Oregon, and Washington	1,317	0	6,044	0
Blainville's beaked whale	Hawaiian	3,687	0	16,364	0
Cuvier's beaked whale	California, Oregon, and Washington	6,965	0	32,185	0
	Hawaiian	1,235	0	5,497	0
Longman's beaked whale	Hawaiian	13,010	0	57,172	0
Mesoplodon spp	California, Oregon, and Washington	3,750	0	17,329	0
Family Delphinidae (dolphins)					
Bottlenose dolphin	California Coastal	214	0	876	0
	California, Oregon, and Washington Offshore.	31,986	2	142,966	9
	Hawaiian Pelagic	2,086	0	9,055	0
	Kauai & Niihau	74	0	356	0
	Oahu	8,186	1	40,918	5
	4-Island	152	0	750	0
	Hawaii	42	0	207	0
False killer whale †	Hawaii Pelagic	701	0	3,005	0
	Main Hawaiian Islands Insular†	405	0	1,915	0
	Northwestern Hawaiian Islands	256	0	1,094	0
Fraser's dolphin	Hawaiian	28,409	1	122,784	3
Killer whale	Eastern North Pacific Offshore	73	0	326	0
	Eastern North Pacific Transient/ West Coast Transient.	135	0	606	0
	Hawaiian	84	0	352	0
Long-beaked common dolphin	California	128,994	14	559,540	69
Melon-headed whale	Hawaiian Islands	2,335	0	9,705	0
	Kohala Resident	182	0	913	0
Northern right whale dolphin	California, Oregon, and Washington	56,820	8	253,068	40
Pacific white-sided dolphin	California, Oregon, and Washington	43,914	3	194,882	12
Pantropical spotted dolphin	Hawaii Island	2,585	0	12,603	0
	Hawaii Pelagic	6,809	0	29,207	0
	Oahu	4,127	0	20,610	0
	4-Island	260	0	1,295	0
Pygmy killer whale	Hawaiian	5,816	0	24,428	0
	Tropical	471	0	2,105	0
Risso's dolphin	California, Oregon, and Washington	76,276	6	338,560	30
	Hawaiian	6,590	0	28,143	0
Rough-toothed dolphin	Hawaiian	4,292	0	18,506	0
	NSD [1]	0	0	0	0
Short-beaked common dolphin	California, Oregon, and Washington	932,453	46	4,161,283	222
Short-finned pilot whale	California, Oregon, and Washington	990	1	4,492	5
	Hawaiian	8,594	0	37,077	0
Spinner dolphin	Hawaii Island	89	0	433	0
	Hawaii Pelagic	3,138	0	12,826	0
	Kauai & Niihau	310	0	1,387	0
	Oahu & 4-Island	1,493	1	7,445	5
Striped dolphin	California, Oregon, and Washington	119,219	1	550,936	3
	Hawaiian	5,388	0	22,526	0
Family Phocoenidae (porpoises)					
Dall's porpoise	California, Oregon, and Washington	27,282	137	121,236	634
Suborder Pinnipedia					
Family Otariidae (eared seals)					
California sea lion	U.S	69,543	91	327,136	455
Guadalupe fur seal *	Mexico	518	0	2,386	0
Northern fur seal	California	9,786	0	44,017	0
Family Phocidae (true seals)					
Harbor seal	California	3,119	7	13,636	34

TABLE 41—SPECIES-SPECIFIC PROPOSED TAKE AUTHORIZATION FOR ACOUSTIC AND EXPLOSIVE EFFECTS FOR ALL TRAINING ACTIVITIES IN THE HSTT STUDY AREA—Continued

Species	Stock	Annual		5-Year total **	
		Level B	Level A	Level B	Level A
Hawaiian monk seal *	Hawaiian	139	1	662	3
Northern elephant seal	California	38,169	72	170,926	349

* ESA-listed species (all stocks) within the HSTT Study Area.
** 5-year total impacts may be less than sum total of each year. Not all activities occur every year; some activities occur multiple times within a year; and some activities only occur a few times over course of a 5-year period.
† Only designated stocks are ESA-listed.
[1] NSD: No stock designation.

Nonlethal Take Reasonably Expected To Occur From Testing Activities

Table 42 summarizes the Navy's take request and the amount and type of take that is reasonably likely to occur (Level A and Level B harassment) by species associated with all testing activities. Note that Level B harassment take includes both behavioral disruption and TTS. Figures 6–12 through 6–50 in Section 6 of the Navy's rulemaking/LOA application illustrate the comparative amounts of TTS and behavioral disruption (at the level of a take) for each species, noting that if a ''taken'' animat was exposed to both TTS and behavioral disruption in the model, it was recorded as a TTS.

TABLE 42—SPECIES-SPECIFIC PROPOSED TAKE AUTHORIZATION FOR ACOUSTIC AND EXPLOSIVE SOUND SOURCE EFFECTS FOR ALL TESTING ACTIVITIES IN THE HSTT STUDY AREA

Species	Stock	Annual		5-Year total **	
		Level B	Level A	Level B	Level A
Suborder Mysticeti (baleen whales)					
Family Balaenopteridae (rorquals)					
Blue whale *	Central North Pacific	14	0	65	0
	Eastern North Pacific	833	0	4,005	0
Bryde's whale †	Eastern Tropical Pacific	14	0	69	0
	Hawaiian †	41	0	194	0
Fin whale *	California, Oregon, and Washington	980	1	4,695	3
	Hawaiian	15	0	74	0
Humpback whale †	California, Oregon, and Washington †.	740	0	3,508	0
	Central North Pacific	3,522	2	16,777	10
Minke whale	California, Oregon, and Washington	276	0	1,309	0
	Hawaiian	1,467	1	6,918	4
Sei whale *	Eastern North Pacific	26	0	124	0
	Hawaiian	49	0	229	0
Family Eschrichtiidae					
Gray whale †	Eastern North Pacific	1,920	2	9,277	7
	Western North Pacific †	2	0	11	0
Suborder Odontoceti (toothed whales)					
Family Physeteridae (sperm whale)					
Sperm whale *	California, Oregon, and Washington	1,096	0	5,259	0
	Hawaiian	782	0	3,731	0
Family Kogiidae (sperm whales)					
Dwarf sperm whale	Hawaiian	6,459	29	30,607	140
Pygmy sperm whale	Hawaiian	2,595	13	12,270	60
Kogia whales	California, Oregon, and Washington	3,120	15	14,643	67
Family Ziphiidae (beaked whales)					
Baird's beaked whale	California, Oregon, and Washington	727	0	3,418	0
Blainville's beaked whale	Hawaiian	1,698	0	8,117	0
Cuvier's beaked whale	California, Oregon, and Washington	4,461	0	20,919	0
	Hawaiian	561	0	2,675	0
Longman's beaked whale	Hawaiian	6,223	0	29,746	0
Mesoplodon spp	California, Oregon, and Washington	2,402	0	11,262	0

TABLE 42—SPECIES-SPECIFIC PROPOSED TAKE AUTHORIZATION FOR ACOUSTIC AND EXPLOSIVE SOUND SOURCE EFFECTS FOR ALL TESTING ACTIVITIES IN THE HSTT STUDY AREA—Continued

Species	Stock	Annual		5-Year total **	
		Level B	Level A	Level B	Level A
Family Delphinidae (dolphins)					
Bottlenose dolphin	California Coastal	1,595	0	7,968	0
	California, Oregon, and Washington Offshore.	23,436	1	112,410	4
	Hawaiian Pelagic	1,242	0	6,013	0
	Kauai & Niihau	491	0	2,161	0
	Oahu	475	0	2,294	0
	4-Island	207	0	778	0
	Hawaii	38	0	186	0
False killer whale †	Hawaii Pelagic	340	0	1,622	0
	Main Hawaiian Islands Insular †	184	0	892	0
	Northwestern Hawaiian Islands	125	0	594	0
Fraser's dolphin	Hawaiian	12,664	1	60,345	5
Killer whale	Eastern North Pacific Offshore	34	0	166	0
	Eastern North Pacific Transient/ West Coast Transient.	64	0	309	0
	Hawaiian	40	0	198	0
Long-beaked common dolphin	California	118,278	6	568,020	24
Melon-headed whale	Hawaiian Islands	1,157	0	5,423	0
	Kohala Resident	168	0	795	0
Northern right whale dolphin	California, Oregon, and Washington	41,279	3	198,917	15
Pacific white-sided dolphin	California, Oregon, and Washington	31,424	2	151,000	8
Pantropical spotted dolphin	Hawaii Island	1,409	0	6,791	0
	Hawaii Pelagic	3,640	0	17,615	0
	Oahu	202	0	957	0
	4-Island	458	0	1,734	0
Pygmy killer whale	Hawaiian	2,708	0	13,008	0
	Tropical	289	0	1,351	0
Risso's dolphin	California, Oregon, and Washington	49,985	3	240,646	15
	Hawaiian	2,808	0	13,495	0
Rough-toothed dolphin	Hawaiian	2,193	0	10,532	0
	NSD [1]	0	0	0	0
Short-beaked common dolphin	California, Oregon, and Washington	560,120	45	2,673,431	222
Short-finned pilot whale	California, Oregon, and Washington	923	0	4,440	0
	Hawaiian	4,338	0	20,757	0
Spinner dolphin	Hawaii Island	202	0	993	0
	Hawaii Pelagic	1,396	0	6,770	0
	Kauai & Niihau	1,436	0	6,530	0
	Oahu & 4-Island	331	0	1,389	0
Striped dolphin	California, Oregon, and Washington	56,035	2	262,973	10
	Hawaiian	2,396	0	11,546	0
Family Phocoenidae (porpoises)					
Dall's porpoise	California, Oregon, and Washington	17,091	72	81,611	338
Suborder Pinnipedia					
Family Otariidae (eared seals)					
California sea lion	U.S.	48,665	6	237,870	23
Guadalupe fur seal *	Mexico	939	0	4,357	0
Northern fur seal	California	5,505	1	26,168	4
Family Phocidae (true seals)					
Harbor seal	California	2,325	1	11,258	5
Hawaiian monk seal *	Hawaiian	66	0	254	0
Northern elephant seal	California	22,702	27	107,343	131

* ESA-listed species (all stocks) within the HSTT Study Area.

** 5-year total impacts may be less than sum total of each year. Not all activities occur every year; some activities occur multiple times within a year; and some activities only occur a few times over course of a 5-year period.

† Only designated stocks are ESA-listed.

[1] NSD: No stock designation.

Take From Vessel Strikes and Explosives by Serious Injury or Mortality

Vessel Strike

A detailed analysis for vessel strike is contained in Chapters 5 and 6 the Navy's rulemaking/LOA application. Vessel strike to marine mammals is not associated with any specific training or testing activity but rather is a limited, sporadic, and incidental result of Navy vessel movement within the HSTT Study Area. To support the prediction of strikes that could occur in the five years covered by the rule, the Navy calculated probabilities derived from a Poisson distribution using ship strike data between 2009–2016 in the HSTT Study Area, as well as historical at-sea days in HSTT from 2009–2016 and estimated potential at-sea days for the period from 2019 to 2023 to determine the probabilities of a specific number of strikes (n=0, 1, 2, etc.) over the period from 2019 to 2023. The Navy struck two whales in 2009 (both fin whales) in the HSTT Study Area, and there have been no strikes since that time from activities in the HSTT study area that would be covered by these regulations. The Navy used those two fin whale strikes in their calculations and evaluated data beginning in 2009 as that was the start of the Navy's Marine Species Awareness Training and adoption of additional mitigation measures to address ship strike. However, there have been no incidents of vessel strikes between June 2009 and April 2018 from HSTT Study Area activities. Based on the resulting probabilities presented in the Navy's analysis, there is a 10 percent chance of three strikes over the period from 2019 to 2023. Therefore, the Navy estimates, and NMFS agrees, that there is some probability that it could strike, and take by serious injury or mortality, up to three large whales incidental to training and testing activities within the HSTT Study Area over the course of the five years.

The Navy then refined its take request based on the species/stocks most likely to be present in the HSTT Study Area based on documented abundance and where overlap is between a species' common occurrence and core Navy training and testing areas within the HSTT Study Area. To determine which species may be struck, a weight of evidence approach was used to qualitatively rank range complex specific species using historic and current stranding data from NMFS, relative abundance as derived by NMFS for the HSTT Phase II Biological Opinion, and the Navy funded monitoring within each range complex. Results of this approach are presented in Table 5–4 of the Navy's rulemaking/LOA application.

The Navy anticipates, and NMFS preliminarily concurs, based on the Navy's ship strike analysis presented in the Navy's rulemaking/LOA application, that three vessel strikes could occur over the course of five years, and that no more than two would involve (and therefore the Navy is requesting no more than two lethal takes from) the following species and stocks:

- Gray whale (Eastern North Pacific stock);
- Fin whale (California, Oregon, Washington stock);
- Humpback whale (California, Oregon, California stock or Mexico DPS);
- Humpback whale (Central Pacific stock or Hawaii DPS); and
- Sperm whale (Hawaiian stock).

Of the possibility for three vessel strikes over the five years, no more than one would involve the species below; therefore, the Navy is requesting no more than one lethal take from) the following species and stocks:

- Blue whale (Eastern North Pacific stock);
- Bryde's whale (Eastern Tropical Pacific stock);
- Bryde's whale (Hawaiian stock);
- Humpback whale (California, Oregon, California stock or Central America DPS);
- Minke whale (California, Oregon, Washington stock);
- Minke whale (Hawaiian stock);
- Sperm whale (California, Oregon, Washington stock);
- Sei whale (Hawaiian stock); and
- Sei whale (Eastern North Pacific stock).

Vessel strikes to the stocks below are very unlikely to occur due to their relatively low occurrence in the Study Area, particularly in core HSTT training and testing subareas, and therefore the Navy is not requesting lethal take authorization for the following species and stocks:

- Blue whale (Central North Pacific stock);
- Fin whale (Hawaiian stock); and
- Gray whale (Western North Pacific stock).

Explosives

The Navy's model and quantitative analysis process used for the HSTT DEIS/OEIS and in the Navy's rulemaking/LOA application to estimate potential exposures of marine mammals to explosive stressors is detailed in the technical report titled *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing report* (U.S. Department of the Navy, 2017b). Specifically, over the course of a year, the Navy's model and quantitative analysis process estimates mortality of two short-beaked common dolphin and one California sea lion as a result of exposure to explosive training and testing activities (please refer to section 6 of the Navy's rule making/LOA application). Over the 5-year period of the regulations being requested, mortality of 10 marine mammals in total (6 short-beaked common dolphins and 4 California sea lions) is estimated as a result of exposure to explosive training and testing activities. NMFS coordinated with the Navy in the development of their take estimates and concurs with the Navy's proposed approach for estimating the number of animals from each species that could be affected by mortality takes from explosives.

Proposed Mitigation Measures

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

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

Before NMFS can issue incidental take regulations under section 101(a)(5)(A) of the MMPA, it must make a finding that the total taking will have a ''negligible impact'' on the affected ''species or stocks'' of marine mammals. NMFS's and U.S. Fish and Wildlife Service's implementing regulations for section 101(a)(5) both define ''negligible impact'' as ''an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival'' (50 CFR 216.103 and 50 CFR 18.27(c)). Recruitment (*i.e.,* reproduction) and survival rates are used to determine population growth rates [2] and, therefore are considered in evaluating population level impacts.

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

While some level of impact on population numbers or growth rates of a species or stock may occur and still satisfy the negligible impact requirement—even without consideration of mitigation—the least practicable adverse impact provision separately requires NMFS to prescribe means of ''effecting the least practicable adverse impact on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance'' 50 CFR 216.102(b), which are typically identified as mitigation measures.[3]

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

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

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

Section 101(a)(5)(A)(i)(II) requires NMFS to issue, in conjunction with its authorization, binding—and enforceable—restrictions (in the form of regulations) setting forth how the activity must be conducted, thus ensuring the activity has the ''least practicable adverse impact'' on the affected species or stocks. In situations where mitigation is specifically needed to reach a negligible impact determination, section 101(a)(5)(A)(i)(II) also provides a mechanism for ensuring compliance with the ''negligible impact'' requirement. Finally, we reiterate that the least practicable adverse impact standard also requires consideration of measures for marine mammal habitat, with particular attention to rookeries, mating grounds, and other areas of similar significance, and for subsistence impacts; whereas the negligible impact standard is concerned solely with conclusions about the impact of an activity on annual rates of recruitment and survival.[4]

In *NRDC* v. *Pritzker,* the Court stated, ''[t]he statute is properly read to mean that even if population levels are not threatened *significantly,* still the agency must adopt mitigation measures aimed at protecting *marine mammals* to the greatest extent practicable in light of

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

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

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

military readiness needs.'' *Id.* at 1134 (emphases added). This statement is consistent with our understanding stated above that even when the effects of an action satisfy the negligible impact standard (*i.e.,* in the Court's words, ''population levels are not threatened significantly''), still the agency must prescribe mitigation under the least practicable adverse impact standard. However, as the statute indicates, the focus of both standards is ultimately the impact on the affected ''species or stock,'' and not solely focused on or directed at the impact on individual marine mammals.

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

Implementation of Least Practicable Adverse Impact Standard

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

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

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

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

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

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

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

1. *Reduction of adverse impacts to marine mammal species or stocks and their habitat.*[5] The emphasis given to a measure's ability to reduce the impacts on a species or stock considers the degree, likelihood, and context of the anticipated reduction of impacts to individuals (and how many individuals) as well as the status of the species or stock.

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

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

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

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

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

NMFS reviewed the Specified Activities and the proposed mitigation measures as described in the Navy's rulemaking/LOA application and the HSTT DEIS/OEIS to determine if they would result in the least practicable adverse effect on marine mammals. NMFS worked with the Navy in the development of the Navy's initially proposed measures, which are informed by years of implementation and monitoring. A complete discussion of the evaluation process used to develop, assess, and select mitigation measures, which was informed by input from NMFS, can be found in Chapter 5 (Mitigation) and Appendix K (Geographic Mitigation Assessment) of the HSTT DEIS/OEIS and is summarized below. We agree that the process described in Chapter 5 and Appendix K of the HSTT DEIS/OEIS is an accurate and appropriate process for evaluating whether the mitigation measures proposed in this rule meet the least practicable adverse impact standard for the testing and training activities in this proposed rule. The Navy proposes to implement these mitigation measures to avoid potential impacts from acoustic, explosive, and physical disturbance and strike stressors.

In summary (and described in more detail below), the Navy proposes procedural mitigation measures that we find will reduce the probability and/or severity of impacts expected to result from acute exposure to acoustic sources or explosives, ship strike, and impacts to marine mammal habitat. Specifically, the Navy would use a combination of delayed starts, powerdowns, and shutdowns to minimize or avoid serious injury or mortality, minimize the likelihood or severity of PTS or other injury, and reduce instances of TTS or more severe behavioral disruption caused by acoustic sources or explosives. The Navy also proposes to implement multiple time/area restrictions (several of which have been added since the Phase II rule) that would reduce take of marine mammals in areas or at times where they are known to engage in important behaviors, such as feeding or calving, where the disruption of those behaviors would have a higher probability of resulting in impacts on reproduction or survival of individuals that could lead to population-level impacts. The Navy assessed the practicability of the measures it proposed in the context of personnel safety, practicality of implementation, and their impacts on the Navy's ability to meet their Title 10 requirements and found that the measures were supportable. As summarized in this paragraph and described in more detail below, NMFS has evaluated the measures the Navy has proposed in the manner described earlier in this section (*i.e.,* in consideration of their ability to reduce adverse impacts on marine mammal species or stocks and their habitat and their practicability for implementation) and has determined that the measures will both significantly and adequately reduce impacts on the affected marine

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

mammal species or stocks and their habitat and be practicable for Navy implementation. Therefore, the mitigation measures assure that Navy's activities will have the least practicable adverse impact on the species and stocks and their habitat.

The Navy also evaluated numerous measures in the Navy's HSTT DEIS/OEIS that are not included in the Navy's rulemaking/LOA application for the Specified Activities, and NMFS preliminarily concurs with Navy's analysis that their inclusion was not appropriate under the least practicable adverse impact standard based on our assessment. The Navy considers these additional potential mitigation measures in two groups. Chapter 5 of the HSTT DEIS/OEIS, in the ''Measures Considered but Eliminated'' section, includes an analysis of an array of different types of mitigation that have been recommended over the years by NGOs or the public, through scoping or public comment on environmental compliance documents. Appendix K of the HSTT DEIS/OEIS includes an in-depth analysis of time/area restrictions that have been recommended over time or previously implemented as a result of litigation. As described in Chapter 5 of the DEIS/OEIS, commenters sometimes recommend that the Navy reduce their overall amount of training, reduce explosive use, modify their sound sources, completely replace live training with computer simulation, or include time of day restrictions. All of these proposed measures could potentially reduce the number of marine mammals taken, via direct reduction of the activities or amount of sound energy put in the water. However, as the Navy has described in Chapter 5 of the HSTT DEIS/OEIS, they need to train and test in the conditions in which they fight—and these types of modifications fundamentally change the activity in a manner that would not support the purpose and need for the training and testing (*i.e.,* are entirely impracticable) and therefore are not considered further. NMFS finds the Navy's explanation for why adoption of these recommendations would unacceptably undermine the purpose of the testing and training persuasive. In addition, NMFS must rely on Navy's judgment to a great extent on issues such as its personnel's safety, practicability of Navy's implementation, and extent to which a potential measure would undermine the effectiveness of Navy's testing and training. For these reasons, NMFS finds that these measures do not meet the least practicable adverse impact standard because they are not practicable.

Second in Chapter 5 of the DEIS/OEIS, the Navy evaluated additional potential procedural mitigation measures, including increased mitigation zones, ramp-up measures, additional passive acoustic and visual monitoring, and decreased vessel speeds. Some of these measures have the potential to incrementally reduce take to some degree in certain circumstances, though the degree to which this would occur is typically low or uncertain. However, as described in the Navy's analysis, the impracticability of implementation outweighed the potential reduction of impacts to marine mammal species or stocks (see Chapter 5 of HSTT DEIS/OEIS). NMFS reviewed the Navy's evaluation and concurred with this assessment that this additional mitigation was not warranted.

Appendix K describes a comprehensive method for analyzing potential geographic mitigation that includes consideration of both a biological assessment of how the potential time/area limitation would benefit the species or stock and its habitat (*e.g.,* is a key area of biological importance or would result in avoidance or reduction of impacts) in the context of the stressors of concern in the specific area and an operational assessment of the practicability of implementation (*e.g.,* including an assessment of the specific importance of that area for training—considering proximity to training ranges and emergency landing fields and other issues). The analysis analyzes an extensive list of areas including Biologically Important Areas, areas agreed to under the HSTT settlement agreement, areas identified by the California Coastal Commission, and areas suggested during scoping. For the areas that were agreed to under the settlement agreement, the Navy notes two important facts that NMFS generally concurs with: (1) The measures were derived pursuant to negotiations with plaintiffs and were specifically not evaluated or selected based on the examination of the best available science that NMFS typically applies to a mitigation assessment and; (2) the Navy's adoption of restrictions on its activities as part of a relatively short-term settlement does not mean that those restrictions are practicable to implement over the longer term.

Navy has proposed several time/area mitigations that were not included in the Phase II HSTT regulations. For the areas that are not included in the proposed regulations, though, the Navy found that on balance, the mitigation was not warranted because the anticipated reduction of adverse impacts on marine mammal species or stock and their habitat was not sufficient to offset the impracticability of implementation (in some cases potential benefits to marine mammals were limited to non-existent, in others the consequences on mission effectiveness were too great). NMFS has reviewed the Navy's analysis (Chapter 5 and Appendix K referenced above), which considers the same factors that NMFS would consider to satisfy the least practical adverse impact standard, and has preliminarily concurred with the conclusions, and is not proposing to include any of the measures that the Navy ruled out in the proposed regulations. Below are the mitigation measures that NMFS determined will ensure the least practicable adverse impact on all affected species and stocks and their habitat, including the specific considerations for military readiness activities. The following sections summarize the mitigation measures that will be implemented in association with the training and testing activities analyzed in this document. The mitigation measures are organized into two categories: Procedural mitigation and mitigation areas.

Procedural Mitigation

Procedural mitigation is mitigation that the Navy will implement whenever and wherever an applicable training or testing activity takes place within the HSTT Study Area. The Navy customizes procedural mitigation for each applicable activity category or stressor. Procedural mitigation generally involves: (1) The use of one or more trained Lookouts to diligently observe for specific biological resources (including marine mammals) within a mitigation zone, (2) requirements for Lookouts to immediately communicate sightings of specific biological resources to the appropriate watch station for information dissemination, and (3) requirements for the watch station to implement mitigation (*e.g.,* halt an activity) until certain recommencement conditions have been met. The first procedural mitigation (Table 42) is designed to aid Lookouts and other applicable personnel with their observation, environmental compliance, and reporting responsibilities. The remainder of the procedural mitigations (Tables 43 through Tables 62) are organized by stressor type and activity category and includes acoustic stressors (*i.e.,* active sonar, air guns, pile driving, weapons firing noise), explosive stressors (*i.e.,* sonobuoys, torpedoes, medium-caliber and large-caliber projectiles, missiles and rockets, bombs, sinking exercises, mines, underwater demolition multiple charge mat weave and obstacles loading, anti-swimmer grenades), and physical disturbance and strike stressors (*i.e.,* vessel movement, towed in-water devices, small-, medium-, and large-caliber non-explosive practice munitions, non-explosive missiles and rockets, non-explosive bombs and mine shapes).

TABLE 43—PROCEDURAL MITIGATION FOR ENVIRONMENTAL AWARENESS AND EDUCATION

Procedural mitigation description
Stressor or Activity: • All training and testing activities, as applicable. *Mitigation Zone Size and Mitigation Requirements:* • Appropriate personnel involved in mitigation and training or testing activity reporting under the Specified Activities will complete one or more modules of the U.S. Navy Afloat Environmental Compliance Training Series, as identified in their career path training plan. Modules include: • Introduction to the U.S. Navy Afloat Environmental Compliance Training Series. The introductory module provides information on environmental laws (*e.g.,* ESA, MMPA) and the corresponding responsibilities relevant to Navy training and testing. The material explains why environmental compliance is important in supporting the Navy's commitment to environmental stewardship. • Marine Species Awareness Training. All bridge watch personnel, Commanding Officers, Executive Officers, maritime patrol aircraft aircrews, anti-submarine warfare and mine warfare rotary-wing aircrews, Lookouts, and equivalent civilian personnel must successfully complete the Marine Species Awareness Training prior to standing watch or serving as a Lookout. The Marine Species Awareness Training provides information on sighting cues, visual observation tools and techniques, and sighting notification procedures. Navy biologists developed Marine Species Awareness Training to improve the effectiveness of visual observations for biological resources, focusing on marine mammals and sea turtles, and including floating vegetation, jellyfish aggregations, and flocks of seabirds. • U.S. Navy Sonar Positional Reporting System and Marine Mammal Incident Reporting. This module provides instruction on the procedures and activity reporting requirements for the Sonar Positional Reporting System and marine mammal incident reporting. • U.S. Navy Protective Measures Assessment Protocol. This module provides the necessary instruction for accessing mitigation requirements during the event planning phase using the Protective Measures Assessment Protocol software tool. Also related are annual marine mammal awareness messages promulgated annually to Fleet units: *For Hawaii:* • Humpback Whale Awareness Notification Message Area (November 15–April 15): —The Navy will issue a seasonal awareness notification message to alert ships and aircraft operating in the area to the possible presence of concentrations of large whales, including humpback whales. —To maintain safety of navigation and to avoid interactions with large whales during transits, the Navy will instruct vessels to remain vigilant to the presence of large whale species (including humpback whales), that when concentrated seasonally, may become vulnerable to vessel strikes. —Lookouts will use the information from the awareness notification message to assist their visual observation of applicable mitigation zones during training and testing activities and to aid in the implementation of procedural mitigation. *For Southern California:* • Blue Whale Awareness Notification Message Area (June 1–October 31): —The Navy will issue a seasonal awareness notification message to alert ships and aircraft operating in the area to the possible presence of concentrations of large whales, including blue whales. —To maintain safety of navigation and to avoid interactions with large whales during transits, the Navy will instruct vessels to remain vigilant to the presence of large whale species (including blue whales), that when concentrated seasonally, may become vulnerable to vessel strikes. —Lookouts will use the information from the awareness notification messages to assist their visual observation of applicable mitigation zones during training and testing activities and to aid in the implementation of procedural mitigation observation of applicable mitigation zones during training and testing activities and to aid in the implementation of procedural mitigation. • Gray Whale Awareness Notification Message Area (November 1–March 31): —The Navy will issue a seasonal awareness notification message to alert ships and aircraft operating in the area to the possible presence of concentrations of large whales, including gray whales. —To maintain safety of navigation and to avoid interactions with large whales during transits, the Navy will instruct vessels to remain vigilant to the presence of large whale species (including gray whales), that when concentrated seasonally, may become vulnerable to vessel strikes. —Lookouts will use the information from the awareness notification messages to assist their visual observation of applicable mitigation zones during training and testing activities and to aid in the implementation of procedural mitigation. • Fin Whale Awareness Notification Message Area (November 1–May 31): —The Navy will issue a seasonal awareness notification message to alert ships and aircraft operating in the area to the possible presence of concentrations of large whales, including fin whales. —To maintain safety of navigation and to avoid interactions with large whales during transits, the Navy will instruct vessels to remain vigilant to the presence of large whale species (including fin whales), that when concentrated seasonally, may become vulnerable to vessel strikes. —Lookouts will use the information from the awareness notification messages to assist their visual observation of applicable mitigation zones during training and testing activities and to aid in implementation of procedural mitigation.

Procedural Mitigation for Acoustic Stressors

Mitigation measures for acoustic stressors are provided in Tables 44 through 47.

Procedural Mitigation for Active Sonar

Procedural mitigation for active sonar is described in Table 44 below.

TABLE 44—PROCEDURAL MITIGATION FOR ACTIVE SONAR

Procedural mitigation description

Stressor or Activity:
• Low-frequency active sonar, mid-frequency active sonar, high-frequency active sonar.
• For vessel-based active sonar activities, mitigation applies only to sources that are positively controlled and deployed from manned surface vessels (*e.g.,* sonar sources towed from manned surface platforms).
• For aircraft-based active sonar activities, mitigation applies only to sources that are positively controlled and deployed from manned aircraft that do not operate at high altitudes (*e.g.,* rotary-wing aircraft). Mitigation does not apply to active sonar sources deployed from unmanned aircraft or aircraft operating at high altitudes (*e.g.,* maritime patrol aircraft).
Number of Lookouts and Observation Platform:
• Hull-mounted sources:
  • Platforms without space or manning restrictions while underway: 2 Lookouts at the forward part of the ship.
  • Platforms with space or manning restrictions while underway: 1 Lookout at the forward part of a small boat or ship
  • Platforms using active sonar while moored or at anchor (including pierside): 1 Lookout
• Sources that are not hull-mounted:
  • 1 Lookout on the ship or aircraft conducting the activity.
Mitigation Zone Size and Mitigation Requirements:
• Prior to the start of the activity (*e.g.,* when maneuvering on station), observe for floating vegetation and marine mammals; if resource is observed, do not commence use of active sonar.
• Low-frequency active sonar at 200 dB or more, and hull-mounted mid-frequency active sonar will implement the following mitigation zones:
  • During the activity, observe for marine mammals; power down active sonar transmission by 6 dB if resource is observed within 1,000 yd of the sonar source; power down by an additional 4 dB (10 dB total) if resource is observed within 500 yd of the sonar source; and cease transmission if resource is observed within 200 yd of the sonar source.
• Low-frequency active sonar below 200 dB, mid-frequency active sonar sources that are not hull-mounted, and high-frequency active sonar will implement the following mitigation zone:
  • During the activity, observe for marine mammals; cease active sonar transmission if resource is observed within 200 yd of the sonar source.
• To allow an observed marine mammal to leave the mitigation zone, the Navy will not recommence active sonar transmission until one of the recommencement conditions has been met: (1) The animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the sonar source; (3) the mitigation zone has been clear from any additional sightings for 10 min for aircraft-deployed sonar sources or 30 min for vessel-deployed sonar sources; (4) for mobile activities, the active sonar source has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting; or (5) for activities using hull-mounted sonar, the Lookout concludes that dolphins are deliberately closing in on the ship to ride the ship's bow wave, and are therefore out of the main transmission axis of the sonar (and there are no other marine mammal sightings within the mitigation zone).

Procedural Mitigation for Air Guns

Procedural mitigation for air guns is described in Table 45 below.

TABLE 45—PROCEDURAL MITIGATION FOR AIR GUNS

Procedural mitigation description

Stressor or Activity:
• Air guns.
Number of Lookouts and Observation Platform:
• 1 Lookout positioned on a ship or pierside.
Mitigation Zone Size and Mitigation Requirements:
• 150 yd around the air gun:
  • Prior to the start of the activity (*e.g.,* when maneuvering on station), observe for floating vegetation and marine mammals; if resource is observed, do not commence use of air guns.
  • During the activity, observe for marine mammals; if resource is observed, cease use of air guns.
  • To allow an observed marine mammal to leave the mitigation zone, the Navy will not recommence the use of air guns until one of the recommencement conditions has been met: (1) The animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the air gun; (3) the mitigation zone has been clear from any additional sightings for 30 min; or (4) for mobile activities, the air gun has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting.

Procedural Mitigation for Pile Driving

Procedural mitigation for pile driving is described in Table 46 below.

TABLE 46—PROCEDURAL MITIGATION FOR PILE DRIVING

Procedural mitigation description
Stressor or Activity: • Pile driving and pile extraction sound during Elevated Causeway System Training. *Number of Lookouts and Observation Platform:* • 1 Lookout positioned on the shore, the elevated causeway, or a small boat. *Mitigation Zone Size and Mitigation Requirements:* • 100 yd around the pile driver: • 30 min prior to the start of the activity, observe for floating vegetation and marine mammals; if resource is observed, do not commence impact pile driving or vibratory pile extraction. • During the activity, observe for marine mammals; if resource is observed, cease impact pile driving or vibratory pile extraction. • To allow an observed marine mammal to leave the mitigation zone, the Navy will not recommence pile driving until one of the recommencement conditions has been met: (1) The animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the pile driving location; or (3) the mitigation zone has been clear from any additional sightings for 30 min.

Procedural Mitigation for Weapons Firing Noise

Procedural mitigation for weapons firing noise is described in Table 47 below.

TABLE 47—PROCEDURAL MITIGATION FOR WEAPONS FIRING NOISE

Procedural mitigation description
Stressor or Activity: • Weapons firing noise associated with large-caliber gunnery activities. *Number of Lookouts and Observation Platform:* • 1 Lookout positioned on the ship conducting the firing. • Depending on the activity, the Lookout could be the same as the one described in Table 50 (Procedural Mitigation for Explosive Medium-Caliber and Large-Caliber Projectiles) or Table 60 (Procedural Mitigation for Small-, Medium-, and Large-Caliber Non-Explosive Practice Munitions) *Mitigation Zone Size and Mitigation Requirements:* • 30 degrees on either side of the firing line out to 70 yd from the muzzle of the weapon being fired: • Prior to the start of the activity, observe for floating vegetation and marine mammals; if resource is observed, do not commence weapons firing. • During the activity, observe for marine mammals; if resource is observed, cease weapons firing. • To allow an observed marine mammal to leave the mitigation zone, the Navy will not recommence weapons firing until one of the recommencement conditions has been met: (1) The animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the firing ship; (3) the mitigation zone has been clear from any additional sightings for 30 min; or (4) for mobile activities, the firing ship has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting.

Procedural Mitigation for Explosive Stressors

Mitigation measures for explosive stressors are provided in Tables 48 through 52.

Procedural Mitigation for Explosive Sonobuoys

Procedural mitigation for explosive sonobuoys is described in Table 48 below.

TABLE 48—PROCEDURAL MITIGATION FOR EXPLOSIVE SONOBUOYS

Procedural mitigation description
Stressor or Activity: • Explosive sonobuoys. *Number of Lookouts and Observation Platform:* • 1 Lookout positioned in an aircraft or on small boat. *Mitigation Zone Size and Mitigation Requirements:* • 600 yd around an explosive sonobuoy: • Prior to the start of the activity (*e.g.,* during deployment of a sonobuoy field, which typically lasts 20–30 min), conduct passive acoustic monitoring for marine mammals, and observe for floating vegetation and marine mammals; if resource is visually observed, do not commence sonobuoy or source/receiver pair detonations. • During the activity, observe for marine mammals; if resource is observed, cease sonobuoy or source/receiver pair detonations.

TABLE 48—PROCEDURAL MITIGATION FOR EXPLOSIVE SONOBUOYS—Continued

Procedural mitigation description
• To allow an observed marine mammal to leave the mitigation zone, the Navy will not recommence the use of explosive sonobuoys until one of the recommencement conditions has been met: (1) The animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the sonobuoy; or (3) the mitigation zone has been clear from any additional sightings for 10 min when the activity involves aircraft that have fuel constraints, or 30 min when the activity involves aircraft that are not typically fuel constrained.

Procedural Mitigation for Explosive Torpedoes

Procedural mitigation for explosive torpedoes is described in Table 49 below.

TABLE 49—PROCEDURAL MITIGATION FOR EXPLOSIVE TORPEDOES

Procedural mitigation description
Stressor or Activity: • Explosive torpedoes. *Number of Lookouts and Observation Platform:* • 1 Lookout positioned in an aircraft. *Mitigation Zone Size and Mitigation Requirements:* • 2,100 yd around the intended impact location: • Prior to the start of the activity (*e.g.,* during deployment of the target), conduct passive acoustic monitoring for marine mammals, and observe for floating vegetation, jellyfish aggregations and marine mammals; if resource is visually observed, do not commence firing. • During the activity, observe for marine mammals and jellyfish aggregations; if resource is observed, cease firing. • To allow an observed marine mammal to leave the mitigation zone, the Navy will not recommence firing until one of the recommencement conditions has been met: (1) The animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended impact location; or (3) the mitigation zone has been clear from any additional sightings for 10 min when the activity involves aircraft that have fuel constraints, or 30 min when the activity involves aircraft that are not typically fuel constrained. • After completion of the activity, observe for marine mammals; if any injured or dead resources are observed, follow established incident reporting procedures.

Procedural Mitigation for Medium- and Large-Caliber Projectiles

Procedural mitigation for medium- and large-caliber projectiles is described in Table 50 below.

TABLE 50—PROCEDURAL MITIGATION FOR EXPLOSIVE MEDIUM-CALIBER AND LARGE-CALIBER PROJECTILES

Procedural mitigation description
Stressor or Activity: • Gunnery activities using explosive medium-caliber and large-caliber projectiles. • Mitigation applies to activities using a surface target. *Number of Lookouts and Observation Platform:* • 1 Lookout on the vessel or aircraft conducting the activity. *Mitigation Zone Size and Mitigation Requirements:* • 200 yd around the intended impact location for air-to-surface activities using explosive medium-caliber projectiles, or • 600 yd around the intended impact location for surface-to-surface activities using explosive medium-caliber projectiles, or • 1,000 yd around the intended impact location for surface-to-surface activities using explosive large-caliber projectiles: • Prior to the start of the activity (*e.g.,* when maneuvering on station), observe for floating vegetation and marine mammals; if resource is observed, do not commence firing. • During the activity, observe for marine mammals; if resource is observed, cease firing. • To allow an observed marine mammal to leave the mitigation zone, the Navy will not recommence firing until one of the recommencement conditions has been met: (1) The animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended impact location; (3) the mitigation zone has been clear from any additional sightings for 10 min for aircraft-based firing or 30 min for vessel-based firing; or (4) for activities using mobile targets, the intended impact location has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting.

Procedural Mitigation for Explosive Missiles and Rockets

Procedural mitigation for explosive missiles and rockets is described in Table 51 below.

TABLE 51—PROCEDURAL MITIGATION FOR EXPLOSIVE MISSILES AND ROCKETS

Procedural mitigation description
Stressor or Activity: • Aircraft-deployed explosive missiles and rockets. • Mitigation applies to activities using a surface target. *Number of Lookouts and Observation Platform:* • 1 Lookout positioned in an aircraft. *Mitigation Zone Size and Mitigation Requirements:* • 900 yd around the intended impact location during activities for missiles or rockets with 0.6–20 lb net explosive weight, or • 2,000 yd around the intended impact location for missiles with 21–500 lb net explosive weight: • Prior to the start of the activity (*e.g.,* during a fly-over of the mitigation zone), observe for floating vegetation and marine mammals; if resource is observed, do not commence firing. • During the activity, observe for marine mammals; if resource is observed, cease firing. • To allow an observed marine mammal to leave the mitigation zone, the Navy will not recommence firing until one of the recommencement conditions has been met: (1) The animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended impact location; or (3) the mitigation zone has been clear from any additional sightings for 10 min when the activity involves aircraft that have fuel constraints, or 30 min when the activity involves aircraft that are not typically fuel constrained.

Procedural Mitigation for Explosive Bombs

Procedural mitigation for explosive bombs is described in Table 52 below.

TABLE 52—PROCEDURAL MITIGATION FOR EXPLOSIVE BOMBS

Procedural mitigation description
Stressor or Activity: • Explosive bombs. *Number of Lookouts and Observation Platform:* • 1 Lookout positioned in the aircraft conducting the activity. *Mitigation Zone Size and Mitigation Requirements:* • 2,500 yd around the intended target: • Prior to the start of the activity (*e.g.,* when arriving on station), observe for floating vegetation and marine mammals; if resource is observed, do not commence bomb deployment. • During target approach, observe for marine mammals; if resource is observed, cease bomb deployment. • To allow an observed marine mammal to leave the mitigation zone, the Navy will not recommence bomb deployment until one of the recommencement conditions has been met: (1) The animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended target; (3) the mitigation zone has been clear from any additional sightings for 10 min; or (4) for activities using mobile targets, the intended target has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting.

Procedural Mitigation for Sinking Exercises

Procedural mitigation for sinking exercises is described in Table 53 below.

TABLE 53—PROCEDURAL MITIGATION FOR SINKING EXERCISES

Procedural mitigation description
Stressor or Activity: • Sinking exercises. *Number of Lookouts and Observation Platform:* • 2 Lookouts (one positioned in an aircraft and one on a vessel). *Mitigation Zone Size and Mitigation Requirements:* • 2.5 nmi around the target ship hulk: • 90 min prior to the first firing, conduct aerial observations for floating vegetation, jellyfish aggregations and marine mammals; if resource is observed, do not commence firing.

TABLE 53—PROCEDURAL MITIGATION FOR SINKING EXERCISES—Continued

Procedural mitigation description
• During the activity, conduct passive acoustic monitoring and visually observe for marine mammals from the vessel; if resource is visually observed, cease firing. • Immediately after any planned or unplanned breaks in weapons firing of longer than 2 hours, observe for marine mammals from the aircraft and vessel; if resource is observed, do not commence firing. • To allow an observed marine mammal to leave the mitigation zone, the Navy will not recommence firing until one of the recommencement conditions has been met: (1) The animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the target ship hulk; or (3) the mitigation zone has been clear from any additional sightings for 30 min. • For 2 hours after sinking the vessel (or until sunset, whichever comes first), observe for marine mammals; if any injured or dead resources are observed, follow established incident reporting procedures.

Procedural Mitigation for Explosive Mine Countermeasure and Neutralization Activities

Procedural mitigation for explosive mine countermeasure and neutralization activities is described in Table 54 below.

TABLE 54—PROCEDURAL MITIGATION FOR EXPLOSIVE MINE COUNTERMEASURE AND NEUTRALIZATION ACTIVITIES

Procedural mitigation description
Stressor or Activity: • Explosive mine countermeasure and neutralization activities. *Number of Lookouts and Observation Platform:* • 1 Lookout positioned on a vessel or in an aircraft when implementing the smaller mitigation zone. • 2 Lookouts (one positioned in an aircraft and one on a small boat) when implementing the larger mitigation zone. *Mitigaton Zone Size and Mitigation Requirements:* • 600 yd around the detonation site for activities using 0.1–5-lb net explosive weight, or 2,100 yd around the detonation site for 6–650 lb net explosive weight (including high explosive target mines): • Prior to the start of the activity (*e.g.,* when maneuvering on station; typically, 10 min when the activity involves aircraft that have fuel constraints, or 30 min when the activity involves aircraft that are not typically fuel constrained), observe for floating vegetation and marine mammals; if resource is observed, do not commence detonations. • During the activity, observe for marine mammals; if resource is observed, cease detonations. • To allow an observed marine mammal to leave the mitigation zone, the Navy will not recommence detonations until one of the recommencement conditions has been met: (1) The animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to detonation site; or (3) the mitigation zone has been clear from any additional sightings for 10 min when the activity involves aircraft with fuel constraints, or 30 min when the activity involves aircraft that are not typically fuel constrained. • After completion of the activity, observe for marine mammals (typically 10 min when the activity involves aircraft that have fuel constraints or 30 min when the activity involves aircraft that are not typically fuel constrained); if any injured or dead resources are observed, follow established incident reporting procedures.

Procedural Mitigation for Explosive Mine Neutralization Activities Involving Navy Divers

Procedural mitigation for explosive mine neutralization activities involving Navy divers is described in Table 55 below.

TABLE 55—PROCEDURAL MITIGATION FOR EXPLOSIVE MINE NEUTRALIZATION ACTIVITIES INVOLVING NAVY DIVERS

Procedural mitigation description
Stressor or Activity: • Explosive mine neutralization activities involving Navy divers. *Number of Lookouts and Observation Platform:* • 2 Lookouts (two small boats with one Lookout each, or one Lookout on a small boat and one in a rotary-wing aircraft) when implementing the smaller mitigation zone. • 4 Lookouts (two small boats with two Lookouts each), and a pilot or member of an aircrew will serve as an additional Lookout if aircraft are used during the activity, when implementing the larger mitigation zone. *Mitigation Zone Size and Mitigation Requirements:* • The Navy will not set time-delay firing devices (0.1–29 lb net explosive weight) to exceed 10 min. • 500 yd around the detonation site during activities under positive control using 0.1–20 lb net explosive weight, or • 1,000 yd around the detonation site during all activities using time-delay fuses (0.1–29 lb net explosive weight) and during activities under positive control using 21–60 lb net explosive weight:

TABLE 55—PROCEDURAL MITIGATION FOR EXPLOSIVE MINE NEUTRALIZATION ACTIVITIES INVOLVING NAVY DIVERS—Continued

Procedural mitigation description
• Prior to the start of the activity (*e.g.,* when maneuvering on station for activities under positive control; 30 min for activities using time-delay firing devices), observe for floating vegetation and marine mammals; if resource is observed, do not commence detonations or fuse initiation. • During the activity, observe for marine mammals; if resource is observed, cease detonations or fuse initiation. • All divers placing the charges on mines will support the Lookouts while performing their regular duties and will report all sightings to their supporting small boat or Range Safety Officer. • To the maximum extent practicable depending on mission requirements, safety, and environmental conditions, boats will position themselves near the mid-point of the mitigation zone radius (but outside of the detonation plume and human safety zone), will position themselves on opposite sides of the detonation location (when two boats are used), and will travel in a circular pattern around the detonation location with one Lookout observing inward toward the detonation site and the other observing outward toward the perimeter of the mitigation zone. • If used, aircraft will travel in a circular pattern around the detonation location to the maximum extent practicable. • To allow an observed marine mammal to leave the mitigation zone, the Navy will not recommence detonations or fuse initiation until one of the recommencement conditions has been met: (1) The animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the detonation site; (3) the mitigation zone has been clear from any additional sightings for 10 min during activities under positive control with aircraft that have fuel constraints, or 30 min during activities under positive control with aircraft that are not typically fuel constrained and during activities using time-delay firing devices. • After completion of an activity using time-delay firing devices, observe for marine mammals for 30 min; if any injured or dead resources are observed, follow established incident reporting procedures.

Procedural Mitigation for Underwater Demolition Multiple Charge—Mat Weave and Obstacle Loading

Procedural mitigation for underwater demolition multiple charge—mat weave and obstacle Loading is described in Table 56 below.

TABLE 56—PROCEDURAL MITIGATION FOR UNDERWATER DEMOLITION MULTIPLE CHARGE—MAT WEAVE AND OBSTACLE LOADING

Procedural mitigation description
Stressor or Activity: • Underwater Demolition Multiple Charge—Mat Weave and Obstacle Loading exercises. *Number of Lookouts and Observation Platform:* • 2 Lookouts (one on a small boat and one on shore from an elevated platform). *Mitigation Zone Size and Mitigation Requirements:* • 700 yd around the detonation site: • For 30 min prior to the first detonation, the Lookout positioned on a small boat will observe for floating vegetation and marine mammals; if resource is observed, do not commence the initial detonation. • For 10 min prior to the first detonation, the Lookout positioned on shore will use binoculars to observe for marine mammals; if resource is observed, do not commence the initial detonation until the mitigation zone has been clear of any additional sightings for a minimum of 10 min. • During the activity, observe for marine mammals; if resource is observed, cease detonations. • To allow an observed marine mammal to leave the mitigation zone, the Navy will not recommence detonations until one of the recommencement conditions has been met: (1) The animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the detonation site; or (3) the mitigation zone has been clear from any additional sightings for 10 min (as determined by the shore observer). • After completion of the activity, the Lookout positioned on a small boat will observe for marine mammals for 30 min; if any injured or dead resources are observed, follow established incident reporting procedures.

Procedural Mitigation for Maritime Security Operations—Anti-Swimmer Grenades

Procedural mitigation for maritime security operations—anti-swimmer grenades is described in Table 57 below.

TABLE 57—PROCEDURAL MITIGATION FOR MARITIME SECURITY OPERATIONS—ANTI-SWIMMER GRENADES

Procedural mitigation description
Stressor or Activity: • Maritime Security Operations—Anti-Swimmer Grenades.

TABLE 57—PROCEDURAL MITIGATION FOR MARITIME SECURITY OPERATIONS—ANTI-SWIMMER GRENADES—Continued

Procedural mitigation description

Number of Lookouts and Observation Platform:
• 1 Lookout positioned on the small boat conducting the activity.
Mitigation Zone Size and Mitigation Requirements:
• 200 yd around the intended detonation location:
  • Prior to the start of the activity (*e.g.,* when maneuvering on station), observe for floating vegetation and marine mammals; if resource is observed, do not commence detonations.
  • During the activity, observe for marine mammals; if resource is observed, cease detonations.
  • To allow an observed marine mammal to leave the mitigation zone, the Navy will not recommence detonations until one of the recommencement conditions has been met: (1) The animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended detonation location; (3) the mitigation zone has been clear from any additional sightings for 30 min; or (4) the intended detonation location has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting.

Procedural Mitigation for Physical Disturbance and Strike Stressors

Mitigation measures for physical disturbance and strike stressors are provided in Table 58 through Table 62.

Procedural Mitigation for Vessel Movement

Procedural mitigation for vessel movement is described in Table 58 below.

TABLE 58—PROCEDURAL MITIGATION FOR VESSEL MOVEMENT

Procedural mitigation description

Stressor or Activity:
• Vessel movement.
• The mitigation will not be applied if (1) the vessel's safety is threatened, (2) the vessel is restricted in its ability to maneuver (*e.g.,* during launching and recovery of aircraft or landing craft, during towing activities, when mooring, etc.), (3) the vessel is operated autonomously, or (4) when impracticable based on mission requirements (*e.g.,* during Amphibious Assault—Battalion Landing exercises).
Number of Lookouts and Observation Platform:
• 1 Lookout on the vessel that is underway.
Mitigation Zone Size and Mitigation Requirements:
• 500 yd around whales:
  • When underway, observe for marine mammals; if a whale is observed, maneuver to maintain distance.
• 200 yd around all other marine mammals (except bow-riding dolphins and pinnipeds hauled out on man-made navigational structures, port structures, and vessels):
  • When underway, observe for marine mammals; if a marine mammal other than a whale, bow-riding dolphin, or hauled-out pinniped is observed, maneuver to maintain distance.

Procedural Mitigation for Towed In-Water Devices

Procedural mitigation for towed in-water devices is described in Table 59 below.

TABLE 59—PROCEDURAL MITIGATION FOR TOWED IN-WATER DEVICES

Procedural mitigation description
Stressor or Activity: • Towed in-water devices. • Mitigation applies to devices that are towed from a manned surface platform or manned aircraft. • The mitigation will not be applied if the safety of the towing platform or in-water device is threatened. *Number of Lookouts and Observation Platform:* • 1 Lookout positioned on the manned towing platform. *Mitigation Zone Size and Mitigation Requirements:* • 250 yd around marine mammals: • During the activity, observe for marine mammals; if resource is observed, maneuver to maintain distance.

Procedural Mitigation for Small-, Medium-, and Large-Caliber Non-Explosive Practice Munitions

Procedural mitigation for small-, medium-, and large-caliber non-explosive practice munitions is described in Table 60 below.

TABLE 60—PROCEDURAL MITIGATION FOR SMALL-, MEDIUM-, AND LARGE-CALIBER NON-EXPLOSIVE PRACTICE MUNITIONS

Procedural mitigation description
Stressor or Activity: • Gunnery activities using small-, medium-, and large-caliber non-explosive practice munitions. • Mitigation applies to activities using a surface target. *Number of Lookouts and Observation Platform:* • 1 Lookout positioned on the platform conducting the activity. • Depending on the activity, the Lookout could be the same as the one described in Table 47 (Procedural Mitigation for Weapons Firing Noise). *Mitigation Zone Size and Mitigation Requirements:* • 200 yd around the intended impact location: • Prior to the start of the activity (*e.g.,* when maneuvering on station), observe for floating vegetation and marine mammals; if resource is observed, do not commence firing. • During the activity, observe for marine mammals; if resource is observed, cease firing. • To allow an observed marine mammal to leave the mitigation zone, the Navy will not recommence firing until one of the re-commencement conditions has been met: (1) The animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended impact location; (3) the mitigation zone has been clear from any additional sightings for 10 min for aircraft-based firing or 30 min for vessel-based firing; or (4) for activities using a mobile target, the intended impact location has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting.

Procedural Mitigation for Non-Explosive Missiles and Rockets

Procedural mitigation for non-explosive missiles and rockets is described in Table 61 below.

TABLE 61—PROCEDURAL MITIGATION FOR NON-EXPLOSIVE MISSILES AND ROCKETS

Procedural mitigation description
Stressor or Activity: • Aircraft-deployed non-explosive missiles and rockets. • Mitigation applies to activities using a surface target. *Number of Lookouts and Observation Platform:* • 1 Lookout positioned in an aircraft. *Mitigation Zone Size and Mitigation Requirements:* • 900 yd around the intended impact location: • Prior to the start of the activity (*e.g.,* during a fly-over of the mitigation zone), observe for floating vegetation and marine mammals; if resource is observed, do not commence firing. • During the activity, observe for marine mammals; if resource is observed, cease firing. • To allow an observed marine mammal to leave the mitigation zone, the Navy will not recommence firing until one of the re-commencement conditions has been met: (1) The animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended impact location; or (3) the mitigation zone has been clear from any additional sightings for 10 min when the activity involves aircraft that have fuel constraints, or 30 min when the activity involves aircraft that are not typically fuel constrained.

Procedural Mitigation for Non-Explosive Bombs and Mine Shapes

Procedural mitigation for non-explosive bombs and mine shapes is described in Table 62 below.

TABLE 62—PROCEDURAL MITIGATION FOR NON-EXPLOSIVE BOMBS AND MINE SHAPES

Procedural mitigation description
Stressor or Activity: • Non-explosive bombs. • Non-explosive mine shapes during mine laying activities. *Number of Lookouts and Observation Platform:* • 1 Lookout positioned in an aircraft. *Mitigation Zone Size and Mitigation Requirements:* • 1,000 yd around the intended target: • Prior to the start of the activity (*e.g.,* when arriving on station), observe for floating vegetation and marine mammals; if resource is observed, do not commence bomb deployment or mine laying. • During approach of the target or intended minefield location, observe for marine mammals; if resource is observed, cease bomb deployment or mine laying.

TABLE 62—PROCEDURAL MITIGATION FOR NON-EXPLOSIVE BOMBS AND MINE SHAPES—Continued

Procedural mitigation description
• To allow an observed marine mammal to leave the mitigation zone, the Navy will not recommence bomb deployment or mine laying until one of the recommencement conditions has been met: (1) The animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended target or minefield location; (3) the mitigation zone has been clear from any additional sightings for 10 min; or (4) for activities using mobile targets, the intended target has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting.

Mitigation Areas

In addition to procedural mitigation, the Navy will implement mitigation measures within mitigation areas to avoid or minimize potential impacts on marine mammals (see the revised Figures provided in the Navy's addendum to the application). A full technical analysis (for which the methods were summarized above) of the mitigation areas that the Navy considered for marine mammals is provided in Appendix K (Geographic Mitigation Assessment) of the HSTT DEIS/OEIS. The Navy has taken into account public comments received from the HSTT DEIS/OEIS, best available science, and the practicability of implementing additional mitigations and has enhanced their mitigation areas and mitigation measures to further reduce impacts to marine mammals, and therefore, the Navy revised their mitigation areas since their application. These revisions are discussed below and can be found as an addendum to the Navy's application at *https://www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-military-readiness-activities*. The Navy will continue to work with NMFS to finalize its mitigation areas through the development of the rule.

Information on the mitigation measures that the Navy will implement within mitigation areas is provided in Tables 63 and 64. The mitigation applies year-round unless specified otherwise in the tables.

Mitigation Areas for the HRC

Mitigation areas for the HRC are described in Table 63 below. The location of each mitigation area is in the Navy's addendum to the application on Mitigation Areas.

TABLE 63—MITIGATION AREAS FOR MARINE MAMMALS IN THE HAWAII RANGE COMPLEX

Mitigation area description

Stressor or Activity:
- Sonar.
- Explosives.[1]
- Vessel strikes.

Resource Protection Focus:
- Marine mammals

Mitigation Area Requirements:

Hawaii Island Mitigation Area (year-round):
- The Navy will minimize the use of mid-frequency active anti-submarine warfare sensor bins MF1 and MF4 to the maximum extent practicable.
  - The Navy will not conduct more than 300 hrs of MF1 and 20 hrs of MF4 per year.
  - Should national security present a requirement to conduct more than 300 hrs of MF1 or 20 hrs of MF4 per year, naval units will obtain permission from the appropriate designated Command authority prior to commencement of the activity. The Navy will provide NMFS with advance notification and include the information (*e.g.,* hours of sonar usage) in its annual activity reports.
- The Navy will not use explosives[1] during training and testing.
  - Should national security present a requirement for the use of explosives in the area, naval units will obtain permission from the appropriate designated Command authority prior to commencement of the activity. The Navy will provide NMFS with advance notification and include the information (*e.g.,* explosives usage) in its annual activity reports.

4-Islands Region Mitigation Area (November 15–April 15):
- The Navy will not use mid-frequency active anti-submarine warfare sensor MF1 from November 15–April 15.
  - Should national security present a requirement for the use of MF1 in the area from November 15–April 15, naval units will obtain permission from the appropriate designated Command authority prior to commencement of the activity. The Navy will provide NMFS with advance notification and include the information (*e.g.,* hours of sonar usage) in its annual activity reports.

Humpback Whale Special Reporting Areas (December 15–April 15):
- The Navy will report the hours of MF1 used in the special reporting areas in its annual activity reports.

Humpback Whale Awareness Notification Message Area (November 1–April 30):
- The Navy will issue a seasonal awareness notification message to alert ships and aircraft operating in the area to the possible presence of concentrations of large whales, including humpback whales.
  - To maintain safety of navigation and to avoid interactions with large whales during transits, the Navy will instruct vessels to remain vigilant to the presence of large whale species (including humpback whales), that when concentrated seasonally, may become vulnerable to vessel strikes.
  - Lookouts will use the information from the awareness notification message to assist their visual observation of applicable mitigation zones during training and testing activities and to aid in the implementation of procedural mitigation.

Notes:

[1] Explosive restrictions for the Hawaii Island Mitigation Area apply only to those activities for which the Navy seeks MMPA authorization (*e.g.,* surface-to-surface or air-to-surface missile and gunnery events, BOMBEX, and mine neutralization).

Mitigation Areas for the SOCAL Portion of the Study Area

Mitigation areas for the SOCAL portion of the Study Area are described in Table 64 below. The location of each mitigation area is shown in the Navy's addendum to the application on Mitigation Areas.

TABLE 64—MITIGATION AREAS FOR MARINE MAMMALS IN THE SOUTHERN CALIFORNIA PORTION OF THE STUDY AREA

Mitigation area description

Stressor or Activity:
- Sonar.
- Explosives.
- Vessel strikes.

Resource Protection Focus:
- Marine mammals.

Mitigation Area Requirements:
- San Diego Arc Mitigation Area (June 1–October 31):
  - The Navy will minimize the use of mid-frequency active anti-submarine warfare sensor bin MF1 to the maximum extent practicable.
    - The Navy will not conduct more than 200 hrs of MF1 (with the exception of active sonar maintenance and systems checks) per year from June 1–October 31.
    - Should national security present a requirement to conduct more than 200 hrs of MF1 (with the exception of active sonar maintenance and systems checks) per year from June 1–October 31, naval units will obtain permission from the appropriate designated Command authority prior to commencement of the activity. The Navy will provide NMFS with advance notification and include the information (*e.g.,* hours of sonar usage) in its annual activity reports.
  - The Navy will not use explosives during large-caliber gunnery, torpedo, bombing, and missile (including 2.75 in rockets) activities during training and testing.
    - Should national security present a requirement to conduct large-caliber gunnery, torpedo, bombing, and missile (including 2.75 in rockets) activities using explosives, naval units will obtain permission from the appropriate designated Command authority prior to commencement of the activity. The Navy will provide NMFS with advance notification and include the information (*e.g.,* explosives usage) in its annual activity reports.
- Santa Barbara Island Mitigation Area (year-round):
  - The Navy will not use mid-frequency active anti-submarine warfare sensor MF1 and explosives in small-, medium-, and large-caliber gunnery; torpedo; bombing; and missile (including 2.75 in rockets) activities during unit-level training and major training exercises.
  - Should national security present a requirement for the use of mid-frequency active anti-submarine warfare sensor MF1 or explosives in small-, medium-, and large-caliber gunnery; torpedo; bombing; and missile (including 2.75 in rockets) activities during unit-level training or major training exercises for national security, naval units will obtain permission from the appropriate designated Command authority prior to commencement of the activity. The Navy will provide NMFS with advance notification and include the information in its annual activity reports.
- Blue Whale (June 1–October 31), Gray Whale (November 1–March 31), and Fin Whale (November 1–May 31) Awareness Notification Message Areas:
  - The Navy will issue a seasonal awareness notification message to alert ships and aircraft operating in the area to the possible presence of concentrations of large whales, including blue, gray, or fin whales.
    - To maintain safety of navigation and to avoid interactions with large whales during transits, the Navy will instruct vessels to remain vigilant to the presence of large whale species, that when concentrated seasonally, may become vulnerable to vessel strikes.
    - Lookouts will use the information from the awareness notification messages to assist their visual observation of applicable mitigation zones during training and testing activities and to aid in the implementation of procedural mitigation.

NMFS conducted an independent analysis of the mitigation areas that the Navy proposed, which are described below. NMFS concurs with the Navy's analysis, which indicates that the measures in these mitigation areas are both practicable (which is the Navy's purview to determine) and will reduce the likelihood or severity of adverse impacts to marine mammal species or stocks or their habitat in the manner described in the Navy's analysis. Specifically, the mitigation areas will provide the following benefits to the affected stocks:

4-Islands Region Mitigation Area (Seasonal Nov 15–Apr 15): The Maui/Molokai area (4-Islands Region) is an important reproductive and calving area for humpback whales. Recent scientific research indicates peak humpback whale season has expanded, with higher densities of whales occurring earlier than prior studies had indicated. In addition, a portion of this area has also been identified as biologically important for the ESA-listed small and resident population, main Hawaiian Island insular false killer whales. While the season for this area used to be from December 15 to April 15, the Navy has proposed to extend it from November 15 to April 15. Extending the season and size of the 4-Islands Region Mitigation Area will provide some added protection for that species during half of the year. Minimizing impacts in this area and time is expected to reduce the likelihood of more serious impacts from sonar that could interfere with important cow/calf communication or have unforeseen impacts on more sensitive calves. This area also overlaps with identified biologically important areas for other marine mammal species such as dolphin species including Common bottlenose dolphin, pantropical spotted dolphin, and spinner dolphin (small and resident populations).

Hawaii Island Mitigation Area (Year-round): The endangered main Hawaiian Island insular false killer whale, which is a small and resident populations, and two species of beaked whales (Cuvier and Blainville's) have been documented using this area year-round to support multiple biological functions. Main Hawaiian Island insular false killer whales are an endangered species and beaked whales are scientifically shown to be highly sensitive to exposure to sonar. This area also overlaps with other identified biologically important areas for other marine mammal species such as humpback whale (important reproductive/calving area), dwarf sperm whale (small and resident populations), pygmy killer whale (small and resident population), melon-headed whale (small and resident population), short-finned pilot whale (small and resident population) and dolphin species including Common bottlenose dolphin, pantropical spotted dolphin, spinner dolphin, and rough-toothed dolphin (small and resident populations) for which the Hawaii Island Mitigation Area would provide additional protection.

Potential benefits to humpback whales are noted in the section above. For beaked whales, which have been shown to be more sensitive to loud sounds, a reduction of impacts in general where the stock is known to live or concentrate is expected to reduce the likelihood that more severe responses that could affect individual fitness would occur. For small resident populations, one goal is to ensure that the entirety of any small population is not being extensively impacted, in order to reduce the probability that repeated behavioral exposures to small numbers of individuals will result in energetic impacts, or other impacts with the potential to reduce survival or reproductive success on individuals that will more readily accrue to population level impacts in smaller stocks.

Santa Barbara Island Mitigation Area (Year-round): Numerous marine mammal species use the Channel Islands NMS and it provides valuable, and protected, marine mammal habitat. Particularly, this mitigation area will overlap with identified biologically important feeding area for blue whales and migration areas for gray whales. Generally, a reduction of impacts in the Santa Barbara Island Mitigation Area (inclusive of a portion of the Channel Islands NMS) is expected to reduce stressors in an area that likely contains high value habitat that is more typically free of other anthropogenic stressors.

San Diego Arc Mitigation Area (Seasonal Jun 1–Oct 31): Endangered blue whales have been documented foraging in this area seasonally. Reducing harassing exposures of marine mammals to sonar and explosives in feeding areas, even when the animals have demonstrated some tolerance for disturbance when in a feeding state, is expected to reduce the likelihood that feeding would be interrupted to a degree that energetic reserves might be affected in a manner that could reduce survivorship or reproductive success. This mitigation area will also partially overlap with an important migration area for gray whales.

Summary of Mitigation

The Navy's proposed mitigation measures are summarized in Tables 65 and 66.

Summary of Procedural Mitigation

A summary of procedural mitigation is described in Table 65 below.

TABLE 65—SUMMARY OF PROCEDURAL MITIGATION

Stressor or activity	Summary of mitigation requirements
Environmental Awareness and Education	Afloat Environmental Compliance Training program for applicable personnel.
Active Sonar (depending on system)	Depending on sonar source: 1,000 yd power down, 500 yd power down, and 200 yd shut down or 200 yd shut down.
Air Guns	150 yd.
Pile Driving	100 yd.
Weapons Firing Noise	30 degrees on either side of the firing line out to 70 yd.
Explosive Sonobuoys	600 yd.
Explosive Torpedoes	2,100 yd.
Explosive Medium-Caliber and Large-Caliber Projectiles	1,000 yd (large-caliber projectiles); 600 yd (medium-caliber projectiles during surface-to-surface activities) or 200 yd (medium-caliber projectiles during air-to-surface activities).
Explosive Missiles and Rockets	900 yd (0.6–20 lb net explosive weight) or 2,000 yd (21–500 lb net explosive weight).
Explosive Bombs	2,500 yd.
Sinking Exercises	2.5 nmi.
Explosive Mine Countermeasure and Neutralization Activities	600 yd (0.1–5 lb net explosive weight) or 2,100 yd (6–650 lb net explosive weight).
Explosive Mine Neutralization Activities Involving Navy Divers	500 yd (0.1–20 lb net explosive weight for positive control charges), or 1,000 yd (21–60 lb net explosive weight for positive control charges and all charges using time-delay fuses).
Underwater Demolition Multiple Charge—Mat Weave and Obstacle Loading.	700 yd.
Maritime Security Operations—Anti-Swimmer Grenades	200 yd.
Vessel Movement	500 yd (whales) or 200 yd (other marine mammals).
Towed In-Water Devices	250 yd.
Small-, Medium-, and Large-Caliber Non-Explosive Practice Munitions.	200 yd.
Non-Explosive Missiles and Rockets	900 yd.
Non-Explosive Bombs and Mine Shapes	1,000 yd.

Summary of Mitigation Areas

A summary of mitigation areas for marine mammals is described in Table 66 below.

TABLE 66—SUMMARY OF MITIGATION AREAS FOR MARINE MAMMALS

Mitigation area	Summary of mitigation requirements
Mitigation Areas for Marine Mammals	
Hawaii Island Mitigation Area (Year-round).	• The Navy would not exceed 300 hrs of mid-frequency active anti-submarine warfare sensor MF1 and 20 hrs of mid-frequency active anti-submarine warfare sensor MF4 per season annually. • Should national security present a requirement to conduct additional training and testing using MF1 or MF4 in the mitigation area for national security, naval units will obtain permission from the appropriate designated Command authority prior to commencement of the activity. The Navy will provide NMFS with advance notification and include the information in associated reports. • The Navy will not use explosives [1] during training or testing activities. • Should national security present a requirement to use explosives, naval units will obtain permission from the appropriate designated Command authority prior to commencement of the activity. The Navy will provide NMFS with advance notification and include the information in associated annual reports.
4-Islands Region Mitigation Area (November 15–April 15).	• The Navy will not use mid-frequency active anti-submarine warfare sensor MF1 during training or testing activities. • Should national security present a requirement to use MF1 during training or testing, naval units will obtain permission from the appropriate designated Command authority prior to commencement of the activity. The Navy will provide NMFS with advance notification and include the information in associated annual reports.
San Diego Arc Mitigation Area (June 1–October 31).	• The Navy would not exceed 200 hrs of mid-frequency active anti-submarine warfare sensor MF1 (with the exception of active sonar maintenance and systems checks) annually within the area. • Should national security present a requirement to conduct additional training and testing using MF1, naval units will obtain permission from the appropriate designated Command authority prior to commencement of the activity. The Navy will provide NMFS with advance notification and include the information in associated annual reports. • The Navy will not use explosives during large-caliber gunnery, torpedo, bombing, and missile (including 2.75 in rockets) activities during training or testing activities. • Should national security present a requirement to use these explosives during training or testing activities, naval units will obtain permission from the appropriate designated Command authority prior to commencement of the activity. The Navy will provide NMFS with advance notification and include the information in associated annual reports.
Santa Barbara Island Mitigation Area (Year-round).	• The Navy will not use mid-frequency active anti-submarine warfare sensor MF1 and explosives in small-, medium-, and large-caliber gunnery; torpedo; bombing; and missile (including 2.75 in rockets) activities during unit-level training or major training exercises. • Should national security present a requirement to use MF1 or these explosives during training or testing activities, naval units will obtain permission from the appropriate designated Command authority prior to commencement of the activity. The Navy will provide NMFS with advance notification and include the information in associated annual reports.

Notes:

[1] Explosive restrictions within the Hawaii Island Mitigation Area apply only to those activities for which the Navy seeks MMPA authorization (*e.g.,* surface-to-surface or air-to-surface missile and gunnery events, BOMBEX, and mine neutralization).

Mitigation Conclusions

NMFS has carefully evaluated the Navy's proposed mitigation measures—many of which were developed with NMFS's input during the previous phases of Navy training and testing authorizations—and considered a broad range of other measures (*i.e.,* the measures considered but eliminated in the Navy's DEIS/OEIS, which reflect many of the comments that have arisen via NMFS or public input in past years) 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 mitigation measures is expected to reduce the likelihood and/or magnitude of adverse impacts to marine mammal species and stocks and their habitat; the proven or likely efficacy of the measures; and the practicability of the measures for applicant implementation, including consideration of personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity.

Based on our evaluation of the Navy's proposed measures, as well as other measures considered by the Navy and NMFS, NMFS has preliminarily determined that the Navy's proposed mitigation measures are adequate 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. Additionally, the adaptive management component helps further ensure that mitigation is regularly assessed and opportunities are available to improve the mitigation, based on the factors above, through modification as appropriate. The proposed rule comment period provides the public an opportunity to submit recommendations, views, and/or concerns regarding the proposed mitigation measures. While NMFS has preliminarily determined that the Navy's proposed mitigation measures would effect the least practicable adverse impact on the affected species or stocks and their habitat, NMFS will consider all public comments to help inform our final decision. Consequently, the proposed mitigation measures may be refined, modified, removed, or added to prior to the issuance of any final rule based on public comments received, and where appropriate, further analysis of any additional mitigation measures.

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 and of the level of taking or impacts on populations of marine mammals that are expected to be present.

Although the Navy has been conducting research and monitoring in the HSTT Study Area for over 20 years, they developed a formal marine species monitoring program in support of the MMPA and ESA authorizations for the Hawaii and Southern California range complexes in 2009. This robust program has resulted in hundreds of technical reports and publications on marine mammals that have informed Navy and NMFS analysis in environmental planning documents, Rules and Biological Opinions. The reports are made available to the public on the Navy's marine species monitoring website (*www.navymarinespecies monitoring.us*) and the data on the Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations (OBIS–SEAMAP) (*www.seamap.env.duke.edu*).

The Navy would continue collecting monitoring data to inform our understanding of: The occurrence of marine mammals in the action area; the likely exposure of marine mammals to stressors of concern in the area; the response of marine mammals to exposures to stressors; the consequences of a particular marine mammal response to their individual fitness and, ultimately, populations; and, the effectiveness of implemented mitigation measures. Taken together, mitigation and monitoring comprise the Navy's integrated approach for reducing environmental impacts from the specified activities. The Navy's overall monitoring approach will seek to leverage and build on existing research efforts whenever possible.

Consistent with the cooperating agency agreement between the Navy and NMFS, monitoring measures presented here, as well as the mitigation measures described above, focus on the protection and management of potentially affected marine mammals. A well-designed monitoring program can provide important feedback for validating assumptions made in analyses and allow for adaptive management of marine resources. Monitoring is required under the MMPA, and details of the monitoring program for the specified activities have been developed through coordination between NMFS and the Navy through the regulatory process for previous Navy at-sea training and testing actions. Input received during the public comment period and discussions with other agencies or NMFS offices during the rulemaking process could result in changes to the monitoring as described in this document.

Integrated Comprehensive Monitoring Program (ICMP)

The Navy's ICMP is intended to coordinate marine species monitoring efforts across all regions and to allocate the most appropriate level and type of effort for each range complex based on a set of standardized objectives, and in acknowledgement of regional expertise and resource availability. The ICMP is designed to be flexible, scalable, and adaptable through the adaptive management and strategic planning processes to periodically assess progress and reevaluate objectives. This process includes conducting an annual adaptive management review meeting, at which the Navy and NMFS jointly consider the prior-year goals, monitoring results, and related scientific advances to determine if monitoring plan modifications are warranted to more effectively address program goals. Although the ICMP does not specify actual monitoring field work or individual projects, it does establish a matrix of goals and objectives that have been developed in coordination with NMFS. As the ICMP is implemented through the Strategic Planning Process, detailed and specific studies will be developed which support the Navy's and NMFS top-level monitoring goals. In essence, the ICMP directs that monitoring activities relating to the effects of Navy training and testing activities on marine species should be designed to contribute towards one or more of the following top-level goals:

• An increase in understanding of the likely occurrence of marine mammals and/or ESA-listed marine species in the vicinity of the action (*i.e.,* presence, abundance, distribution, and/or density of species);

• An increase in understanding of the nature, scope, or context of the likely exposure of marine mammals and/or ESA-listed species to any of the potential stressor(s) associated with the action (*e.g.,* sound, explosive detonation, or military expended materials), through better understanding of one or more of the following: (1) The action and the environment in which it occurs (*e.g.,* sound source characterization, propagation, and ambient noise levels); (2) the affected species (*e.g.,* life history or dive patterns); (3) the likely co-occurrence of marine mammals and/or ESA-listed marine species with the action (in whole or part), and/or; (4) the likely biological or behavioral context of exposure to the stressor for the marine mammal and/or ESA-listed marine species (*e.g.,* age class of exposed animals or known pupping, calving or feeding areas);

• An increase in understanding of how individual marine mammals or ESA-listed marine species respond (behaviorally or physiologically) to the specific stressors associated with the action (in specific contexts, where possible, *e.g.,* at what distance or received level);

• An increase in understanding of how anticipated individual responses, to individual stressors or anticipated combinations of stressors, may impact either: (1) The long-term fitness and survival of an individual; or (2) the population, species, or stock (*e.g.,* through effects on annual rates of recruitment or survival);

• An increase in understanding of the effectiveness of mitigation and monitoring measures;

• A better understanding and record of the manner in which the authorized entity complies with the ITA and Incidental Take Statement;

• An increase in the probability of detecting marine mammals (through improved technology or methods), both specifically within the mitigation zone (thus allowing for more effective implementation of the mitigation) and in general, to better achieve the above goals; and

• A reduction in the adverse impact of activities to the least practicable level, as defined in the MMPA.

Strategic Planning Process for Marine Species Monitoring

The Navy also developed the Strategic Planning Process for Marine Species Monitoring, which establishes the guidelines and processes necessary to develop, evaluate, and fund individual projects based on objective scientific study questions. The process uses an underlying framework designed around the ICMP's top-level goals, and a conceptual framework incorporating a progression of knowledge, spanning occurrence, exposure, response, and consequences. The Strategic Planning Process for Marine Species Monitoring is used to set overarching intermediate scientific objectives, develop individual monitoring project concepts, identify potential species of interest at a regional scale, evaluate, prioritize and select specific monitoring projects to fund or continue supporting for a given fiscal year, execute and manage selected monitoring projects, and report and evaluate progress and results. This process addresses relative investments to different range complexes based on goals across all range complexes, and monitoring leverages multiple techniques for data acquisition and analysis whenever possible. The Strategic Planning Process for Marine Species Monitoring is also available online (*http://www.navymarinespeciesmonitoring.us/*).

Monitoring Progress in the Study Area

The monitoring program has undergone significant changes that highlight its evolution through the process of adaptive management. The monitoring program developed for the first cycle of environmental compliance documents (*e.g.,* (U.S. Department of the Navy, 2008)) utilized effort-based compliance metrics that were somewhat limiting. Through adaptive management discussions, the Navy designed and conducted monitoring studies according to scientific objectives, thereby eliminating basing requirements upon metrics of level-of-effort. Furthermore, refinements of scientific objective have continued through the latest permit cycle through 2018.

Progress has also been made on the monitoring program's conceptual framework categories from the Scientific Advisory Group for Navy Marine Species Monitoring (U.S. Department of the Navy, 2011e), ranging from occurrence of animals, to their exposure, response, and population consequences. Lessons-learned with Phase I and II monitoring in HRC and SOCAL suggested that ''layering'' multiple components of monitoring simultaneously provides a way to leverage an increase in return of the progress toward answering scientific monitoring questions.

Specific Phase II monitoring has included:

- HRC
  - Long-term Trends in Abundance of Marine Mammals at PMRF;
  - Estimation of Received Levels of Mid-Frequency Active Sonar on Marine Mammals at PMRF;
  - Behavioral Response of Marine Mammals to Navy Training and Testing at PMRF; and
  - Navy Civilian Marine Mammal Observers on MFAS Ships in Offshore Waters of HRC.
- SOCAL
  - Blue and Fin Whale Satellite Tagging;
  - Cuvier's Beaked Whale Impact Assessment at the Southern California Offshore Antisubmarine Warfare Range (SOAR);
  - Cuvier's Beaked Whale, Blue Whale, and Fin Whale Impact Assessments at Non-Instrumented Range Locations in SOCAL; and
  - Marine Mammal Sightings during California Cooperative Oceanic Fisheries Investigation (CalCOFI) Cruises.

Numerous publications, dissertations and conference presentations have resulted from research conducted under the Navy's marine species monitoring program (*https://www.navymarinespeciesmonitoring.us/reading-room/publications/*), resulting in a significant contribution to the body of marine mammal science. Publications on occurrence, distribution and density have fed the modeling input, and publications on exposure and response have informed Navy and NMFS analyses of behavioral response and consideration of mitigation measures.

Furthermore, collaboration between the monitoring program and the Navy's research and development (*e.g.,* the Office of Naval Research) and demonstration-validation (*e.g.,* Living Marine Resources) programs has been strengthened, leading to research tools and products that have already transitioned to the monitoring program. These include Marine Mammal Monitoring on Ranges (M3R), controlled exposure experiment behavioral response studies (CEE BRS), acoustic sea glider surveys, and global positioning system-enabled satellite tags. Recent progress has been made with better integration of monitoring across all Navy at-sea study areas, including study areas in the Pacific and the Atlantic Oceans, and various testing ranges. Publications from the Living Marine Resources and Office of Naval Research programs have also resulted in significant contributions to hearing, acoustic criteria used in effects modeling, exposure, and response, as well as developing tools to assess biological significance (*e.g.,* population-level consequences).

NMFS and Navy also consider data collected during procedural mitigations as monitoring. Data are collected by shipboard personnel on hours spent training, hours of observation, hours of sonar, marine mammals observed within the mitigation zone during Major Training Exercises when mitigations are implemented. These data are provided to NMFS in both classified and unclassified annual exercise reports.

Past and Current Monitoring in the Study Area

NMFS has received multiple years' worth of annual exercise and monitoring reports addressing active sonar use and explosive detonations within the HSTT Study Area and other Navy range complexes. The data and information contained in these reports have been considered in developing mitigation and monitoring measures for the proposed training and testing activities within the HSTT Study Area. The Navy's annual exercise and monitoring reports may be viewed at: *http://www.nmfs.noaa.gov/pr/permits/incidental/military.htm* and *http://www.navymarinespeciesmonitoring.us.*

The Navy has been funding various marine mammal studies and research within the HSTT Study Area for the past 20 years. Under permitting from NMFS starting in 2009, this effort has transitioned from a specific metric based approach, to a broader new research only approach (*e.g.,* set number of visual surveys, specific number of passive acoustic recording devices, etc.), and more recently since 2014 a more regional (Hawaii or Southern California) species-specific study question design (*e.g.,* what is distribution of species A within the HSTT Study Area, what is response of species B to Navy activities, etc.).

In adaptive management consultation with NMFS, some variation of these ongoing studies or proposed new studies will continue within the HSTT Study Area for either the duration of any new regulations, or for a set period as specified in a given project's scope. Some projects may only require one or two years of field effort. Other projects could entail multi-year field efforts (two to five years). For instance, in the SOCAL portion of the HSTT Study Area, the Navy has funded development and application of new passive acoustic technology since the early 2000's for detecting Cuvier's beaked whales. This also includes ongoing effort to further identify and update population demographics for Cuvier's beaked whales (re-sighting rates, population growth, calving rates, movements, etc.) specific to Navy training and testing areas, as well as responses to Navy activity. Variations of these Cuvier's beaked whale monitoring studies will likely continue under future authorizations. The Navy's marine species monitoring web portal provides details on past and current monitoring projects, including technical reports, publications, presentations, and access to available data and can be found at: *https://www.navymarinespeciesmonitoring.us/regions/pacific/current-projects/*.

The Navy's marine species monitoring program typically supports 6–10 monitoring projects in the HSTT Study Area at any given time. Projects can be either major multi-year major efforts, or one to two year special studies. Navy monitoring projects in HSTT through 2018 currently include:

- Long-term Trends In Abundance Of Marine Mammals At The Pacific Missile Range Facility (Hawaii—began in 2015);
- Estimation Of Received Levels Of Mid-frequency Active Sonar On Marine Mammals At The Pacific Missile Range Facility (Hawaii—began in 2009);
- Behavioral Response Of Marine Mammals To Training And Testing At The Pacific Missile Range Facility (Hawaii—began in 2009);
- Humpback Whale Satellite Tracking And Genetics (Hawaii, Southern California—began in 2017);
- Navy Civilian Marine Mammal Observers On Navy Destroyers (Hawaii, Southern California began in 2010);
- Blue and Fin Whale Satellite Tracking And Genetics (Southern California—field work 2014–2017 with ongoing analysis);
- Cuvier's Beaked Whale Population Assessment And Impact Assessment At Southern California Anti-Submarine Range (Southern California—began in 2015);
- Cuvier's Beaked Whale Occurrence In Southern California From Passive Acoustic Monitoring (Southern California—began in 2012); and
- Guadalupe Fur Seal Satellite Tracking and Census (Southern California—one-year effort beginning in 2018).

Additional scientific projects may have field efforts within Hawaii and Southern California under separate Navy funding from the Navy's two marine species research programs, the Office of Naval Research Marine Mammals and Biology Program and the Living Marine Resources Program. The periodicity of these research projects are more variable than the Navy's compliance monitoring described above.

Adaptive Management

The final regulations governing the take of marine mammals incidental to Navy training and testing activities in the Study Area would contain an adaptive management component. Our understanding of the effects of Navy training and testing activities (*e.g.,* acoustic and explosive stressors) on marine mammals continues to evolve, which makes the inclusion of an adaptive management component both valuable and necessary within the context of five-year regulations.

The reporting requirements associated with this proposed rule are designed to provide NMFS with monitoring data from the previous year to allow NMFS to consider whether any changes to existing mitigation and monitoring requirements are appropriate. NMFS and the Navy would meet to discuss the monitoring reports, Navy R&D developments, and current science and whether mitigation or monitoring modifications are appropriate. The use of adaptive management allows NMFS to consider new information from different sources to determine (with input from the Navy regarding practicability) on an annual or biennial basis if mitigation or monitoring measures should be modified (including additions or deletions). Mitigation measures could be modified if new data suggests that such modifications would have a reasonable likelihood of reducing adverse effects to marine mammals and if the measures are practicable.

The following are some of the possible sources of applicable data to be considered through the adaptive management process: (1) Results from monitoring and exercises reports, as required by MMPA authorizations; (2) compiled results of Navy funded R&D studies; (3) results from specific stranding investigations; (4) results from general marine mammal and sound research; and (5) any information which reveals that marine mammals may have been taken in a manner, extent, or number not authorized by these regulations or subsequent LOAs.

Proposed Reporting

In order to issue an incidental take authorization 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. Some of the reporting requirements are still in development and the final rulemaking may contain additional minor details not contained here. Additionally, proposed reporting requirements may be modified, removed, or added based on information or comments received during the public comment period. Reports from individual monitoring events, results of analyses, publications, and periodic progress reports for specific monitoring projects would be posted to the Navy's Marine Species Monitoring web portal: *http://www.navymarinespeciesmonitoring.us*. Currently, there are several different reporting requirements pursuant to these proposed regulations:

Notification of Injured, Live Stranded or Dead Marine Mammals

The Navy will abide by the Notification and Reporting Plan, which sets out notification, reporting, and other requirements when injured, live stranded, or dead marine mammals are detected. The Notification and Reporting Plan will be available for review at *https://www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-military-readiness-activities*.

Annual HSTT Monitoring Report

The Navy shall submit an annual report to NMFS of the HSTT monitoring describing the implementation and results from the previous calendar year. Data collection methods will be standardized across range complexes and HSTT Study Area to allow for comparison in different geographic locations. The draft of the annual monitoring report shall be submitted either three months after the calendar year, or three months after the conclusion of the monitoring year to be determined by the Adaptive Management process. Such a report would describe progress of knowledge made with respect to intermediate scientific objectives within the HSTT Study Area associated with the Integrated Comprehensive Monitoring Program. Similar study questions shall be treated together so that summaries can be provided for each topic area. The report need not include analyses and content that does not provide direct assessment of cumulative progress on the monitoring plan study questions. NMFS will submit comments on the draft monitoring report, if any, within three months of receipt. The report will be considered final after the Navy has addressed NMFS's comments, or three months after the submittal of the draft if NMFS does not have comments.

As an alternative, the Navy may submit a multi-Range Complex annual Monitoring Plan report to fulfill this requirement. Such a report would describe progress of knowledge made with respect to monitoring study questions across multiple Navy ranges associated with the ICMP. Similar study questions shall be treated together so that progress on each topic shall be summarized across multiple Navy ranges. The report need not include analyses and content that does not provide direct assessment of cumulative progress on the monitoring study question. This will continue to allow Navy to provide a cohesive monitoring report covering multiple ranges (as per ICMP goals), rather than entirely separate reports for the HSTT, Gulf of Alaska, Mariana Islands, and the Northwest Study Areas, etc.

Annual HSTT Training Exercise Report and Testing Activity Report

Each year, the Navy will submit two preliminary reports to NMFS detailing the status of authorized sound sources within 21 days after the anniversary of the date of issuance of the LOA. Each year, the Navy shall submit detailed reports to NMFS within 3 months after the anniversary of the date of issuance of the LOA. The annual reports shall contain information on MTEs, Sinking Exercise (SINKEX) events, and a summary of all sound sources used (total hours or quantity (per the LOA) of each bin of sonar or other non-impulsive source; total annual number of each type of explosive exercises; and total annual expended/detonated rounds (missiles, bombs, sonobuoys, etc.) for each explosive bin). The analysis in the detailed reports will be based on the accumulation of data from the current year's report and data collected from previous reports. The Annual HSTT Training Exercise Report and Testing Activity Navy reports can be consolidated with other exercise reports from other range complexes in the Pacific Ocean for a single Pacific Exercise Report, if desired. Specific sub-reporting in these annual reports include:

- Humpback Whale Special Reporting Area (December 15–April 15): The Navy will report the total hours of operation of surface ship hull-mounted mid-frequency active sonar used in the special reporting area;
- HSTT Mitigation Areas (see section 11 of the Navy's application): The Navy will report any use that occurred as specifically described in these areas; and
- Information included in the classified annual reports may be used to inform future adaptive management of activities within the HSTT Study Area.

Other Reporting and Coordination

The Navy will continue to report and coordinate with NMFS for the following:

- Annual marine species monitoring technical review meetings with researchers, regulators and Marine Mammal Commission (currently, every two years a joint Pacific-Atlantic meeting is held); and
- Annual Adaptive Management meetings with NMFS, regulators and Marine Mammal Commission (recently modified to occur in conjunction with the annual monitoring technical review meeting).

Preliminary Negligible Impact Analysis and Determination

Negligible Impact Analysis

Introduction

NMFS has defined negligible impact as ''an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival: (50 CFR 216.103). A negligible impact finding is based on the lack of likely adverse effects on annual rates of recruitment or survival (*i.e.,* population-level effects). An estimate of the number of takes alone is not enough information on which to base an impact determination. In addition to considering estimates of the number of marine mammals that might be ''taken'' through mortality, serious injury, and Level A or Level B harassment (as presented in Tables 41 and 42), NMFS considers other factors, such as the likely nature of any responses (*e.g.,* intensity, duration), the context of any responses (*e.g.,* critical reproductive time or location, migration), as well as effects on habitat, and the likely effectiveness of the mitigation. We also assess the number, intensity, and context of estimated takes by evaluating this information relative to population status. Consistent with the 1989 preamble for NMFS's implementing regulations (54 FR 40338; September 29, 1989), the impacts from other past and ongoing anthropogenic activities are incorporated into this analysis via their impacts on the environmental baseline (*e.g.,* as reflected in the regulatory status of the species, population size and growth rate where known, other ongoing sources of human-caused mortality, ambient noise levels, and specific consideration of take by Level A harassment or serious injury or mortality (hereafter referred to as M/SI) previously authorized for other NMFS activities).

In the Estimated Take section, we identified the subset of potential effects that would be expected to rise to the level of takes, and then identified the number of each of those takes that we believe could occur (mortality) or are likely to occur (harassment) based on the methods described. The impact that any given take will have is dependent on many case-specific factors that need to be considered in the negligible impact analysis (*e.g.,* the context of behavioral exposures such as duration or intensity of an disturbance, the health of impacted animals, the status of a species that incurs fitness-level impacts to individuals, *etc.*). Here, we evaluate the likely impacts of the enumerated harassment takes that are proposed for authorization and anticipated to occur in this rule, in the context of the specific circumstances surrounding these predicted takes. We also include a specific assessment of serious injury or mortality takes that could occur, as well as consideration of the traits and statuses of the affected species and stocks. Last, we pull all of this information, as well as other more taxa-specific information and the mitigation measure effectiveness, together into group-specific discussions that support our negligible impact conclusions for each stock.

Harassment

The Navy's Specified Activities reflects representative levels/ranges of training and testing activities, accounting for the natural fluctuation in training, testing, and deployment schedules. This approach is representative of how Navy's activities are conducted over any given year over any given five-year period. Specifically, to calculate take, the Navy provided a range of levels for each activity/source type for a year—they used the maximum annual level to calculate annual takes, and they used the sum of three nominal years (average level) and two maximum years to calculate five-year takes for each source type. The Specified Activities section contains a more realistic annual representation of activities, but includes years of a higher maximum amount of training and testing to account for these fluctuations. There may be some flexibility in the exact number of hours, items, or detonations that may vary from year to year, but take totals would not exceed the five-year totals indicated in Tables 41 and 42. We base our analysis and negligible impact determination (NID) on the maximum number of takes that could occur or are likely to occur, although, as stated before, the number of takes are only a part of the analysis, which includes extensive qualitative consideration of other contextual factors that influence the degree of impact of the takes on the affected individuals. To avoid repetition, we provide some general analysis immediately below that applies to all the species listed in Tables 41 and 42, given that some of the anticipated effects of the Navy's training and testing activities on marine mammals are expected to be relatively similar in nature. However, below that, we break our analysis into species (and/or stock), or groups of species (and the associated stocks) where relevant similarities exist, to provide more specific information related to the anticipated effects on individuals of a specific stock or where there is information about the status or structure of any species that would lead to a differing assessment of the effects on the species or stock.

The Navy's harassment take request is based on its model and quantitative assessment of mitigation, which NMFS believes appropriately predicts that amount of harassment that is likely to occur. In the discussions below, the ''acoustic analysis'' refers to the Navy's modeling results and quantitative assessment of mitigation. The model calculates sound energy propagation from sonar, other active acoustic sources, and explosives during naval activities; the sound or impulse received by animat dosimeters representing marine mammals distributed in the area around the modeled activity; and whether the sound or impulse energy received by a marine mammal exceeds the thresholds for effects. Assumptions in the Navy model intentionally err on the side of overestimation when there are unknowns. Naval activities are modeled as though they would occur regardless of proximity to marine mammals, meaning that no mitigation is considered (*e.g.,* no power down or shut down) and without any avoidance of the activity by the animal. The final step of the quantitative analysis of acoustic effects, which occurs after the modeling, is to consider the implementation of mitigation and the possibility that marine mammals would avoid continued or repeated sound exposures. NMFS provided input to, and concurred with, the Navy on this process and the Navy's analysis, which is described in detail in Section 6 of the Navy's rulemaking/LOA application (*https://www.fisheries.noaa.gov/;national/marine-mammal-protection/incidental-take-authorizations-military-readiness-activities*), was used to quantify harassment takes for this rule.

Generally speaking, 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 for behavioral effects throughout species, individuals, or circumstances) and less severe effects from takes resulting from exposure to lower received levels. However, there is also growing evidence of the importance of distance in predicting marine mammal behavioral response to sound—*i.e.,* sounds of a similar level emanating from a more distant source have been shown to be less likely to evoke a response of equal magnitude (DeRuiter 2012). The estimated number of Level A and Level B takes does not equate to the number of individual animals the Navy expects to harass (which is lower), but rather to the instances of take (*i.e.,* exposures above the Level A and Level B harassment threshold) that are anticipated to occur over the five-year period. These instances may represent either brief exposures (seconds or minutes) or, in some cases, longer durations of exposure within a day. Some individuals may experience multiple instances of take (meaning over multiple days) over the course of the year, while some members of a species or stock may not experience take at all which means that the number of individuals taken is smaller than the total estimated takes. In other words, where the instances of take exceed the number of individuals in the population, repeated takes (on more than one day) of some individuals are predicted. Generally speaking, the higher the number of takes as compared to the population abundance, the more repeated takes of individuals are likely, and the higher the actual percentage of individuals in the population that are likely taken at least once in a year. We look at this comparative metric to give us a relative sense across species/stocks of where larger portions of the stocks are being taken by Navy activities and where there is a higher likelihood that the same individuals are being taken across multiple days and where that number of days might be higher. In the ocean, the use of sonar and other active acoustic sources is often transient and is unlikely to repeatedly expose the same individual animals within a short period, for example within one specific exercise, however, some repeated exposures across different activities could occur over the year, especially where events occur in generally the same area with more resident species. In short, we expect that the total anticipated takes represent exposures of a smaller number of individuals of which some were exposed multiple times, but based on the nature of the Navy activities and the movement patterns of marine mammals, it is unlikely any particular subset would be taken over more than a few sequential days—*i.e.,* where repeated takes of individuals are likely to occur, they are more likely to result from non-sequential exposures from different activities and marine mammals are not predicted to be taken for more than a few days in a row, at most. As described elsewhere, the nature of the majority of the exposures would be expected to be of a less severe nature and based on the numbers it is still likely that any individual exposed multiple times is still only taken on a small percentage of the days of the year. The greater likelihood is that not every individual is taken, or perhaps a smaller subset is taken with a slightly higher average and larger variability of highs and lows, but still with no reason to think that any individuals would be taken every day for months out of the year, much less on sequential days.

Depending on the location, duration, and frequency of activities, along with the distribution and movement of marine mammals, individual animals may be exposed to impulse or non-impulse sounds at or above the Level A and Level B harassment threshold on multiple days. However, the Navy is currently unable to estimate the number of individuals that may be taken during training and testing activities. The model results estimate the total number of takes that may occur to a smaller number of individuals.

Some of the lower level physiological stress responses (*e.g.,* orientation or startle response, change in respiration, change in heart rate) discussed earlier would 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. Level B takes, then, may have a stress-related physiological component as well; however, we would not expect the Navy's generally short-term, intermittent, and (typically in the case of sonar) transitory activities to create conditions of long-term, continuous noise leading to long-term physiological stress responses in marine mammals.

The estimates calculated using the behavioral response function do not differentiate between the different types of behavioral responses that rise to the level of Level B harassments. As described in the Navy's application, the Navy identified (with NMFS's input) the types of behaviors that would be considered a take (moderate behavioral responses as characterized in Southall *et al.,* 2007 (*e.g.,* altered migration paths or dive profiles, interrupted nursing breeding or feeding, or avoidance) that also would be expected to continue for the duration of an exposure) and then compiled the available data indicating at what received levels and distances those responses have occurred, and used the indicated literature to build biphasic behavioral response curves that are used to predict how many instances of behavioral take occur in a day. Nor do the estimates provide information regarding the potential fitness or other biological consequences of the reactions on the affected individuals. We therefore consider the available activity-specific, environmental, and species-specific information to determine the likely nature of the modeled behavioral responses and the potential fitness consequences for affected individuals.

Use of sonar and other transducers would typically be transient and temporary. The majority of acoustic effects to mysticetes from sonar and other active sound sources during testing and training activities would be primarily from ASW events. It is important to note although ASW is one of the warfare areas of focus during MTEs, there are significant periods when active ASW sonars are not in use. Nevertheless, behavioral reactions are assumed more likely to be significant during MTEs than during other ASW activities due to the duration (*i.e.,* multiple days), scale (*i.e.,* multiple sonar platforms), and use of highpower hull-mounted sonar in the MTEs. In other words, in the range of potential behavioral effects that might expect to be part of a response that qualifies as an instance take (which by nature of the way it is modeled/counted, occurs within one day), the less severe end might include exposure to comparatively lower levels of a sound, at a detectably greater distance from the animal, for a few or several minutes, and that could result in a behavioral response such as avoiding an area that an animal would otherwise have chosen to move through or feed in for some amount of time or breaking off one or a few feeding bouts. The more severe end, which occurs a smaller amount of the time (when the animal gets close enough to the source to receive a comparatively higher level, is exposed continuously to one source for a longer time, or is exposed intermittently to different sources throughout a day) might result in an animal having a more severe flight response and leaving a larger area for a day or more or potentially losing feeding opportunities for a day. To help assess this, for sonar (LFAS/MFAS/HFAS) used in the HSTT Study Area, the Navy provided information estimating the percentage of animals that may exhibit a significant behavior response under each behavioral response function that would occur within 6-dB increments (percentages discussed below in the Group and Species-Specific Analysis section). As mentioned above, all else being equal, an animal's exposure to a higher received level is more likely to result in a behavioral response that is more likely to lead to adverse effects, which could more likely accumulate to impacts on reproductive success or survivorship of the animal, but as mentioned previously other contextual factors (such as distance) are important also. The majority of Level B takes are expected to be in the form of milder responses (*i.e.,* lower-level exposures that still rise to the level of take, but would likely be less severe in the range of responses that qualify as take) of a generally shorter duration. We anticipate more severe effects from takes when animals are exposed to higher received levels or at closer proximity to the source. These discussions are presented within each species group below in the Group and Species-Specific Analysis section. Specifically, given a range of behavioral responses that may be classified as Level B harassment, to the degree that higher received levels are expected to result in more severe behavioral responses, only a smaller percentage of the anticipated Level B harassment (see the Group and Species-Specific Analysis section below for more detailed information) from Navy activities might necessarily be expected to potentially result in more severe responses. To fully understand the likely impacts of the predicted/authorized take on an individual (*i.e.,* what is the likelihood or degree of fitness impacts), one must look closely at the available contextual information, such as the duration of likely exposures and the likely severity of the exposures (*e.g.,* will they occur from high level hull-mounted sonars or smaller less impactful sources). Moore and Barlow (2013) emphasizes the importance of context (*e.g.,* behavioral state of the animals, distance from the sound source, etc.) in evaluating behavioral responses of marine mammals to acoustic sources.

Diel Cycle

As noted previously, many animals perform vital functions, such as feeding, resting, traveling, and socializing on a diel cycle (24-hour cycle). Behavioral reactions to noise exposure (when taking place in a biologically important context, 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). Henderson *et al.,* 2016 found that ongoing smaller scale events had little to no impact on foraging dives for Blainville's beaked whale, while multi-day training events may decrease foraging behavior for Blainville's beaked whale (Manzano-Roth *et al.,* 2016). Consequently, a behavioral response lasting less than one day and not recurring on subsequent days is not considered severe unless it could directly affect reproduction or survival (Southall *et al.,* 2007). Note that there is a difference between multiple-day substantive behavioral reactions and multiple-day anthropogenic activities. For example, just because an at-sea exercise lasts for multiple days does not necessarily mean that individual animals are either exposed to those exercises for multiple days or, further, exposed in a manner resulting in a sustained multiple day substantive behavioral response. Large multi-day Navy exercises such as ASW activities, typically include vessels that are continuously moving at speeds typically 10–15 kn, or higher, and likely cover large areas that are relatively far from shore (typically more than 3 nmi from shore) and in waters greater than 600 ft deep, in addition to the fact that marine mammals are moving as well, which would make it unlikely that the same animal could remain in the immediate vicinity of the ship for the entire duration of the exercise. Further, the Navy does not necessarily operate active sonar the entire time during an exercise. While it is certainly possible that these sorts of exercises could overlap with individual marine mammals multiple days in a row at levels above those anticipated to result in a take, because of the factors mentioned above, it is considered unlikely for the majority of takes. However, it is also worth noting that the Navy conducts many different types of noise-producing activities over the course of the year and it is likely that some marine mammals will be exposed to more than one and taken on multiple days, even if they are not sequential.

Durations of Navy activities utilizing tactical sonar sources and explosives vary and are fully described in Appendix A of the HSTT DEIS/OEIS. Sonar used during ASW would impart the greatest amount of acoustic energy of any category of sonar and other transducers analyzed in the Navy's rulemaking/LOA application and included hull-mounted, towed, sonobuoy, helicopter dipping, and torpedo sonars. Most ASW sonars are MFAS (1–10 kHz); however, some sources may use higher or lower frequencies. ASW training activities using hull mounted sonar proposed for the HSTT Study Area generally last for only a few hours. Some ASW training and testing can generally last for 2–10 days, or as much as 21 days for an MTE-Large Integrated ASW (see Table 4). For these multi-day exercises there will be extended intervals of non-activity in between active sonar periods. Because of the need to train in a large variety of situations, the Navy does not typically conduct successive ASW exercises in the same locations. Given the average length of ASW exercises (times of sonar use) and typical vessel speed, combined with the fact that the majority of the cetaceans would not likely remain in proximity to the sound source, it is unlikely that an animal would be exposed to LFAS/MFAS/HFAS at levels or durations likely to result in a substantive response that would then be carried on for more than one day or on successive days.

Most planned explosive events are scheduled to occur over a short duration (1–8 hours); however, the explosive component of the activity only lasts for minutes (see Tables 4 through 7). Although explosive exercises may sometimes be conducted in the same general areas repeatedly, because of their short duration and the fact that they are in the open ocean and animals can easily move away, it is similarly unlikely that animals would be exposed for long, continuous amounts of time. Although SINKEXs may last for up to 48 hrs (4–8 hrs, possibly 1–2 days), they are almost always completed in a single day and only one event is planned annually for the HSTT training activities. They are stationary and conducted in deep, open water (where fewer marine mammals would typically be expected to be randomly encountered), and they have rigorous monitoring (*i.e.,* during the activity, conduct passive acoustic monitoring and visually observe for marine mammals 90 min prior to the first firing, during the event, and 2 hrs after sinking the vessel) and shutdown procedures all of which make it unlikely that individuals would be exposed to the exercise for extended periods or on consecutive days.

Last, as described previously, Navy modeling uses the best available science to predict the instances of exposure above certain acoustic thresholds, which are equated, as appropriate, to harassment takes (and further corrected to account for mitigation and avoidance). As further noted, for active acoustics, it is more challenging to parse out the number of individuals taken from this larger number of instances. One method that NMFS can use to help better understand the overall scope of the impacts is to compare these total instances of take against the abundance of that stock. For example, if there are 100 takes in a population of 100, one can assume either that every individual was exposed above acoustic thresholds in no more than one day, or that some smaller number were exposed in one day but a few of those individuals were exposed multiple days within a year. Where the instances of take exceed 100 percent of the population, multiple takes of some individuals are predicted to occur within a year. Generally speaking, the higher the number of takes as compared to the population abundance, the more multiple takes of individuals are likely, and the higher the actual percentage of individuals in the population that are likely taken at least once in a year. We look at this comparative metric to give us a relative sense across species/stocks of where larger portions of the stocks are being taken by Navy activities and where there is a higher likelihood that the same individuals are being taken across multiple days and where that number of days might be higher. At a minimum, it provides a relative picture of the scale of impacts to each stock.

In the ocean, unlike a modeling simulation with static animals, the use of sonar and other active acoustic sources is often transient, and is unlikely to repeatedly expose the same individual animals within a short period, for example within one specific exercise. However, some repeated exposures across different activities would likely occur over the year, especially where numerous activities occur in generally the same area (for example on instrumented ranges) with more resident species. In short, we expect that the total anticipated takes represent exposures of a smaller number of individuals of which some would be exposed multiple times, but based on the nature of the Navy's activities and the movement patterns of marine mammals, it is unlikely that any particular subset would be taken over more than a few sequential days—*i.e.,* where repeated takes of individuals are likely to occur. They are more likely to result from non-sequential exposures from different activities and the majority of marine mammal stocks are not predicted to be taken for more than a few days in a row.

When calculating the proportion of a population affected by takes (*e.g.,* the number of takes divided by population abundance), it is important to choose an appropriate population estimate to make the comparison. The SARs provide the official population estimate for a given species or stock in U.S. waters in a given year (and are typically based solely on the most recent survey data). However, the Study Area encompasses large areas of ocean space outside U.S. waters; therefore, the SARs do not account for the total abundance in the Study Area. Additionally, the SARs are not to the only information used to estimate takes, instead modeled density layers are used, which incorporate the SAR surveys and other survey data. If takes are calculated from another dataset (for example a broader sample of survey data) and compared to the population estimate from the SARs, it may distort the percent of the population affected because of different population baselines. The estimates found in NMFS's SARs remain the official estimates of stock abundance where they are current. These estimates are typically generated from the most recent shipboard and/or aerial surveys conducted. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance within U.S. waters. In some cases, NMFS's abundance estimates show substantial year-to-year variability. However, for highly migratory species (*e.g.,* large whales) or those whose geographic distribution extends well beyond the boundaries of the Navy's study area (*e.g.,* population with distribution along the entire California Current versus just SOCAL), comparisons to the SAR may be more appropriate. This is because the Navy's acoustic modeling process does not horizontally move animats, and therefore does not account for immigration and emigration within the study area. For instance, while it may be accurate that the abundance of animals in Southern California at any one time for a particular species is 200 individuals, if the species is highly migratory or has large daily home ranges, it is not likely that the same 200 individuals would be present every day. A good descriptive example is blue whales, which tagging data have shown traverse the SOCAL area in a few days to weeks on their migrations. Therefore, at any one time there may be a stable number of animals, but over the course of the entire year the entire population may cycle through SOCAL. Therefore, when comparing the estimated takes to an abundance, in this case the SAR, which represents the total population, may be more appropriate than the Navy's modeled abundance for SOCAL. In each of the species write-ups for the negligible impact assessment we explain which abundance was used for making the comparison of takes to the impacts to the population.

NMFS's Southwest Fisheries Science Center derived densities for the Navy, and NMFS supports, the use of spatially and temporally explicit density models that vary in space and time to estimate their potential impacts to species. See the *U.S. Navy Marine Species Density Database Phase III Hawaii-Southern California Training and Testing Area Technical Report* to learn more on how the Navy selects density information and the models selected for individual species. These models may better characterize how Navy impacts can vary in space and time but often predict different population abundances than the SARs.

Models may predict different population abundances for many reasons. The models may be based on different data sets or different temporal predictions may be made. The SARs are often based on single years of NMFS surveys, whereas the models used by the Navy generally include multiple years of survey data from NMFS, the Navy, and other sources. To present a single, best estimate, the SARs often use a single season survey where they have the best spatial coverage (generally summer). Navy models often use predictions for multiple seasons, where appropriate for the species, even when survey coverage in non-summer seasons is limited, to characterize impacts over multiple seasons as Navy activities may occur in any season. Predictions may be made for different spatial extents. Many different, but equally valid, habitat and density modeling techniques exist and these can also be the cause of differences in population predictions. Differences in population estimates may be caused by a combination of these factors. Even similar estimates should be interpreted with caution and differences in models be fully understood before drawing conclusions.

The Navy Study Area covers a broad area off of Hawaii and Southern California, and the Navy has tried to find density estimates for this entire area, where appropriate given species distributions. However, only a small number of Navy training and testing activities occur outside of the U.S. EEZ. Because of the differences in the availability of data in the U.S. EEZ versus outside (which results in more accurate density and abundance estimates inside the U.S. EEZ) and the fact that activities and takes are more concentrated in the U.S. EEZ, NMFS chose to look at how estimated instances of take compare to predicted abundance both within the U.S. EEZ and across the entire study area to help better understand, at least in a relative sense, what the estimated instances of take tell us about either the likely number of individuals taken, and/or over how many days they might be taken. These comparisons are undertaken below in the taxa-specific sections.

Temporary Threshold Shift

NMFS and the Navy have estimated that some individuals of some species of marine mammals may sustain some level of TTS from active sonar. As mentioned previously, TTS can last from a few minutes to days, be of varying degree, and occur across various frequency bandwidths, all of which determine the severity of the impacts on the affected individual, which can range from minor to more severe. Tables 69–81 indicate the amounts of TTS that may be incurred by different stocks from exposure to acoustic sources (sonar, air guns, pile driving) and explosives. The TTS sustained by an animal is primarily classified by three characteristics:

1. Frequency—Available data (of mid-frequency hearing specialists exposed to mid- or high-frequency sounds; Southall *et al.,* 2007) suggest that most TTS occurs in the frequency range of the source up to one octave higher than the source (with the maximum TTS at ½ octave above). The Navy's MF sources the 1–10 kHz frequency band, which suggests that if TTS were to be induced by any of these MF sources would be in a frequency band somewhere between approximately 2 and 20 kHz. There are fewer hours of HF source use and the sounds would attenuate more quickly, plus they have lower source levels, but if an animal were to incur TTS from these sources, it would cover a higher frequency range (sources are between 10 and 100 kHz, which means that TTS could range up to 200 kHz; however, HF systems are typically used less frequently and for shorter time periods than surface ship and aircraft MF systems, so TTS from these sources is even less likely). TTS from explosives would be broadband.

2. Degree of the shift (*i.e.,* by how many dB the sensitivity of the hearing is reduced)—Generally, both the degree of TTS and the duration of TTS will be greater if the marine mammal is exposed to a higher level of energy (which would occur when the peak dB level is higher or the duration is longer). The threshold for the onset of TTS was discussed previously in this proposed rule. An animal would have to approach closer to the source or remain in the vicinity of the sound source appreciably longer to increase the received SEL, which would be difficult considering the Lookouts and the nominal speed of an active sonar vessel (10–15 kn). In the TTS studies (see Threshold Shift section), some using exposures of almost an hour in duration or up to 217 SEL, most of the TTS induced was 15 dB or less, though Finneran *et al.* (2007) induced 43 dB of TTS with a 64-second exposure to a 20 kHz source. However, since any hull-mounted sonar such as the SQS–53 (MFAS), emits a ping typically every 50 sec, incurring those levels of TTS is highly unlikely.

3. Duration of TTS (recovery time)—In the TTS laboratory studies (see Threshold Shift) section), some using exposures of almost an hour in duration or up to 217 SEL, almost all individuals recovered within 1 day (or less, often in minutes), although in one study (Finneran *et al.,* 2007), recovery took 4 days.

Based on the range of degree and duration of TTS reportedly induced by exposures to non-pulse sounds of energy higher than that to which free-swimming marine mammals in the field are likely to be exposed during LFAS/MFAS/HFAS training and testing exercises in the HSTT Study Area, it is unlikely that marine mammals would ever sustain a TTS from MFAS that alters their sensitivity by more than 20 dB for more than a few hours (and any incident of TTS would likely be far less severe due to the short duration of the majority of the events and the speed of a typical vessel). Also, for the same reasons discussed in the Diel Cycle section, and because of the short distance within which animals would need to approach the sound source, it is unlikely that animals would be exposed to the levels necessary to induce TTS in subsequent time periods such that their recovery is impeded. Additionally, though the frequency range of TTS that marine mammals might sustain would overlap with some of the frequency ranges of their vocalization types, the frequency range of TTS from MFAS (the source from which TTS would most likely be sustained because the higher source level and slower attenuation make it more likely that an animal would be exposed to a higher received level) would not usually span the entire frequency range of one vocalization type, much less span all types of vocalizations or other critical auditory cues. If impaired, marine mammals would typically be aware of their impairment and would sometimes able to implement behaviors to compensate (see Acoustic Masking or Communication Impairment section), though these compensations may incur energetic costs.

Therefore, even though the models show that the affected species and stocks will experience Level B harassment at the levels shown in Tables 69–81 and that much of that harassment will occur in the form of TTS, the actual TTS that will result from Navy's activities is expected to be both mild and short-term for the majority of exposed animals. While the TTS experienced by some animals would overlap with the frequency ranges of their vocalizations, it is unlikely that it would affect all vocalizations and other critical auditory clues, and impaired animals may be able to compensate until they have recovered. For these reasons, the majority of the Level B harassment in the form of TTS shown in Tables 69–81 is expected to be short-term and not to have significant impacts on affected animals in a manner that would affect reproduction or survival.

Acoustic Masking or Communication Impairment

Masking only occurs during the time of the signal (and potential secondary arrivals of indirect rays), versus TTS, which continues beyond the duration of the signal. Standard MFAS typically pings every 50 seconds for hull-mounted sources. Hull-mounted anti-submarine sonars can also be used in an object detection mode known as ''Kingfisher'' mode (*e.g.,* used on vessels when transiting to and from port), pulse length is shorter, but pings are much closer together in both time and space, since the vessel goes slower when operating in this mode. For the majority of sources, the pulse length is significantly shorter than hull-mounted active sonar, on the order of several microseconds to tens of microseconds. For hull-mounted active sonar, though some of the vocalizations that marine mammals make are less than one second long, there is only a 1 in 50 chance that they would occur exactly when the ping was received, and when vocalizations are longer than one second, only parts of them are masked. Alternately, when the pulses are only several microseconds long, the majority of most animals' vocalizations would not be masked.

Most ASW sonars and countermeasures use MF frequencies and a few use LF and HF frequencies. Most of these sonar signals are limited in the temporal, frequency, and spatial domains. The duration of most individual sounds is short, lasting up to a few seconds each. Very few systems operate with higher duty cycles or nearly continuously, but typically use lower power. Nevertheless, masking may be more prevalent at closer ranges to these high-duty cycle and continuous active sonar systems. Most ASW activities are geographically dispersed and last for only a few hours, often with intermittent sonar use even within this period. Most ASW sonars also have a narrow frequency band (typically less than one-third octave). These factors reduce the likelihood of sources causing significant masking in mysticetes. HF sonars are typically used for mine hunting, navigation, and object detection, HF (greater than 10 kHz) sonars fall outside of the best hearing and vocalization ranges of mysticetes. Furthermore, HF (above 10 kHz) attenuate more rapidly in the water due to absorption than do lower frequency signals, thus producing only a small zone of potential masking. Masking in mysticetes due to exposure to high-frequency sonar is unlikely. Masking effects from LFAS/MFAS/HFAS are expected to be minimal. If masking or communication impairment were to occur briefly, it would be in the frequency range of MFAS, which overlaps with some marine mammal vocalizations; however, it would likely not mask the entirety of any particular vocalization, communication series, or other critical auditory cue, because the signal length, frequency, and duty cycle of the MFAS/HFAS signal does not perfectly resemble the characteristics of any marine mammal's vocalizations. Masking could occur in mysticetes due to the overlap between their low-frequency vocalizations and the dominant frequencies of air gun pulses. However, masking in odontocetes or pinnipeds is less likely unless the air gun activity is in close range when the pulses are more broadband. Masking is more likely to occur in the presence of broadband, relatively continuous noise sources such as during vibratory pile driving and from vessels. The other sources used in Navy training and testing, many of either higher frequencies (meaning that the sounds generated attenuate even closer to the source) or lower amounts of operation, are similarly not expected to result in masking. For the reasons described here, any limited masking that could potentially occur would be minor and short-term and not expected to have adverse impacts on reproductive success or survivorship.

PTS From Sonar Acoustic Sources and Explosives and Tissue Damage From Explosives

Tables 69–81 indicate the number of individuals of each species and stock for which Level A harassment in the form of PTS resulting from exposure to active sonar and/or explosives is estimated to occur. Tables 69–81 also indicate the number of individuals of each species and stock for which Level A harassment in the form of tissue damage resulting from exposure to explosive detonations is estimated to occur. The number of individuals to potentially incur PTS annually (from sonar and explosives) for the predicted species ranges from 0 to 209 (209 for Dall's porpoise), but is more typically zero or a few up to 18 (with the exception of a few species *i.e.,* short-beaked common dolphin, Kogia whales, Dall's porpoise, California sea lion, and Northern elephant seal). The number of individuals to potentially incur tissue damage from explosives for the predicted species ranges from 0 to 10 (10 for short-beaked common dolphin and 9 for California sea lion), but is typically zero in most cases. Overall the Navy's model estimated that a total 24 marine mammals annually would be exposed to explosives during training and testing at levels that could result in non-auditory injury. Overall, takes from Level A harassment (PTS and Tissue Damage) account for less than one percent of all total takes.

NMFS believes that many marine mammals would deliberately avoid exposing themselves to the received levels of active sonar necessary to induce injury by moving away from or at least modifying their path to avoid a close approach. Additionally, in the unlikely event that an animal approaches the sonar-emitting vessel at a close distance, NMFS believes that the mitigation measures (*i.e.,* shutdown/powerdown zones for active sonar) would typically ensure that animals would not be exposed to injurious levels of sound. Some, but likely not all, of the anticipated avoidance and mitigation has been accounted for in the Navy's quantitative assessment of mitigation—regardless we analyze the impacts of those potential takes in case they should occur. As discussed previously, the Navy utilizes both aerial (when available) and passive acoustic monitoring (during ASW exercises—passive acoustic detections are used as a cue for Lookouts' visual observations when passive acoustic assets are already participating in an activity) in addition to lookouts on vessels to detect marine mammals for mitigation implementation.

If a marine mammal is able to approach a surface vessel within the distance necessary to incur PTS, the likely speed of the vessel (nominally 10–15 kn) would make it very difficult for the animal to remain in range long enough to accumulate enough energy to result in more than a mild case of PTS. As mentioned previously and in relation to TTS, the likely consequences to the health of an individual that incurs PTS can range from mild to more serious dependent upon the degree of PTS and the frequency band it is in, and many animals are able to compensate for the shift, although it may include energetic costs. We also assume that the acoustic exposures sufficient to trigger onset PTS (or TTS) would be accompanied by physiological stress responses, although the sound characteristics that correlate with specific stress responses in marine mammals are poorly understood. As discussed above for Behavioral Harassment, we would not expect the Navy's generally short-term, intermittent, and (in the case of sonar) transitory activities to create conditions of long-term, continuous noise leading to long-term physiological stress responses in marine mammals.

For explosive activities, the Navy implements mitigation measures (described in Proposed Mitigation Measures) during explosive activities, including delaying detonations when a marine mammal is observed in the mitigation zone. Observing for marine mammals during the explosive activities will include aerial and passive acoustic detection methods (when they are available and part of the activity) before the activity begins, in order to cover the mitigation zones that can range from 200 yds (183 m) to 2,500 yds (2,286 m) depending on the source (*e.g.,* explosive sonobuoy, explosive torpedo, explosive bombs) and 2.5 nmi for sinking exercise (see Tables 48–55).

Nearly all explosive events will occur during daylight hours to improve the sightability of marine mammals improving mitigation effectiveness. The proposed mitigation is expected to reduce the likelihood that all of the proposed takes will occur. Some, though likely not all, of that reduction was quantified in the Navy's quantitative assessment of mitigation; however, we analyze the type and amount of Level A take indicated in Tables 41 and 42. Generally speaking, the number and degree of potential injury are low.

Therefore, given that the numbers of anticipated injury in the form of PTS or tissue damage are very low (<18 or single digits, respectively), for any given stock, with the exception of a few species, and the severity of these impacts are expected to be on the less severe end of what could potentially occur because of the factors described above, as well as the fact that any PTS incurred may overlap with the frequency ranges of their vocalizations, but is unlikely to affect all vocalizations and other critical auditory clues, the Level A harassment shown in Tables 69–81 is not expected to have significant or long-term impacts on affected animals in a manner that would affect reproduction or survival.

Serious Injury and Mortality

NMFS proposes to authorize a very small number of serious injuries or mortalities that could occur in the event of a ship strike or as a result of marine mammal exposure to explosive detonations. We note here that the takes from potential ship strikes or explosive exposures enumerated below could result in non-serious injury, but their worse potential outcome (mortality) is analyzed for the purposes of the negligible impact determination.

In addition, we discuss here the connection between the mechanisms for authorizing incidental take under section 101(a)(5) for activities, such as Navy's testing and training in the HSTT Study Area, and for authorizing incidental take from commercial fisheries. In 1988, Congress amended the MMPA's provisions for addressing incidental take of marine mammals in commercial fishing operations. Congress directed NMFS to develop and recommend a new long-term regime to govern such incidental taking (see MMC, 1994). The need to develop a system suited to the unique circumstances of commercial fishing operations led NMFS to suggest a new conceptual means and associated regulatory framework. That concept, Potential Biological Removal (PBR), and a system for developing plans containing regulatory and voluntary measures to reduce incidental take for fisheries that exceed PBR were incorporated as sections 117 and 118 in the 1994 amendments to the MMPA.

PBR is defined in the MMPA (16 U.S.C. 1362(20)) as "the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population" (OSP) and is a measure to be considered when evaluating the effects of M/SI on a marine mammal species or stock. OSP is defined by the MMPA (16 U.S.C. 1362(9)) as "the number of animals which will result in the maximum productivity of the population or the species, keeping in mind the carrying capacity of the habitat and the health of the ecosystem of which they form a constituent element." A primary goal of the MMPA is to ensure that each species or stock of marine mammal is maintained at or returned to its OSP.

PBR values are calculated by NMFS as the level of annual removal from a stock that will allow that stock to equilibrate within OSP at least 95 percent of the time, and is the product of factors relating to the minimum population estimate of the stock (N_{min}); the productivity rate of the stock at a small population size; and a recovery factor. Determination of appropriate values for these three elements incorporates significant precaution, such that application of the parameter to the management of marine mammal stocks may be reasonably certain to achieve the goals of the MMPA. For example, calculation of N_{min} incorporates the precision and variability associated with abundance information and is intended to provide reasonable assurance that the stock size is equal to or greater than the estimate (Barlow *et al.,* 1995). In general, the three factors are developed on a stock-specific basis in consideration of one another in order to produce conservative PBR values that appropriately account for both imprecision that may be estimated, as well as potential bias stemming from lack of knowledge (Wade, 1998).

PBR can be used as a consideration of the effects of M/SI on a marine mammal stock but was applied specifically to work within the management framework for commercial fishing incidental take. PBR cannot be applied appropriately outside of the section 118 regulatory framework for which it was designed without consideration of how it applies in section 118 and how other statutory management frameworks in the MMPA differ. PBR was not designed as an absolute threshold limiting commercial fisheries, but rather as a means to evaluate the relative impacts of those activities on marine mammal stocks. Even where commercial fishing is causing M/SI at levels that exceed PBR, the fishery is not suspended. When M/SI exceeds PBR, NMFS may develop a take reduction plan, usually with the assistance of a take reduction team. The take reduction plan will include measures to reduce and/or minimize the taking of marine mammals by commercial fisheries to a level below the stock's PBR. That is, where the total annual human-caused M/SI exceeds PBR, NMFS is not required to halt fishing activities contributing to total M/SI but rather utilizes the take reduction process to further mitigate the effects of fishery activities via additional bycatch reduction measures. PBR is not used to grant or deny authorization of commercial fisheries that may incidentally take marine mammals.

Similarly, to the extent consideration of PBR may be relevant to considering the impacts of incidental take from activities other than commercial fisheries, using it as the sole reason to deny incidental take authorization for those activities would be inconsistent with Congress's intent under section 101(a)(5) and the use of PBR under section 118. The standard for authorizing incidental take under section 101(a)(5) continues to be, among other things, whether the total taking will have a negligible impact on the species or stock. When Congress amended the MMPA in 1994 to add section 118 for commercial fishing, it did not alter the standards for authorizing non-commercial fishing incidental take under section 101(a)(5), acknowledging that negligible impact under section 101(a)(5) is a separate standard from PBR under section 118. In fact, in 1994 Congress also amended section 101(a)(5)(E) (a separate provision governing commercial fishing incidental take for species listed under the Endangered Species Act) to add compliance with the new section 118 but kept the requirement for a negligible impact finding, showing that the determination of negligible impact and application of PBR may share certain features but are different.

Since the introduction of PBR, NMFS has used the concept almost entirely within the context of implementing sections 117 and 118 and other commercial fisheries management-related provisions of the MMPA. The MMPA requires that PBR be estimated in stock assessment reports and that it be used in applications related to the management of take incidental to commercial fisheries (*i.e.,* the take reduction planning process described in section 118 of the MMPA and the determination of whether a stock is ''strategic'' (16 U.S.C. 1362(19))), but nothing in the MMPA requires the application of PBR outside the management of commercial fisheries interactions with marine mammals.

Nonetheless, NMFS recognizes that as a quantitative metric, PBR may be useful in certain instances as a consideration when evaluating the impacts of other human-caused activities on marine mammal stocks. Outside the commercial fishing context, and in consideration of all known human-caused mortality, PBR can help inform the potential effects of M/SI caused by activities authorized under 101(a)(5)(A) on marine mammal stocks. As noted by NMFS and the USFWS in our implementation regulations for the 1986 amendments to the MMPA (54 FR 40341, September 29, 1989), the Services consider many factors, when available, in making a negligible impact determination, including, but not limited to, the status of the species or stock relative to OSP (if known), whether the recruitment rate for the species or stock is increasing, decreasing, stable, or unknown, the size and distribution of the population, and existing impacts and environmental conditions. To specifically use PBR, along with other factors, to evaluate the effects of M/SI, we first calculate a metric for each species or stock that incorporates information regarding ongoing anthropogenic M/SI into the PBR value (*i.e.,* PBR minus the total annual anthropogenic mortality/serious injury estimate), which is called ''residual PBR.'' (Wood *et al.,* 2012). We then consider how the anticipated potential incidental M/SI from the activities being evaluated compares to residual PBR. Anticipated or potential M/SI that exceeds residual PBR is considered to have a higher likelihood of adversely affecting rates of recruitment or survival, while anticipated M/SI that is equal to or less than residual PBR has a lower likelihood (both examples given without consideration of other types of take, which also obviously factor into a negligible impact determination). In such cases where the anticipated M/SI is near, at, or above PBR, consideration of other factors, including those outlined above as well as mitigation and other factors (positive or negative), is especially important to assessing whether the M/SI will have a negligible impact on the stock. As described above, PBR is a conservative metric and is not intended to be used as a solid cap on mortality—accordingly, impacts from M/SI that exceed PBR may still potentially be found to be negligible in light of other factors that offset concern, especially when robust mitigation and adaptive management provisions are included.

Alternately, for a species or stock with incidental M/SI less than 10 percent of residual PBR, we consider M/SI from the specified activities to represent an insignificant incremental increase in ongoing anthropogenic M/SI that alone (*i.e.,* in the absence of any other take) cannot affect annual rates of recruitment and survival. In a prior incidental take rulemaking and in the commercial fishing context, this threshold is identified as the significance threshold, but it is more accurately an insignificance threshold outside commercial fishing because it represents the level at which there is no need to consider other factors in determining the role of M/SI in affecting rates of recruitment and survival. Assuming that any additional incidental take by harassment would not exceed the negligible impact level, the anticipated M/SI caused by the activities being evaluated would have a negligible impact on the species or stock. This 10% was identified as a workload simplification consideration to avoid the need to provide unnecessary additional information when the conclusion is relatively obvious, but as described above, values above 10 percent have no particular significance associated with them until and unless they approach residual PBR.

Our evaluation of the M/SI for each of the species and stocks for which mortality could occur follows. In addition, all mortality authorized for some of the same species or stocks over the next several years pursuant to our final rulemaking for the NMFS Southwest and Pacific Islands Fisheries Science Centers has been incorporated into the residual PBR.

We first consider maximum potential incidental M/SI from Navy's ship strike analysis for the affected mysticetes and sperm whales (see Table 67) and from the Navy's explosive detonations for California sea lions and short-beaked common dolphin (see Table 68) in consideration of NMFS's threshold for identifying insignificant M/SI take (10 percent of residual PBR (69 FR 43338; July 20, 2004)). By considering the maximum potential incidental M/SI in relation to PBR and ongoing sources of anthropogenic mortality, we begin our evaluation of whether the potential incremental addition of M/SI through Navy's ship strikes and explosive detonations may affect the species' or stocks' annual rates of recruitment or survival. We also consider the interaction of those mortalities with incidental taking of that species or stock by harassment pursuant to the specified activity.

Based on the methods discussed previously, NMFS believes that mortal takes of three large whales over the course of the five-year rule, with no more than two from any of the following species/stocks over the five-year period: Gray whale (Eastern North Pacific stock), fin whale (CA/OR/WA stock), humpback whale (CA/OR/WA stock or Mexico DPS), humpback whale (Central Pacific stock or Hawaii DPS) and sperm whale (Hawaiian stock). Of the mortal takes of three large whales that could occur, no more than one mortality would occur from any of the following species/stocks over the five-year period: Blue whale (Eastern North Pacific stock), Bryde's whale (Eastern Tropical Pacific stock), Bryde's whale (Hawaiian stock), humpback whale (CA/OR/WA stock or Central America DPS), minke whale (CA/OR/WA stock), minke whale (Hawaiian stock), sperm whale (CA/OR/WA stock), sei whale (Hawaiian stock), and sei whale (Eastern North Pacific stock). The Navy is not requesting, and we do not anticipate, ship strike takes to blue whale (Central North Pacific stock), fin whale (Hawaiian stock), and gray whale (Western North Pacific stock) due to their relatively low occurrence in the Study Area, in particular core HSTT training and testing subareas. This means an annual average of 0.2 whales from each species or stock where one mortality may occur or an annual average of 0.4 whales from each species or stock where two mortalities may occur as described in Table 67 (*i.e.,* 1 or 2 takes over 5 years divided by 5 to get the annual number) is proposed for authorization.

The Navy has also requested a small number of takes by serious injury or mortality from explosives. To calculate the annual average of mortalities for explosives in Table 68 we used the same method as described for vessel strikes. The annual average is the number of takes divided by five years to get the annual number.

TABLE 67—SUMMARY INFORMATION RELATED TO MORTALITIES REQUESTED FOR SHIP STRIKE, 2018–2023

Species (stock)	Stock abundance (Nbest) *	Annual proposed take by serious injury or mortality [1]	Total annual M/SI * [2]	Fisheries interactions (Y/N); annual rate of M/SI from fisheries interactions *	Vessel collisions (Y/N); annual rate of M/SI from vessel collision *	PBR *	Residual PBR–PBR minus annual M/SI and SWFSC authorized take (%) [3]	Stock trend * [4]	Recent UME (Y/N); number and year (since 2007)
Fin whale (CA/OR/WA)	9,029	0.4	≥2.0	Y; ≥2.0	1.8	81	78	↑	N
Gray whale (Eastern N Pacific).	20,990	0.4	132	4.25	2.0	624	492	Stable since 2003	N
Humpback whale (CA/OR,WA stock or Mexico DPS).	1,918	0.4	≥6.5	Y; ≥5.3	1.0	11.0	4.5	↑	N
Humpback whale (Central North Pacific stock or Hawaii DPS).	10,103	0.4	24	Y; 7.4	4.7	83	59	↑	N
Sperm whale (Hawaiian stock)	3,354	0.4	0.7	0.7	0	10.2	9.5	?	N
Blue whale (Eastern North Pacific stock).	1,647	0.2	0.9	0	0.9	2.3	1.4	stable	Y; 3, 2007.
Bryde's whale (Eastern Tropical Pacific stock).	unknown	0.2	0.2	unknown	0.2	undet	NA	?	N
Bryde's whale (Hawaiian stock).	798	0.2	0	0	0	6.3	6.3	?	N
Humpback whale (CA/OR/WA stock or Central America DPS).	1,918	0.4	≥6.5	Y; ≥5.3	1.0	11.0	4.5	↑	N
Minke whale (CA/OR/WA stock).	636	0.2	≥1.3	≥1.3	0	3.5	2.2	?	N
Minke whale (Hawaiian stock)	unknown	0.2	0	0	0	undet	NA	?	N
Sperm whale (CA/OR/WA stock).	2,106	0.2	1.7	1.7	0	2.7	1.0	?	N
Sei whale (Hawaiian stock)	178	0.2	0.2	0.2	0	0.2	0	?	N
Sei whale (Eastern N Pacific stock).	519	0.2	0	0	0	0.75	0.75	?	N

* Presented in the SARS.
[1] This column represent the annual take by serious injury or mortality by vessel collision and was calculated by the number of mortalities proposed for authorization divided by five years (the length of the rule and LOAs).
[2] This column represents the total number of incidents of M/SI that could potentially accrue to the specified species or stock. This number comes from the SAR, but deducts the takes accrued from either Navy strikes or SWFSC takes to ensure not double-counted against PBR. However, for these species, there were no takes from either Navy or SWFSC to deduct that would be considered double-counting.
[3] This value represents the calculated PBR less the average annual estimate of ongoing anthropogenic mortalities (*i.e.,* total annual human-caused M/SI, which is presented in the SARs).
[4] See relevant SARs for more information regarding stock status and trends.

The following species are being requested for mortality takes from explosions. A total of 10 mortalities: 4 California sea lions and 6 short-beaked common dolphins over the 5-year period (therefore 0.8 mortalities annually for California sea lions and 1.2 mortalities annually for short-beaked common dolphin) are described in Table 68.

TABLE 68—SUMMARY INFORMATION RELATED TO MORTALITIES FROM EXPLOSIVES, 2018–2023

Species (stock)	Stock abundance (Nbest) *	Annual proposed take by serious injury or mortality * [1]	Total annual M/SI * [2]	Fisheries interactions (Y/N); annual rate of M/SI from fisheries interactions *	PBR *	SWFSC authorized take (annually) [3]	Residual PBR–PBR minus annual M/SI and SWFSC [4]	Stock trend * [5]	Recent UME (Y/N); number and year
California sea lion (U.S.)	296,750	0.8	385	Y; 331	9,200	6.6	8,808.4	↑	Y
Short-beaked common dolphin (CA/OR/WA).	969,861	1.2	≥40	Y; ≥40	8,393	2.8	8,350.2	?	N

* Presented in the SARS.
[1] This column represents the annual take by serious injury or mortality during explosive detonations and was calculated by the number of mortalities proposed for authorization divided by five years (the length of the rule and LOAs).

[2] This column represents the total number of incidents of M/SI that could potentially accrue to the specified species or stock. This number comes from the SAR, but deducts the takes accrued from either Navy or NMFS's Southwest Fisheries Science Center (SWFSC) rulemaking/LOAs takes to ensure not double-counted against PBR.
[3] This column represents annual take authorized for NMFS's SWFSC rulemaking/LOAs (80 FR 58982).
[4] This value represents the calculated PBR less the average annual estimate of ongoing anthropogenic mortalities (*i.e.,* total annual human-caused M/SI, which is presented in the SARs).
[5] See relevant SARs for more information regarding stock status and trends.

Species With M/SI Below the Insignificance Threshold

As noted above, for a species or stock with incidental M/SI less than 10 percent of residual PBR, we consider M/SI from the specified activities to represent an insignificant incremental increase in ongoing anthropogenic M/SI that alone (*i.e.,* in the absence of any other take) cannot affect annual rates of recruitment and survival. There are no known factors that could affect a species or stock to the point where anticipated M/SI below the insignificance threshold could have effects on annual rates of recruitment or survival. In this case, as shown in Table 67, the following species or stocks have anticipated, and proposed authorized, M/SI below their insignificance threshold and, therefore, additional factors are not discussed: Fin whale (CA/OR/WA), gray whale (Eastern North Pacific), Humpback whale (CA/OR/WA stock or Mexico DPS), humpback whale (Central Pacific stock or Hawaii DPS), sperm whale (Hawaiian stock), Bryde's whale (Hawaiian stock), humpback whale (CA/OR/WA stock or Central America DPS), minke whale (CA/OR/WA stock), California sea lion (U.S.), and short-beaked common dolphin (CA/OR/WA stock). For the remaining six stocks with anticipated potential M/SI, how that M/SI compares to residual PBR, as well as additional factors, as appropriate, are discussed below.

Sperm Whale (California, Oregon, Washington Stock)

For sperm whales (CA/OR/WA stock), PBR is currently 2.7 and the total annual M/SI is 1.7 and yields a residual PBR of 1.0. The M/SI value includes incidental fishery interaction records of 1.7, and records of vessel collisions of 0. The proposed authorization of 0.2 mortalities represents 20 percent of residual PBR. Because this value is not close to, at, or exceeding residual PBR, it means that the proposed M/SI is not expected to result in more than a negligible impact on this stock, however, we still address other factors, where available. In regard to mitigation measures that may lessen other human-caused mortality in the future, NOAA is currently implementing marine mammal take reduction measures as identified in the Pacific Offshore Cetacean Take Reduction Plan (including acoustic pingers) to reduce bycatch and incidental serious injury and mortality of sperm whales, and other whales in the CA/OR swordfish drift gillnet fishery. There have been few observed interactions with sperm whales since the fishery was observed, both pre and post-take reduction plan, however, pingers are within the hearing range of sperm whales, and we can infer that they may play a part in reducing sperm whale interactions in this fishery. This information will be considered in combination with our assessment of the impacts of harassment takes later in the section.

Blue Whale (Eastern North Pacific Stock)

For blue whales (Eastern North Pacific stock), PBR is currently set at 2.3 and the total annual M/SI of 0.9 yielding a residual PBR of 1.4. The M/SI value includes incidental fishery interaction records of 0, and records of vessel collisions of 0.9. The proposed authorization of 0.2 represents 14 percent of residual PBR. Because this value is not close to, at, or exceeding residual PBR, it means that the proposed M/SI is not expected to result in more than a negligible impact on this stock, however, we still address other factors, where available. We note that the Eastern North Pacific blue whale stock is considered stable.

In regard to mitigation that may lessen other human-caused mortality in the future, NOAA is currently implementing marine mammal take reduction measures as identified in the Pacific Offshore Cetacean Take Reduction Plan (including the use of acoustic pingers) to reduce the bycatch of blue whales and other marine mammals. In addition, the Channel Islands NMS staff coordinates, collects and monitors whale sightings in and around the Whale Advisory Zone and the Channel Islands NMS region. The seasonally established Whale Advisory Zone spans from Point Arguello to Dana Point, including the Traffic Separation Schemes in the Santa Barbara Channel and San Pedro Channel. Vessels transiting the area from June through November are recommended to exercise caution and voluntarily reduce speed to 10 kn or less for blue, humpback and fin whales. Channel Island NMS observers collect information from aerial surveys conducted by NOAA, the U.S. Coast Guard, California Department of Fish and Game, and U.S. Navy chartered aircraft. Information on seasonal presence, movement and general distribution patterns of large whales is shared with mariners, NMFS Office of Protected Resources, U.S. Coast Guard, California Department of Fish and Game, the Santa Barbara Museum of Natural History, the Marine Exchange of Southern California, and whale scientists. Real time and historical whale observation data collected from multiple sources can be viewed on the Point Blue Whale Database. This information will be considered in combination with our assessment of the impacts of harassment takes later in the section.

Sei Whale (Eastern North Pacific Stock)

For sei whales (*Eastern North Pacific stock*) PBR is currently set at 0.75 and the total annual M/SI is 0 yielding a residual PBR of 0.75. The M/SI value includes incidental fishery interaction records of 0, and records of vessel collisions of 0. The proposed authorization of 0.2 mortalities annually represents 26 percent of residual PBR. Because this value is not close to, at, or exceeding residual PBR, it means that the proposed M/SI is not expected to result in more than a negligible impact on this stock. This information will be considered in combination with our assessment of the impacts of harassment takes later in the section.

Sei Whale (Hawaiian Stock)

For sei whales (*Hawaiian stock*) PBR is currently set at 0.2 and the total annual M/SI is 0.2 yielding a residual PBR of 0. The M/SI value includes incidental fishery interaction records of 0.2, and records of vessel collisions of 0. The proposed authorization of 0.2 mortalities is above residual PBR (by 0.2). We note, however, that this stock occurs within the Hawaiian Islands EEZ and in adjacent high seas waters; however, because data on abundance, distribution, and human-caused impacts are largely lacking for high seas waters, the status of this stock is evaluated based on data from U.S. EEZ waters (NMFS 2005). If the higher number of whales in the high seas (which are uncounted) are considered in combination with the lower likely numbers of mortality in the high seas (since the only known mortality is from fishery interaction, which occurs predominantly in the U.S. EEZ), then the current PBR is likely overly conservative in the context of M/SI takes that could occur in or outside of the U.S. EEZ. Additionally, as noted in the discussion above, PBR is a conservative metric that is not intended to serve as an absolute cap on authorized mortality, one mortality is the smallest amount that could possibly occur in a five-year period, and when this fractional addition is considered in the context of barely exceeding residual PBR, any impacts on the stock are not expected to be more than negligible. This information will be considered in combination with our assessment of the impacts of harassment takes later in the section.

Bryde's Whale (Eastern Tropical Pacific Stock)

For Bryde's whales (Eastern Tropical Pacific stock) PBR is currently undetermined and the total annual M/SI is 0.2. Therefore, residual PBR is unknown. The M/SI value includes incidental fishery interaction records which are unknown, and records of vessel collisions are 0.2. The total human-caused mortality is very low and the Navy's activities would add a fractional amount. Given the fact that this stock contains animals that reside both within and outside the U.S. EEZ (a very large range) and there known M/SI of only 0.2, it is unlikely that the addition of 0.2 annual mortality would result in more than a negligible impact on this stock. This information will be considered in combination with our assessment of the impacts of harassment takes later in the section.

Minke Whale (Hawaiian Stock)

For minke whales (Hawaiian stock) PBR is currently undetermined and the total annual M/SI is unknown; therefore, residual PBR is unknown. The M/SI value includes incidental fishery interaction records of 0, and records of vessel collisions of 0. Given the fact that this stock contains animals that reside both within and outside the U.S. EEZ (a very large range) and there is no known M/SI, it is unlikely that the addition of 0.2 annual mortality would result in more than a negligible impact on this stock. This information will be considered in combination with our assessment of the impacts of harassment takes later in the section.

Group and Species-Specific Analysis

In the discussions below, the ''acoustic analysis'' refers to the Navy's analysis, which includes the use of several models and other applicable calculations as described in the Estimated Take of Marine Mammals section. The quantitative analysis process used for the HSTT DEIS/OEIS and the Navy's rulemaking/LOA application to estimate potential exposures to marine mammals resulting from acoustic and explosive stressors is detailed in the technical report titled *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing report* (U.S. Department of the Navy, 2017b). The Navy Acoustic Effects Model estimates acoustic and explosive effects without taking mitigation into account. Therefore, the model overestimates predicted impacts on marine mammals within mitigation zones. To account for mitigation, as well as avoidance, for marine mammals, the Navy developed a methodology to conservatively quantify the likely degree that mitigation and avoidance will reduce model-estimated PTS to TTS for exposures to sonar and other transducers, and reduce model-estimated mortality and injury for exposures to explosives.

The amount and type of incidental take of marine mammals anticipated to occur from exposures to sonar and other active acoustic sources and explosions during the five-year training and testing period are shown in Tables 41 and 42. The vast majority of predicted exposures (greater than 99 percent) are expected to be Level B harassment (non-injurious TTS and behavioral reactions) from acoustic and explosive sources during training and testing activities at relatively low received levels.

The analysis below may in some cases (*e.g.,* mysticetes, porpoises, pinnipeds) address species collectively if they occupy the same functional hearing group (*i.e.,* low, mid, and high-frequency cetaceans and pinnipeds in water), have similar hearing capabilities, and/or are known to generally behaviorally respond similarly to acoustic stressors. Animals belonging to each stock within a species would have the same hearing capabilities and behaviorally respond in the same manner as animals in other stocks within the species. Therefore, our analysis below also considers the effects of Navy's activities on each affected stock. Where there are meaningful differences between species or stocks in anticipated individual responses to activities, impact of expected take on the population due to differences in population status, or impacts on habitat, they will either be described within the section or the species will be included as a separate sub-section.

Mysticetes

In Table 69 and Table 70 below, for mysticetes, we indicate the total annual mortality, Level A and Level B harassment, and a number indicating the instances of total take as a percentage of abundance. Overall, takes from Level A harassment (PTS and Tissue Damage) account for less than one percent of all total takes.

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Table 69. Annual takes of Level B and Level A harassment, mortality for mysticetes in the HRC of the HSTT study area and number indicating the instances of total take as a percentage of stock abundance.

	Level B Harassment		Level A Harassment		Mortality	Total Takes		Abundance		Instance of total take as percent of abundance	
Species Stock Navy EEZ location (HRC)	Behavioral Disturbance	TTS (may also include disturbance)	PTS	Tissue Damage		TOTAL TAKES (entire Study Area)	Takes (within NAVY EEZ)	Total Navy Abundance in and out EEZ (HRC)	Within Navy EEZ Abundance HRC	Total take as percentage of total Navy abundance (HRC)	EEZ take as percentage of EEZ abundance (HRC)
Blue whale Central North Pacific (HRC)	15	33	0	0	0	48	40	43	33	112	121
Bryde's whale Hawaiian (HRC)	40	107	0	0	0	147	123	108	89	136	138
Fin whale Hawaiian (HRC)	21	28	0	0	0	49	41	52	40	94	103
Humpback whale Central North Pacific (HRC)	2838	6290	5	0	0	9133	7389	5078	4595	180	161
Minke whale Hawaiian (HRC)	1233	3697	2	0	0	4932	4030	3652	2835	135	142
Sei whale Hawaiian (HRC)	47	121	0	0	0	168	135	138	107	122	126

Note: For the HI take estimates, we compare predicted takes to abundance estimates generated from the same underlying density estimates, both in and outside of the U.S. EEZ. Because the portion of the Navy's action area inside the U.S. EEZ is generally concomitant with the study area used to generate the abundance estimates in the SARs, and the abundance predicted by the same underlying density estimates is the preferred abundance to use, there is no need to separately compare the take to the SARs abundance estimate.

Table 70. Annual takes of Level B and Level A harassment, mortality for mysticetes in the SOCAL of the HSTT study area and number indicating the instances of total take as a percentage of stock abundance.

		Instances of indicated types of incidental take (not all takes represent separate individuals, especially for disturbance)									
		Level B Harassment		Level A Harassment			Total Takes	Abundance		Instance of total take as percent of abundance	
Species	Stock	Behavioral Disturbance	TTS (may also include disturbance)	PTS	Tissue Damage	Mortality	TOTAL TAKES (entire Study Area)	NAVY abundance in Action Area SOCAL [1]	NMFS SARS [2]	Total take as percentage of total Navy abundance in Action Area	Total take as percentage of total SAR abundance
Blue whale	Eastern North Pacific	792	1196	1	0	0	1989	785	1647	253	121
Bryde's whale	Eastern Tropical Pacific	14	27	0	0	0	41	1.3	unknown	3154	unknown
Fin whale	CA/OR/WA	835	1390	1	0	0	2226	363	9029	613	25
Humpback whale	CA/OR/WA	480	1514	1	0	0	1995	247	1918	808	104
Minke whale	CA/OR/WA	259	666	1	0	0	926	163	636	568	146
Sei whale	Eastern North Pacific	27	52	0	0	0	79	3	519	2633	15
Gray whale	Eastern North Pacific	1316	3355	7	0	0	4678	193	20990	2424	22
Gray whale	Western North Pacific	2	4	0	0	0	6	0	140	0	4

Note: For the SOCAL take estimates, because of the manner in which the Navy action area overlaps the ranges of many MMPA stocks (*i.e.*, a stock may range far north to Washington state and beyond and abundance may only be predicted within the U.S. EEZ, while the Navy action area is limited to Southern California and northern Mexico, but extends beyond the U.S. EEZ), we compare predicted takes to both the abundance estimates for the action area, as well as the SARs.

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Of these species, blue whale, fin whale, sei whale, humpback whale (CA/OR/WA stock) and gray whale (Western North Pacific stock) are listed as endangered under the ESA and depleted under the MMPA. NMFS is currently engaged in an internal Section 7 consultation under the ESA and the outcome of that consultation will further inform our final decision.

Of the total instances of all of the different types of takes, the numbers indicating the instances of total take as a percentage of abundance for mysticetes ranges from 94 to 180 percent for HRC stocks (blue, Bryde's, fin, humpback minke and sei whales), suggesting that most individuals are taken in an average of 1 to 2 days per year (Table 69). For SOCAL stocks (blue, Bryde's, fin, humpback, minke, sei, and gray whales), the percentages as compared to the abundances across the U.S. EEZ stock range (Predicted in the SAR) are between 4 and 146, suggesting that across these wide-ranging stocks individuals are taken on average on between 0 and 2 days per year (Table 70). Alternately when compared to the abundance estimates within the Navy's SOCAL action area, based on static density estimates, the percentages range from 0 to 3,154, suggesting that if any of these exposed individuals remained in the action area the whole year, they might be taken on average on 32 days in a year. Although we generally do not expect individuals to remain in the action area for the whole year (or to accrue take over this many days), these numbers do suggest that individuals residing in the action area for some amount of time could accrue take on more than the average one or two days per year. Effects are such that these averages allow that perhaps a smaller subset is taken with a slightly higher average and larger variability of highs and lows, but still with no reason to think that any individuals would be taken every day for weeks or months out of the year, much less on sequential days. These behavioral takes are expected to be of a milder to potentially moderate intensity and are not likely to occur over sequential days, which suggests that the overall scale of impacts for any individual would be relatively low and unlikely to result in fitness effects that would impact reproductive success or survival.

Most Level B harassments to mysticetes from hull-mounted sonar (MF1) in the HSTT Study Area would result from received levels between 154 and 172 dB SPL (62 percent). As mentioned earlier in this section, we anticipate more severe effects from takes when animals are exposed to higher received levels. Comparatively minor to potentially moderate behavioral reactions are unlikely to cause long-term consequences for individual animals or populations, and even if some smaller subset of the takes are in the form of a longer (several hours or a day) and more moderate response, because they are not expected to be repeated over sequential multiple days, impacts to individual fitness are not anticipated. Also, as noted in the Potential Effects section, while there are multiple examples from behavioral response studies of odontocetes ceasing their feeding dives when exposed to sonar pulses at certain levels, but alternately, blue whales were less likely to show a visible response to sonar exposures at certain levels when feeding then they have been observed responding to when traveling.

Research and observations show that if mysticetes are exposed to sonar or other active acoustic sources they may react in a number of ways depending on the characteristics of the sound source, their experience with the sound source, and whether they are migrating or on seasonal grounds (*i.e.,* breeding or feeding). Behavioral reactions may include alerting, breaking off feeding dives and surfacing, diving or swimming away, or no response at all (Richardson, 1995; Nowacek, 2007; Southall *et al.,* 2007; Finneran and Jenkins, 2012). Overall, mysticetes have been observed to be more reactive to acoustic disturbance when a noise sources is located directly on their migration route. Mysticetes disturbed while migrating could pause their migration or route around the disturbance. Although they may pause temporarily, they will resume migration shortly after. Animals disturbed while engaged in other activities such as feeding or reproductive behaviors may be more likely to ignore or tolerate the disturbance and continue their natural behavior patterns. Therefore, most behavioral takes of mysticetes are likely to be short-term and low to moderate severity.

While MTEs may have a longer duration, they are not concentrated in small geographic areas over that time period. MTES use hundreds of square miles of ocean space during the course of the event. For example, Goldbogen *et al.* (2013) indicated some horizontal displacement of deep foraging blue whales in response to simulated MFA sonar. Given these animals' mobility and large ranges, we would expect these individuals to temporarily select alternative foraging sites nearby until the exposure levels in their initially selected foraging area have decreased. Therefore, temporary displacement from initially selected foraging habitat is not expected to impact the fitness of any individual animals because we would expect suitable foraging to be available in close proximity.

Richardson *et al.* (1995) noted that avoidance (temporary displacement of an individual from an area) reactions are the most obvious manifestations of disturbance in marine mammals. Avoidance is qualitatively different from the startle or 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. Some mysticetes may avoid larger activities such as a MTE as it moves through an area, although these activities generally do not use the same training locations day-after-day during multi-day activities. Therefore, displaced animals could return quickly after the MTE finishes. Due to the limited number and broad geographic scope of MTEs, it is unlikely that most mysticetes would encounter a major training exercise multiple times per year when transiting through the area. In the ocean, the use of sonar and other active acoustic sources is transient and is unlikely to expose individuals repeatedly over a short period except around homeports and fixed instrumented ranges. However, the more impactful training exercises that result in higher numbers or more severe forms of take do not occur around homeports. While training exercises may be concentrated in instrumented ranges, they are large areas, and in most cases the animals are not limited to those areas and the numbers in the analysis above do not suggest that any individual mysticetes are being exposed to levels above the Level B harassment threshold within more than than maybe 20–30 days at most over the course of a year.

The implementation of mitigation and the sightability of mysticetes (due to their large size) and therefore higher likelihood that shutdown and other mitigation measures will be effective for these species and reduces the potential for a more significant behavioral reaction or a threshold shift to occur (which would be more likely within the shutdown zone, were the mitigation not implemented). As noted previously, when an animal incurs a threshold shift, it occurs in the frequency from that of the source up to one octave above—this means that threshold shift caused by Navy sonar sources will typically occur in the range of 2–20 kHz, and if resulting from hull-mounted sonar, will be in the range of 3.5–7 kHz. The majority of mysticete vocalizations occur in frequencies below 1 kHz, which means that TTS incurred by mysticetes will not interfere with conspecific communication. When we look in ocean areas where the Navy has been intensively training and testing with sonar and other active acoustic sources for decades, there is no data suggesting any long-term consequences to mysticetes from exposure to sonar and other active acoustic sources.

The Navy will implement mitigation areas that will avoid or reduce impacts to mysticetes and where BIAs for large whales have been identified in the SOCAL portion of the HSTT Study Area. The Navy will implement the San Diego Arc Mitigation Area from June 1 through October 31 to protect blue whales. The San Diego Arc overlaps the San Diego Blue Whale Feeding Area (BIA) (see also the HSTT DEIS/OEIS Section K.4 (BIAs within the SOCAL Portion of the HSTT Study Area for blue whale feeding areas)). In the San Diego Arc Mitigation Area the Navy will not exceed 200 hrs of MFAS sensor MF1 use ((with the exception of active sonar maintenance and systems checks) between June 1 and October 31 annually. Additionally, in the San Diego Arc Mitigation Area, the Navy will not use explosives during large-caliber gunnery, torpedo, bombing, and missile (including 2.75 in rockets) activities during training or testing.

In addition, the Navy will implement the Santa Barbara Island Mitigation Area year-round for the protection of blue, fin, and gray whales (and other marine mammals) within that portion of the Channel Islands NMS. The Santa Barbara Island Mitigation Area will partially protect the identified important feeding area, San Nicolas Island for blue whales. The Navy will restrict the use of MFAS sensor MF1 and explosives used in gunnery (all calibers), torpedo, bombing, and missile exercises (including 2.75 in rockets) during unit-level training and MTEs.

The Navy will implement mitigation areas that will avoid or reduce impacts to mysticetes and where BIAs for large whales have been identified in the HRC portion of the HSTT Study Area as described below.

In the 4-Islands Region Mitigation Area, the Navy will not use MFAS sensor MF1 during training or testing activities from November 15 through April 15. Since 2009, the Navy has adhered to a Humpback Whale Cautionary Area as a mitigation area within the Hawaiian Islands Humpback Whale NMS an area identified as having one of the highest concentrations of humpback whales, with calves, during the critical winter months. As added protection, the Navy proposes to expand the size and extend the season of the current Humpback Whale Cautionary Area, renaming this area the 4-Islands Region Mitigation Area to reflect the benefits afforded to multiple species. The season is currently between December 15 and April 15; the Navy proposes to extend it from November 15 through April 15 because the peak humpback whale season has expanded. The size of the 4-Islands Region Mitigation Area would expand to include an area north of Maui and Molokai and overlaps an area identified as a BIA for the critically endangered Main Hawaiian Islands insular false killer whales (Baird *et al.,* 2015; Van Parijs, 2015) (see Figure 5.4–3, in Chapter 5 Mitigation Areas for Marine Mammals in the Hawaii Range Complex of the HSTT DEIS/OEIS). This proposed measure to include the additional area north of Maui and Molokai for this 4-Islands Region Mitigation Area further reduces impacts to humpback whales (and false killer whales).

Within the 4-Islands Region Mitigation Area is the Hawaiian Island Humpback Whale Reproduction Area BIA (4-Islands Region and Penguin Bank). The use of sonar and other transducers primarily occur farther offshore than the designated boundaries of the Hawaiian Islands Humpback Whale Reproduction Area BIA. Explosive events are typically conducted in areas that are designated for explosive use, which are areas outside of the Hawaiian Islands Humpback Whale Reproduction Area BIA.

The restrictions on MFAS sensor MF1 in this area and the fact that the Navy does not plan to use any explosives in this area means that the number of takes of humpback whales will be lessened, as will their potential severity, in that the Navy is avoiding exposures in an area and time where they would be more likely to interfere with cow/calf communication or potentially heightened impacts on sensitive or naïve individuals (calves).

The Navy is also proposing an additional mitigation area, the Hawaii Island Mitigation Area. The Hawaii Island Mitigation Area would be established where year-round, where the Navy will not use more than 300 hrs of MFAS sensory MF1 and will not exceed 20 hrs of MFAS senory MF4 year-round. Also within the Hawaii Island Mitigation Area, the Navy will not use any explosives (*e.g.,* surface-to-surface or air-to-surface missile and gunnery events, BOMBEX, and mine neutralization) during testing and training year-round. Of note here, this measure would provide additional protection in this important reproductive area for humpback whales, reducing impacts in an area and time where they would likely be more severe if incurred. Separately (and addressed more later), these protected areas also reduce impacts for identified biologically important areas for endangered Main Hawaiian Islands insular false killer whales, two species of beaked whales (Cuvier and Blainville's), dwarf sperm whale, pygmy killer whale, melon-headed whale, short-finned pilot whale, and dolphin species (Baird *et al.,* 2015; Van Parijs, 2015).

The 4-Islands Region Mitigation Area and the Hawaii Island Mitigation Area both also overlap with portions of the Hawaiian Islands Humpback Whale NMS. It is also of note that Navy training and testing in the Hawaiian Islands Humpback Whale NMS will follow the procedural mitigation measure that humpbacks are not approached within 100 yds and aircraft operate above 1,000 ft, which further lessens the likelihood of ship strike and behavioral disturbance resulting from aircraft, respectively.

The Navy will continue to issue an annual humpback whale awareness notification message to remind ships and aircraft to be extra vigilant during times of high densities of humpback whales while in transit and to maintain certain distances from animals during the operation of ships and aircraft.

In summary and as described above, the following factors primarily support our preliminary determination that the impacts resulting from Navy's activities are not expected to adversely affect the mysticetes stocks through effects on annual rates of recruitment or survival.

- As described in the ''Serious Injury or Mortality'' section above, between zero and two serious injuries or mortalities over the five-year period could occur for large whales (see Tables 67) depending on the species.
  - Using PBR as a consideration in assessing these possible mortalities, the possible mortality for fin whale (CA/OR/WA), gray whale (Eastern North Pacific stock), humpback whales (CA/OR/WA and Central Pacific stocks), Bryde's whale (Hawaiian stock), and Minke whale (CA/OR/WA stock) is below the insignificance threshold of 10 percent of residual PBR.
  - The possible total mortality for sperm whale (CA/OR/WA stock), blue whale (Eastern North Pacific Stock) and sei whales (Eastern North Pacific stock) is below residual PBR.
  - The possible total mortality for sei whale (Hawaiian stock) is equal to PBR, which places it slightly above residual PBR because of the other known human mortality. PBR is a conservative metric that is not intended to serve as an absolute cap on authorized mortality. One mortality is the smallest amount that could possibly occur in a five-year period, and when this fractional addition is considered in the context of barely exceeding residual PBR, any impacts on the stock are not expected to be more than negligible.
  - While residual PBR is not known for minke whales (Hawaiian stock) and Bryde's whales (Eastern Tropical Pacific stock), very little other human-caused mortality is known for either stock, and the Navy's activities would add a fractional amount to these wide-ranging stocks.
- As described above, any PTS that may occur is expected to be of a small degree, and any TTS of a relatively small degree because of the unlikelihood that animals would be close enough for a long enough period of time to incur more severe PTS (from sonar) and the anticipated effectiveness of mitigation in preventing very close exposures for explosives, as discussed above. Further, as noted above, any threshold shift incurred from sonar would be in the frequency range of 2–20 kHz, which is above the frequency of the majority of mysticete vocalizations, and therefore would not be expected to interfere with conspecific communication.
- While the majority of harassment takes are caused by exposure during ASW activities, the impacts from these exposures are not expected to be significant and are generally expected to be short-term because (and as discussed above):
  - ASW activities typically involve fast-moving assets (relative to marine mammal swim speeds) and individuals are not expected to be exposed either for long periods within a day or over many sequential days.
  - The majority of the harassment takes result from hull-mounted sonar during MTEs. When distance cut offs for mysticetes are applied, this means that all of the takes from hull-mounted sonar (MF1) result from above exposure 154 dB. However, the majority (*e.g.,* 62 percent) of the takes results from exposures below 172 dB. The majority of the takes are not from higher level exposures from which more severe responses would be expected.
  - As described in more detail above, the scale of effects are such that most individuals of the HRC stocks are taken in an average of 1 or 2 days per year and individuals of the SOCAL stocks are taken an average of a few days per year, with the likelihood that some smaller subset might be taken in notably more than a few days per year, but likely something less than 6–32 days per year, but, given this number of takes spread across a year and the nature of the Navy's activities, these takes are not expected to typically occur over sequential days.
- The Navy is implementing mitigation areas that specifically reduce or avoid impacts to humpback whales in their important Hawaii calving area and blue whales in their California feeding areas, and further reduce impacts over all to mysticetes in several other areas, all of which is expected to reduce the

extent, and severity in certain circumstances, of impacts to mysticetes. Consequently, the HSTT activities are not expected to adversely impact rates of recruitment or survival of any of the stocks of mysticete whales (Table 69 and 70 above in this section).

Sperm Whales

In Table 71 and Table 72 below, for sperm whales we indicate the total annual mortality, Level A and Level B harassment, and a number indicating the instances of total take as a percentage of abundance. No PTS or tissue damage is anticipated.

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Table 71. Annual takes of Level B and Level A harassment, mortality for sperm whales in the HRC of the HSTT study area and number indicating the instances of total take as a percentage of stock abundance.

	Instances of indicated types of incidental take (not all takes represent separate individuals, especially for disturbance)										
	Level B Harassment		**Level A Harassment**			**Total Takes**		**Abundance**		**Instance of total take as percent of abundance**	
Species Stock Navy EEZ location (HRC)	**Behavioral Disturbance**	**TTS (may also include disturbance)**	**PTS**	**Tissue Damage**	**Mortality**	**TOTAL TAKES (entire Study Area)**	**Takes (within NAVY EEZ)**	**Total Navy Abundance in and out EEZ (HRC)**	**Within Navy EEZ Abundance HRC (gray)**	**Total take as percentage of total Navy abundance (HRC)**	**EEZ take as percentage of EEZ abundance (HRC)**
Sperm whale Hawaiian (HRC)	2466	30	0	0	0	1930	1317	1656	1317	151	147

Note: For the HI take estimates, we compare predicted takes to abundance estimates generated from the same underlying density estimates, both in and outside of the U.S. EEZ. Because the portion of the Navy's action area inside the U.S. EEZ is generally concomitant with the study area used to generate the abundance estimates in the SARs, and the abundance predicted by the same underlying density estimates is the preferred abundance to use, there is no need to separately compare the take to the SARs abundance estimate.

Table 72. Annual takes of Level B and Level A harassment, mortality for sperm whales in SOCAL of the HSTT study area and number indicating the instances of total take as a percentage of stock abundance.

		Instances of indicated types of incidental take (not all takes represent separate individuals, especially for disturbance)									
		Level B Harassment		Level A Harassment			Total Takes	Abundance		Instance of total take as percent of abundance	
Species	Stock	Behavioral Disturbance	TTS (may also include disturbance)	PTS	Tissue Damage	Mortality	TOTAL TAKES (entire Study Area)	NAVY abundance in Action Area SOCAL [1]	NMFS SARS Abundance [2]	Total take as percentage of total Navy abundance in Action Area	Total take as percentage of total SAR abundance
Sperm whale	CA/OR/WA	2437	56	0	0	0	2493	273	1997	913	125

Note: For the SOCAL take estimates, because of the manner in which the Navy action area overlaps the ranges of many MMPA stocks (*i.e.*, a stock may range far north to Washington state and beyond and abundance may only be predicted within the U.S. EEZ, while the Navy action area is limited to Southern California and northern Mexico, but extends beyond the U.S. EEZ), we compare predicted takes to both the abundance estimates for the action area, as well as the SARs.

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All takes annually for sperm whales are from Level B harassment either behavioral or TTS (Tables 71 and 72 above). Sperm whales are listed as endangered under the ESA (both CA/OR/WA and Hawaii stocks) and depleted under the MMPA. NMFS is currently engaged in an internal Section 7 consultation under the ESA and the outcome of that consultation will further inform our final decision.

Most Level B harassments to sperm whales and from hull-mounted sonar (MF1) in the HSTT Study Area would result from received levels between 154 and 166 dB SPL (85 percent). Therefore, the majority of Level B takes are expected to be in the form of milder responses (*i.e.,* lower-level exposures that still rise to the level of take, but would likely be less severe in the range of responses that qualify as take). As mentioned earlier in this section, we anticipate more severe effects from takes when animals are exposed to higher received levels. Occasional mild to moderate behavioral reactions are unlikely to cause long-term consequences for individual animals or populations, and even if some smaller subset of the takes are in the form of a longer (several hours or a day) and more moderate response, because they are not expected to be repeated over sequential multiple days, impacts to individual fitness are not anticipated.

For the total instances of all of the different types of takes, the numbers indicating the instances of total take as a percentage of abundance for sperm whales are generally between 125 and 151, with 913 for the CA/OR/WA stock of sperm whales specifically when compared against the Navy's action area abundance. Based on the percentages above, most individuals are taken in an average of 1–2 days per year based on the overall abundance of these far-ranging stocks, while some sperm whale individuals that might remain in the Navy's SOCAL action area for extended periods may be taken on more like an average of nine days in a year. These averages allow that perhaps a smaller subset is taken with a slightly higher average and larger variability of highs and lows, but still with no reason to think that any individuals would be taken every day for weeks or months out of the year, much less on sequential days. The majority of these behavioral takes are expected to be of a milder intensity (compared to those that occur at higher levels) and are not likely to occur over sequential days, which suggests that the overall scale of impacts for any individual would be relatively low and unlikely to result in fitness effects that would impact reproductive success or survival.

Sperm whales have shown resilience to acoustic and human disturbance, although they may react to sound sources and activities within a few kilometers. Sperm whales that are exposed to activities that involve the use of sonar and other active acoustic sources may alert, ignore the stimulus, avoid the area by swimming away or diving, or display aggressive behavior (Richardson, 1995; Nowacek, 2007; Southall *et al.,* 2007; Finneran and Jenkins, 2012). Some (but not all) sperm whale vocalizations might overlap with the MFAS/HFAS TTS frequency range, which could temporarily decrease an animal's sensitivity to the calls of conspecifics or returning echolocation signals. However, as noted previously, NMFS does not anticipate TTS of a long duration or severe degree to occur as a result of exposure to MFAS/HFAS. Recovery from a threshold shift (TTS) can take a few minutes to a few days, depending on the exposure duration, sound exposure level, and the magnitude of the initial shift, with larger threshold shifts and longer exposure durations requiring longer recovery times (Finneran *et al.,* 2005; Mooney *et al.,* 2009a; Mooney *et al.,* 2009b; Finneran and Schlundt, 2010).

In summary and as described above, the following factors primarily support our preliminary determination that the impacts resulting from Navy's activities are not expected to adversely affect sperm whales through effects on annual rates of recruitment or survival:

• As described in the ''Serious Injury or Mortality'' section (Table 67), one or two mortalities over five years is proposed for authorization for sperm whales (for CA/OR/WA and Hawaiian stocks, respectively).

○ The proposed serious injury or mortality for the sperm whale (Hawaiian stock) does fall below the insignificance threshold and, therefore, we consider the addition an insignificant incremental increase to human-caused mortality.

○ The possible total serious injury or total mortality for sperm whale (CA/OR/WA stock) falls below residual PBR. NOAA is currently implementing marine mammal take reduction measures as identified in the Pacific Offshore Cetacean Take Reduction Plan that addresses incidental serious injury and mortality of sperm whales, and other whales in the CA/OR swordfish drift gillnet fishery. The total anticipated human-caused mortality is not expected to exceed PBR for both stocks.

• No PTS or injury from acoustic or explosive stressors is proposed for authorization or anticipated to occur for sperm whales.

• While the majority of takes are caused by exposure during ASW activities, the impacts from these exposures are not expected to have either significant or long-term effects because (and as discussed above):

○ ASW activities typically involve fast-moving assets (relative to marine mammal swim speeds) and individuals are not expected to be exposed either for long periods within a day or over many sequential days.

○ As discussed, the majority of the harassment takes result from hull-mounted sonar during MTEs. When distance cutoffs are applied for odontocetes, this means that all of the takes from hull-mounted sonar (MF1) result from above exposure 154 dB. However, the majority (*e.g.,* 85 percent) of the takes results from exposures below 166 dB. The majority of the takes are not from higher level exposures from which more severe responses would be expected.

• As described in more detail above (Table 71 and 72), the scale of the effects are such that for sperm whales, most individuals are take in an average of 1–2 days per year, while some subset of individuals that might remain in the Navy's SOCAL action area for extended periods could be taken on an average of 9 days per year. As described above, given this number of takes spread across a year and the nature of the Navy's activities, these takes are not expected to typically occur over sequential days.

• The HSTT activities are not expected to occur in an area/time of specific importance for reproductive, feeding, or other known critical behaviors for sperm whales and there is no designated critical habitat in the HSTT Study Area.

Consequently, the HSTT activities are not expected to adversely impact rates of recruitment or survival of any of the analyzed stocks of sperm whales (Table 73 above in this section).

Kogia spp.

In Table 73 and 74 below, for *Kogia spp.* we indicate the total annual mortality, Level A and Level B harassment, and a number indicating the instances of total take as a percentage of abundance. Overall, takes from Level A harassment (PTS and Tissue Damage) account for less than one percent of all total takes.

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Table 73. Annual takes of Level B and Level A harassment, mortality for Kogia species in the HRC of the HSTT study area and number indicating the instances of total take as a percentage of stock abundance.

	Instances of indicated types of incidental take (not all takes represent separate individuals, especially for disturbance)										
	Level B Harassment		Level A Harassment		Mortality	Total Takes		Abundance		Instance of total take as percent of abundance	
Species Stock Navy EEZ location (HRC)	Behavioral Disturbance	TTS (may also include disturbance)	PTS	Tissue Damage		TOTAL TAKES (entire Study Area)	Takes (within NAVY EEZ)	Total Navy Abundance in and out EEZ (HRC)	Within Navy EEZ Abundance HRC	Total take as percentage of total Navy abundance (HRC)	EEZ take as percentage of EEZ abundance (HRC)
Dwarf sperm whale Hawaiian (HRC)	5870	14550	64	0	0	20484	15310	8218	6379	249	240
Pygmy sperm whale Hawaiian (HRC)	2329	5822	27	0	0	8178	6098	3349	2600	244	235

Note: For the HI take estimates, we compare predicted takes to abundance estimates generated from the same underlying density estimates, both in and outside of the U.S. EEZ. Because the portion of the Navy's action area inside the U.S. EEZ is generally concomitant with the study area used to generate the abundance estimates in the SARs, and the abundance predicted by the same underlying density estimates is the preferred abundance to use, there is no need to separately compare the take to the SARs abundance estimate.

Table 74. Annual takes of Level B and Level A harassment, mortality for Kogia species in SOCAL of the HSTT study area and number indicating the instances of total take as a percentage of stock abundance.

		Instances of indicated types of incidental take (not all takes represent separate individuals, especially for disturbance)									
		Level B Harassment		Level A Harassment			Total Takes	Abundance		Instance of total take as percent of abundance	
Species	Stock	Behavioral Disturbance	TTS (may also include Disturbance)	PTS	Tissue Damage	Mortality	TOTAL TAKES (entire Study Area)	NAVY abundance in Action Area SOCAL [1]	NMFS SARS Abundance [2]	Total take as percentage of total Navy abundance in Action Area	Total take as percentage of total SAR abundance
Kogia whales	CA/OR/WA	2779	6353	38	0	0	9170	757	4111	1211	223

Note: For the SOCAL take estimates, because of the manner in which the Navy action area overlaps the ranges of many MMPA stocks (*i.e.*, a stock may range far north to Washington state and beyond and abundance may only be predicted within the U.S. EEZ, while the Navy action area is limited to Southern California and northern Mexico, but extends beyond the U.S. EEZ), we compare predicted takes to both the abundance estimates for the action area, as well as the SARs.

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Nearly all takes annually for Kogia species are from Level B harassment either behavioral or TTS (less than 1 percent PTS) (Tables 73 and 74 above). No serious injury, or mortalities are anticipated. These species are not ESA-listed.

Most Level B harassments to *Kogia spp.* from hull-mounted sonar (MF1) in the HSTT Study Area would result from received levels between 154 and 166 dB SPL (85 percent). Therefore, the majority of Level B takes are expected to be in the form of milder responses (as compared to higher level exposures). As mentioned earlier in this section, we anticipate more severe effects from takes when animals are exposed to higher received levels.

For the total instances of all of the different types of takes, the numbers indicating the instances of total take as a percentage of abundance for *Kogia* whales are generally between 223 and 249, with 1,211 for the CA/OR/WA stock of *Kogia,* specifically when compared against the Navy's action area abundance. Based on the percentages above, most individuals are taken in an average of 3 days in a year, while some Kogia individuals that might remain in the SOCAL action area may be taken an average of 12 days in a year. These averages allow that perhaps a smaller subset is taken with a slightly higher average and larger variability of highs and lows, but still with no reason to think that any individuals would be taken every day for weeks or months out of the year, much less on sequential days. The majority of these behavioral takes are expected to be of a milder intensity (compared to those that occur at higher levels) and nor are they likely to occur over sequential days, which suggests that the overall scale of impacts for any individual would be relatively low and unlikely to result in fitness effects that would impact reproductive success or survival.

The quantitative analysis predicts small numbers of PTS per year from sonar and other transducers (during training and testing activities). However, *Kogia* whales would likely avoid sound levels that could cause higher levels of TTS (greater than 20 dB) or PTS. TTS and PTS thresholds for high-frequency cetaceans, including *Kogia* whales, are lower than for all other marine mammals, which leads to a higher number of estimated impacts relative to the number of animals exposed to the sound as compared to other hearing groups (*e.g.,* mid-frequency cetaceans).

Impacts to dwarf and pygmy sperm whale stocks (small and resident populations BIAs) will be reduced through the Hawaii Island Mitigation Area that limits the use of mid-frequency active anti-submarine warfare sensor bins MF1 and MF4 and where the Navy will not use explosives during testing and training (*e.g.,* surface-to-surface or air-to-surface missile and gunnery events, BOMBEX, and mine neutralization).

In summary and as described above, the following factors primarily support our preliminary determination that the impacts resulting from Navy's activities are not expected to adversely affect *Kogia spp.* through effects on annual rates of recruitment or survival.

- No serious injuries or mortalities are proposed for authorization or anticipated to occur for *Kogia spp.*
- While the majority of takes are caused by exposure during ASW activities, the impacts from these exposures are not expected to have either significant or long-term effects because (and as discussed above):
  - ASW activities typically involve fast-moving assets (relative to marine mammal swim speeds) and individuals are not expected to be exposed either for long periods within a day or over many sequential days.
  - As discussed, the majority of the harassment takes result from hull-mounted sonar during MTEs. When distance cutoffs are applied for odontocetes, this means that all of the takes from hull-mounted sonar (MF1) result from above exposure 154 dB. However, the majority (*e.g.,* 85 percent) of the takes results from exposures below 166 dB. The majority of the takes have a relatively lower likelihood in have severe impacts.
- As described in more detail above (Tables 73 and 74), the scale of the effects are such that pygmy and dwarf sperm whale are taken an average of 2–3 days per year, while some subset of individuals that might remain in the SOCAL action area for extended periods could be taken on an average of 12 days per year (based on the percentages above, respectively, but with some taken more or less). As described above, given this number of takes spread across a year and the nature of the Navy's activities, these takes are not expected to typically occur over sequential days.
- Impacts to these small and resident populations of dwarf and pygmy sperm whale stocks will be reduced through the implementation of the requirements in the Hawaii Island Mitigation Area.
- *Kogia spp.* are not depleted under the MMPA, nor are they listed under the ESA.
- The HSTT activities are not expected to occur in an area/time of specific importance for reproductive, feeding, or other known critical behaviors for *Kogia spp.* and there is no designated critical habitat in the HSTT Study Area.

Consequently, the HSTT activities are not expected to adversely impact rates of recruitment or survival of any of the analyzed stocks of *Kogia* whales (Table 73 above in this section).

Beaked Whales

In Tables 75 and 76 below, for beaked whales, we indicate the total annual mortality, Level A and Level B harassment, and a number indicating the instances of total take as a percentage of abundance. No Level A harassment (PTS and Tissue Damage) takes are anticipated.

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Table 75. Annual takes of Level B and Level A harassment, mortality for beaked whales in the HSTT study area and number indicating the instances of total take as a percentage of stock abundance.

	Instances of indicated types of incidental take (not all takes represent separate individuals, especially for disturbance)										
	Level B Harassment		Level A Harassment			Total Takes		Abundance		Instance of total take as percent of abundance	
Species Stock Navy EEZ location (HRC)	Behavioral Disturbance	TTS (may also include disturbance)	PTS	Tissue Damage	Mortality	TOTAL TAKES (entire Study Area)	Takes (within NAVY EEZ)	Total Navy Abundance in and out EEZ (HRC)	Within Navy EEZ Abundance HRC	Total take as percentage of total Navy abundance (HRC)	EEZ take as percentage of EEZ abundance (HRC)
Blainville's beaked whale Hawaiian (HRC)	5369	17	0	0	0	5386	4140	989	768	545	539
Cuvier's beaked whale Hawaiian (HRC)	1792	4	0	0	0	1796	1377	345	268	521	514
Longman's beaked whale Hawaiian (HRC)	19152	81	0	0	0	19233	14585	3568	2770	539	527

Note: For the HI take estimates, we compare predicted takes to abundance estimates generated from the same underlying density estimates, both in and outside of the U.S. EEZ. Because the portion of the Navy's action area inside the U.S. EEZ is generally concomitant with the study area used to generate the abundance estimates in the SARs, and the abundance predicted by the same underlying density estimates is the preferred abundance to use, there is no need to separately compare the take to the SARs abundance estimate.

Table 76. Annual takes of Level B and Level A harassment, mortality for beaked whales in SOCAL in the HSTT study area and number indicating the instances of total take as a percentage of stock abundance.

		Instances of indicated types of incidental take (not all takes represent separate individuals, especially for disturbance)									
		Level B Harassment		Level A Harassment			Total Takes	Abundance		Instance of total take as percent of abundance	
Species	Stock	Behavioral Disturbance	TTS (may also include disturbance)	PTS	Tissue Damage	Mortality	TOTAL TAKES (entire Study Area)	NAVY abundance in Action Area SOCAL [1]	NMFS SARS Abundance [2]	Total take as percentage of total Navy abundance	Total take as percentage of total SAR abundance
Baird's beaked whale	CA/OR/WA	2030	14	0	0	0	2044	74	2697	2762	76
Cuvier's beaked whale	CA/OR/WA	11347	79	0	0	0	11426	520	3274	2197	349
Mesoplodon spp.	CA/OR/WA	6109	43	0	0	0	6152	89	3044	6912	202

Note: For the SOCAL take estimates, because of the manner in which the Navy action area overlaps the ranges of many MMPA stocks (*i.e.*, a stock may range far north to Washington state and beyond and abundance may only be predicted within the U.S. EEZ, while the Navy action area is limited to Southern California and northern Mexico, but extends beyond the U.S. EEZ), we compare predicted takes to both the abundance estimates for the action area, as well as the SARs.

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Nearly all takes annually for beaked whales from Level B harassment are behavioral, less than 1 percent are TTS (Tables 75 and 76 above). No PTS, injury, serious injury, or mortalities are anticipated. No beaked whales are listed under the ESA.

Most Level B harassments to beaked whales from hull-mounted sonar (MF1) in the HSTT Study Area would result from received levels between 154 and 160 dB SPL (94 percent). Therefore, the majority of Level B takes are expected to be in the form of milder responses (*i.e.*, lower-level exposures that still rise to the level of take, but would likely be less severe in the range of responses that qualify as take). As mentioned earlier in this section, we anticipate more severe effects from takes when animals are exposed to higher received levels.

For the total instances of all of the different types of takes, the numbers indicating the instances of total take as a percentage of abundance range from 514 to 545 for Blainville's beaked whale, Cuvier's beaked whale, and Longman's beaked whale (all Hawaiian stocks), with no notable difference in and outside of the U.S. EEZ (Table 75). For beaked whales off of SOCAL, the instances of total take as a percentage of abundance are between 76 and 349 as compared to the total abundance of these far-ranging stocks. However, the percentages are 2762, 2197, and 6912 for Baird's beaked whale, Cuvier's beaked whale, and Mesoplodon *spp.,* respectively, when compared to the abundance within the Navy's action area, which is based on static density estimates (Table 76). This means that generally, beaked whales might be expected to be taken on an average of 1–6 days per year, while some individuals that might remain in the Navy SOCAL action area for extended periods of time could be taken on more, but not likely as high as 22–28 days per year, or potentially more, though not likely as high as 69 days per year, for Mesoplodon *spp.* While the likelihood and extent of repeated takes for some subset of Mesoplodon individuals is comparatively high when using the Navy's abundance, this is likely a result of the fact that the acoustic modeling process does not account for horizontal animal movement and thus and migration of beaked whales in and out the Study Area. The Navy's abundance indicates a population of approximately 89 Mesoplodon individuals in Southern California. However, it is unlikely that it is the same 89 individuals that are present all year long. Even for those beaked whales which show high site fidelity, tagging data indicates that they can travel tens of km to up to 100 km from an initial tagging or sighting location (*e.g.,* Schorr *et al.,* 2009, Sweeney *et al.,* 2007, etc.). Therefore, additional individuals up to a 100 km or more from the study area may also at some time move into the study area and be available to be exposed to Navy activities. As a result, the potential for repeated exposures of Mesoplodon likely falls somewhere in between the numbers estimated using the SAR abundance and the Navy's abundance. Also, we'd note that NMFS's 2017 draft SAR (Caretta *et al.,* 2017) indicates a slight increasing population trend for this stock when 2014 survey data are considered, lessening the likelihood of adverse impacts on rates of recruitment or survival, if some small number of individuals incur fitness impacts. Given the numbers of days within the year that they are expected to be taken, some subset of SOCAL Mesoplodon beaked whale individuals will likely occasionally be taken across sequential days. However, given the milder comparative nature of the majority of the anticipated exposures (*i.e.,* the received level and the fact that most individual exposures would be expected not to be of a long duration due to the nature of the operations and the moving animals), combined with the fact that there are ample alternative nearby feeding opportunities available for odontocetes should disturbances interrupt feeding bouts, and the evidence that beaked whales often leave and area during training exercises but return a few days later (Claridge and Durban, 2009; Moretti *et al.,* 2009, 2010; Tyack *et al.,* 2010, 2011; McCarthy *et al.,* 2011), impacts to individual fitness that could affect survivorship or reproductive success are not anticipated.

Beaked whales have been shown to be particularly sensitive to sound and therefore have been assigned a lower harassment threshold, *i.e.,* a more distant distance cutoff (50 km for high source level, 25 km for moderate source level). This means that many of the authorized takes are expected to result from lower-level exposures. But we also note the growing literature to support the fact that marine mammals differentiate sources of the same level emanating from different distances, and exposures from more distant sources are likely comparatively less impactful.

Behavioral responses can range from a mild orienting response, or a shifting of attention, to flight and panic (Richardson, 1995; Nowacek, 2007; Southall *et al.,* 2007; Finneran and Jenkins, 2012). Research has also shown that beaked whales are especially sensitive to the presence of human activity (Tyack *et al.,* 2011; Pirotta *et al.,* 2012). Beaked whales have been documented to exhibit avoidance of human activity or respond to vessel presence (Pirotta *et al.,* 2012). Beaked whales were observed to react negatively to survey vessels or low altitude aircraft by quick diving and other avoidance maneuvers, and none were observed to approach vessels (Wursig *et al.,* 1998). Some beaked whale vocalizations may overlap with the MFAS/HFAS TTS frequency range (2–20 kHz). However, as noted above, NMFS does not anticipate TTS of a serious degree or extended duration to occur as a result of exposure to MFAS/HFAS.

It has been speculated for some time that beaked whales might have unusual sensitivities to sonar sound due to their likelihood of stranding in conjunction with MFAS use. Research and observations show that if beaked whales are exposed to sonar or other active acoustic sources they may startle, break off feeding dives, and avoid the area of the sound source to levels of 157 dB re 1 µPa, or below (McCarthy *et al.,* 2011). Acoustic monitoring during actual sonar exercises revealed some beaked whales continuing to forage at levels up to 157 dB re 1 µPa (Tyack *et al.* 2011). Stimpert *et al.* (2014) tagged a Baird's beaked whale, which was subsequently exposed to simulated MFAS. Changes in the animal's dive behavior and locomotion were observed when received level reached 127 dB re 1µPa. However, Manzano-Roth *et al.* (2013) found that for beaked whale dives that continued to occur during MFAS activity, differences from normal dive profiles and click rates were not detected with estimated received levels up to 137 dB re 1 µPa while the animals were at depth during their dives. And in research done at the Navy's fixed tracking range in the Bahamas, animals were observed to leave the immediate area of the anti-submarine warfare training exercise (avoiding the sonar acoustic footprint at a distance where the received level was ''around 140 dB'' SPL, according to Tyack *et al.* (2011)) but return within a few days after the event ended (Claridge and Durban, 2009; Moretti *et al.,* 2009, 2010; Tyack *et al.,* 2010, 2011; McCarthy *et al.,* 2011). Tyack *et al.* (2011) report that, in reaction to sonar playbacks, most beaked whales stopped echolocating, made long slow ascent to the surface, and moved away from the sound. A similar behavioral response study conducted in Southern California waters during the 2010–2011 field season found that Cuvier's beaked whales exposed to MFAS displayed behavior ranging from initial orientation changes to avoidance responses characterized by energetic fluking and swimming away from the source (DeRuiter *et al.,* 2013b). However, the authors did not detect similar responses to incidental exposure to distant naval sonar exercises at comparable received levels, indicating that context of the exposures (*e.g.,* source proximity, controlled source ramp-up) may have been a significant factor. The study itself found the results inconclusive and meriting further investigation. Cuvier's beaked whale responses suggested particular sensitivity to sound exposure as consistent with results for Blainville's beaked whale.

Populations of beaked whales and other odontocetes on the Bahamas and other Navy fixed ranges that have been operating for decades, appear to be stable. Behavioral reactions (avoidance of the area of Navy activity) seem likely in most cases if beaked whales are exposed to anti-submarine sonar within a few tens of kilometers, especially for prolonged periods (a few hours or more) since this is one of the most sensitive marine mammal groups to anthropogenic sound of any species or group studied to date and research indicates beaked whales will leave an area where anthropogenic sound is present (Tyack *et al.,* 2011; De Ruiter *et al.,* 2013; Manzano-Roth *et al.,* 2013; Moretti *et al.,* 2014). Research involving tagged Cuvier's beaked whales in the SOCAL Range Complex reported on by Falcone and Schorr (2012, 2014) indicates year-round prolonged use of the Navy's training and testing area by these beaked whales and has documented movements in excess of hundreds of kilometers by some of those animals. Given that some of these animals may routinely move hundreds of kilometers as part of their normal pattern, leaving an area where sonar or other anthropogenic sound is present may have little, if any, cost to such an animal. Photo identification studies in the SOCAL Range Complex, a Navy range that is utilized for training and testing, have identified approximately 100 individual Cuvier's beaked whale individuals with 40 percent having been seen in one or more prior years, with re-sightings up to seven years apart (Falcone and Schorr, 2014). These results indicate long-term residency by individuals in an intensively used Navy training and testing area, which may also suggest a lack of long-term consequences as a result of exposure to Navy training and testing activities. Finally, results from passive acoustic monitoring estimated regional Cuvier's beaked whale densities were higher than indicated by the NMFS's broad scale visual surveys for the U.S. west coast (Hildebrand and McDonald, 2009).

Based on the findings above, it is clear that the Navy's long-term ongoing use of sonar and other active acoustic sources has not precluded beaked whales from also continuing to inhabit those areas. Based on the best available science, the Navy and NMFS believe that beaked whales that exhibit a significant TTS or behavioral reaction due to sonar and other active acoustic training or testing activities would generally not have long-term consequences for individuals or populations.

NMFS does not expect strandings, serious injury, or mortality of beaked whales to occur as a result of training activities. Stranding events coincident with Navy MFAS use in which exposure to sonar is believed to have been a contributing factor were detailed in the Stranding and Mortality section of this proposed rule. However, for some of these stranding events, a causal relationship between sonar exposure and the stranding could not be clearly established (Cox *et al.,* 2006). In other instances, sonar was considered only one of several factors that, in their aggregate, may have contributed to the stranding event (Freitas, 2004; Cox *et al.,* 2006). Because of the association between tactical MFAS use and a small number of marine mammal strandings, the Navy and NMFS have been considering and addressing the potential for strandings in association with Navy activities for years. In addition to the proposed mitigation measures intended to more broadly minimize impacts to marine mammals, the reporting requirements set forth in this rule ensure that NMFS is notified if a stranded marine mammal is found (see General Notification of Injured or Dead Marine Mammals in the regulatory text below). Additionally, through the MMPA process (which allows for adaptive management), NMFS and the Navy will determine the appropriate way to proceed in the event that a causal relationship were to be found between Navy activities and a future stranding.

Biologically important areas for small and resident populations of Cuvier's and Blainville's beaked whales will be protected by the Hawaii Island Mitigation Area that limits the use of mid-frequency active anti-submarine warfare sensor bins MF1 and MF4 and where the Navy will not use explosives during testing and training (*e.g.,* surface-to-surface or air-to-surface missile and gunnery events, BOMBEX, and mine neutralization).

In summary and as described above, the following factors primarily support our preliminary determination that the impacts resulting from the Navy's activities are not expected to adversely affect beaked whales taken through effects on annual rates of recruitment or survival.

• No mortalities of beaked whales are proposed for authorization or anticipated to occur.

• No PTS or injury of beaked whales from acoustic or explosives stressors are proposed for authorization or anticipated to occur.

• While the majority of takes are caused by exposure during ASW activities the impacts from these exposures are not expected to have either significant or long-term effects because (and as discussed above):

○ ASW activities typically involve fast-moving assets (relative to marine mammals swim speeds) and individuals are not expected to be exposed either for long periods within a day or over many sequential days.

○ As discussed, the majority of the harassment takes result from hull-mounted sonar during MTEs. When distance cutoffs are applied for beaked whales, this means that all of the takes from hull-mounted sonar (MF1) result from above exposure 154 dB. However, the majority (*e.g.,* 94 percent) of the takes results from exposures below 160 dB. The majority of the takes have a relatively lower likelihood to have severe impacts.

• As described in more detail above (Tables 75 and 76), the scale of the effects are such that individuals in these stocks are likely taken in an average of 1–6 days per year, while a subset of beaked whale individuals that remain in the SOCAL action area for a substantial portion of the year could be taken in more, though not likely above 22–28 days per year, with Mesolplodon individuals potentially taken more, though not likely above 69 days per year. While the likelihood and extent of repeated takes for some subset of Mesoplodon individuals is comparatively high, we note that the population trend for this stock is increasing slightly, lessening the likelihood of adverse impacts on rates of recruitment or survival. While some of the individuals in SOCAL may occasionally be taken in sequential days, because of the nature of the exposures and the other factors discussed above, any impacts to individual fitness would be limited and with the potential to accrue to no more than a limited number of individuals and would not be expected to affect rates of recruitment or survival.

• Impacts to BIAs for small and resident populations of Cuvier's and Blainville's beaked whales will be reduced through implementation of requirements in the Hawaii Island Mitigation Area.

Consequently, the activities are not expected to adversely impact rates of recruitment or survival of any of the beaked whale stocks analyzed (Tables 75 and 76 above in this section).

Odontocetes (Small Whales and Dolphins)

In Tables 77 and 78 below, for odontocetes (in this section odontocetes refers specifically to the small whales and dolphins indicated in Tables 77 and 78), we indicate the total annual mortality, Level A and Level B harassment, and a number indicating the instances of total take as a percentage of abundance. Overall, takes from Level A harassment (PTS and Tissue Damage) account for less than one percent of all total takes.

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Table 77. Annual takes of Level B and Level A harassment, mortality for odontocetes in the HSTT study area and number indicating the instances of total take as a percentage of stock abundance.

	Instances of indicated types of incidental take (not all takes represent separate individuals, especially for disturbance)										
	Level B Harassment		Level A Harassment		Mortality	Total Takes		Abundance		Instance of total take as percent of abundance	
Species Stock Navy EEZ location (HRC)	Behavioral Disturbance	TTS (may also include disturbance)	PTS	Tissue Damage		TOTAL TAKES (entire Study Area)	Takes (within NAVY EEZ)	Total Navy Abundance in and out EEZ (HRC)	Within Navy EEZ Abundance HRC	Total take as percentage of total Navy abundance (HRC)	EEZ take as percentage of EEZ abundance (HRC)
Bottlenose dolphin Hawaiian Pelagic (HRC)	3196	133	0	0	0	3329	2481	1528	1442	218	172
Bottlenose dolphin Kauai & Niihau (HRC)	534	31	0	0	0	565	264	184	184	307	143
Bottlenose dolphin Oahu (HRC)	8600	62	1	0	0	8663	8376	741	741	1169	1130
Bottlenose dolphin 4-Island (HRC)	349	10	0	0	0	359	316	189	189	190	167
Bottlenose dolphin Hawaii (HRC)	74	5	0	0	0	79	42	131	131	60	32
False killer whale Hawaii Pelagic (HRC)	999	42	0	0	0	1041	766	645	507	161	151
False killer whale Main Hawaiian Islands Insular (HRC)	572	16	0	0	0	588	476	147	147	400	324

False killer whale Northwestern Hawaiian Islands (HRC)	365	16	0	0	0	381	280	215	169	177	166
Fraser's dolphin Hawaiian (HRC)	39784	1289	2	0	0	41075	31120	5408	18763	760	166
Killer whale Hawaiian (HRC)	118	6	0	0	0	124	93	69	54	180	172
Melon-headed whale Hawaiian Islands (HRC)	3260	231	0	0	0	3491	2557	1782	1782	196	143
Melon-headed whale Kohala Resident (HRC)	341	10	0	0	0	351	182	447	447	79	41
Pantropical spotted dolphin Hawaii Island (HRC)	3767	227	0	0	0	3994	2576	2405	2405	166	107
Pantropical spotted dolphin Hawaii Pelagic (HRC)	9973	476	0	0	0	10449	7600	5462	4637	191	164
Pantropical spotted dolphin Oahu (HRC)	4284	45	0	0	0	4329	4194	372	372	1164	1127
Pantropical spotted dolphin 4-Island (HRC)	702	17	0	0	0	719	634	657	657	109	96
Pygmy killer whale Hawaiian	8122	401	0	0	0	8523	6538	4928	3931	173	166

(HRC)											
Pygmy killer whale Tropical (HRC)	710	50	0	0	0	760	490	159	23	478	2130
Risso's dolphin Hawaiian (HRC)	8950	448	0	0	0	9398	7318	1210	4199	777	174
Rough-toothed dolphin Hawaiian (HRC)	6112	373	0	0	0	6485	4859	3054	2808	212	173
Short-finned pilot whale Hawaiian (HRC)	12499	433	1	0	0	12933	9946	6433	5784	201	172
Spinner dolphin Hawaii Island (HRC)	279	12	0	0	0	291	89	629	629	46	14
Spinner dolphin Hawaii Pelagic (HRC)	4331	202	0	0	0	4533	3491	2885	2229	157	157
Spinner dolphin Kauai & Niihau (HRC)	1683	63	0	0	0	1746	812	604	604	289	134
Spinner dolphin Oahu & 4-Island (HRC)	1790	34	1	0	0	1825	1708	354	354	516	482
Striped dolphin Hawaiian (HRC)	7379	405	0	0	0	7784	6034	4779	3646	163	165

Note: For the HI take estimates, we compare predicted takes to abundance estimates generated from the same underlying density estimates, both in and outside of the U.S. EEZ. Because the portion of the Navy's action area inside the U.S. EEZ is generally concomitant with the study area used to generate the abundance estimates in the SARs, and the abundance predicted by the same underlying density estimates is the preferred abundance to use, there is no need to separately compare the take to the SARs abundance estimate.

Table 78. Annual takes of Level B and Level A harassment, mortality for odontocetes in SOCAL of the HSTT study area and number indicating the instances of total take as a percentage of stock abundance.

		Instances of indicated types of incidental take (not all takes represent separate individuals, especially for disturbance)									
		Level B Harassment		Level A Harassment			Total Takes	Abundance		Instance of total take as percent of abundance	
Species	Stock	Behavioral Disturbance	TTS (may also include disturbance)	PTS	Tissue Damage	Mortality	TOTAL TAKES (entire Study Area)	NAVY Abundance in Action Area SOCAL [1]	NMFS SARS Abundance [2]	Total take as percentage of total Navy abundance in Action Area	Total take as percentage of total SAR abundance
Bottlenose dolphin	California Coastal	1771	38	0	0	0	1809	238	515	760	351
Bottlenose dolphin	CA/OR/WA Offshore	51727	3695	3	0	0	55425	5946	1924	932	2881
Killer whale	Eastern North Pacific (ENP) Offshore	96	11	0	0	0	107	4	240	2675	45
Killer whale	ENP Transient/ West Coast Transient	179	20	0	0	0	199	30	243	663	82
Long-beaked common dolphin	California	233485	13787	18	2	0	247292	10258	101305	2411	244
Northern right whale dolphin	CA/OR/WA	90052	8047	10	1	0	98110	7705	26556	1273	369

Pacific white-sided dolphin	CA/OR/WA	69245	6093	5	0	0	75343	6626	26814	1137	281
Risso's dolphin	CA/OR/WA	116143	10118	9	0	0	126270	7784	6336	1622	1993
Short-beaked common dolphin	CA/OR/WA	1374048	118525	79	10	2	1492664	261438	969861	571	154
Short-finned pilot whale	CA/OR/WA	1789	124	1	0	0	1914	208	836	920	229
Striped dolphin	CA/OR/WA	163640	11614	3	0	0	175257	39862	29211	440	600

Note: For the SOCAL take estimates, because of the manner in which the Navy action area overlaps the ranges of many MMPA stocks (*i.e.*, a stock may range far north to Washington state and beyond and abundance may only be predicted within the U.S. EEZ, while the Navy action area is limited to Southern California and northern Mexico, but extends beyond the U.S. EEZ), we compare predicted takes to both the abundance estimates for the action area, as well as the SARs.

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Nearly all takes annually for odonotocetes are from Level B harassment either behavioral or TTS (less than 1 percent PTS) (Tables 77 and 78 above). No serious injuries or mortalities are anticipated. False killer whales (Main Hawaiian Islands Insular) are listed as endangered under the ESA and depleted under the MMPA. NMFS is currently engaged in an internal Section 7 consultation under the ESA and the outcome of that consultation will further inform our final decision.

Most Level B harassments to odontocetes from hull-mounted sonar (MF1) in the HSTT Study Area would result from received levels between 154 and 166 dB SPL (85 percent). Therefore, the majority of Level B takes are expected to be in the form of milder responses compared to higher level exposures). As mentioned earlier in this section, we anticipate more severe effects from takes when animals are exposed to higher received levels.

For the total instances of all of the different types of takes, the numbers indicating the instances of total take for odontocetes addressed in this section as a percentage of abundance range from 14 to 1,169 for Hawaiian stocks (Table 77). For most odontocetes off SOCAL, the instances of total take as a percentage of abundance are between 45 and 1,273 (Table 78). However, the percentages are 2,675 and 2,411 for Killer whale and Long-beaked common dolphin, respectively, when compared to the abundance within the Navy action area, which is based on static density estimates (Table 78). The percentages are 1,993 and 1,622 for Risso's dolphin when compared to the total U.S. EEZ abundance (from the SARs) and to the abundance within the Navy action area, respectively, and 2,811 for Bottlenose dolphin (CA/OR/WA offshore stock) when compared to the total abundance. This means that generally, Hawaiian and SOCAL odontocetes stocks might be expected to be taken an average of 2–13 days per year, while some of a subset of individuals of four stocks (Offshore bottlenose dolphins, killer whales, long-beaked common dolphin, and Risso's dolphin) that might remain in the Navy SOCAL action area for extended periods of time could be taken on more, 17 to 27 days per year. It is notable that for the offshore stock of bottlenose dolphins and for Risso's dolphins, the SAR abundances are actually less than the Navy action area abundances, likely because these are more offshore species and the navy abundance captures the abundance generated outside the U.S. EEZ from the Navy action are density estimates, and therefore the percentages are higher—but either way these stock comparisons fall within the general bounds discussed above. We further note that long-beaked common dolphin, which have a high percentage generated from a high number of takes and a high abundance, have an increasing population trend (Caretta *et al.,* 2017), further lessening the likelihood of adverse impacts to rates of recruitment or survival. The majority of the takes are not from higher level exposures from which more severe responses would be expected. Given the numbers of days within the year that they are expected to be taken, some subset of individuals will likely occasionally be taken across sequential days, however, given the milder to moderate nature of the majority of the anticipated exposures (*i.e.,* the received level and the fact that most individual exposures would be expected not to be of a long duration due to the nature of the operations and the moving animals), combined with the fact that there are ample alternative nearby feeding opportunities available for odontocetes should disturbances interrupt feeding bouts, impacts to individual fitness that could affect survivorship or reproductive success are not anticipated.

Research and observations show that if delphinids are exposed to sonar or other active acoustic sources they may react in a number of ways depending on their experience with the sound source and what activity they are engaged in at the time of the acoustic exposure. Delphinids may not react at all until the sound source is approaching within a few hundred meters to within a few kilometers depending on the environmental conditions and species. Delphinids that are exposed to activities that involve the use of sonar and other active acoustic sources may alert, ignore the stimulus, change their behaviors or vocalizations, avoid the sound source by swimming away or diving, or be attracted to the sound source (Richardson, 1995; Nowacek, 2007; Southall *et al.,* 2007; Finneran and Jenkins, 2012).

Many of the recorded delphinid vocalizations overlap with the MFAS/HFAS TTS frequency range (2–20 kHz); however, as noted above, NMFS does not anticipate TTS of a serious degree or extended duration to occur as a result of exposure to MFAS/HFAS.

Identified important areas for odontocetes will be protected by the Navy's mitigation areas. The size of the 4-Islands Region Mitigation Area would expand to include an area north of Maui and Molokai and overlaps an area identified as a BIA for the endangered Main Hawaiian Islands insular false killer whales (Baird *et al.,* 2015; Van Parijs, 2015) (see Figure 5.4–3, in Chapter 5 Mitigation Areas for Marine Mammals in the Hawaii Range Complex of the HSTT DEIS/OEIS). The 4-Islands Region Mitigation Area provides partial protection for identified biologically important area for dolphin species (small and resident populations) including common bottlenose dolphin, pantropical spotted dolphin, and spinner dolphin by not using mid-frequency active anti-submarine warfare sensor MF1. The Navy's Hawaii Island Mitigation Area also provides additional protection for identified biologically important areas (small and resident populations) for Main Hawaiian Islands insular false killer whales, pygmy killer whale, melon-headed whale, short-finned pilot whale, and dolphin species (common bottlenose dolphin, pantropical spotted dolphin, spinner dolphin, rough-toothed dolphins) by limiting the use of mid-frequency active anti-submarine warfare sensor bins MF1 and MF4 and not using explosives during testing and training (*e.g.,* surface-to-surface or air-to-surface missile and gunnery events, BOMBEX, and mine neutralization).

In summary and as described above, the following factors primarily support our preliminary determination that the impacts resulting from Navy's activities are not expected to adversely affect dolphins and small whales taken through effects on annual rates of recruitment or survival.

- As described in the ''Serious Injury or Mortality'' section (Table 68), 1.2 mortalities annually over five years is proposed for authorization for short-beaked common dolphin (CA/OR/WA stock). The proposed mortality for short-beaked common dolphin (CA/OR/WA stock) falls below the insignificance threshold and, therefore, we consider the addition an insignificant incremental increase to human-caused mortality.
- There are no PTS or injury from acoustic or explosive sources proposed for authorization or anticipated to occur for most odontocetes. As described above, any PTS that may occur is expected to be of a relatively smaller degree because of the unlikelihood that animals would be close enough for a long enough amount of time to incur more severe PTS (for sonar) and the anticipated effectiveness of mitigation in preventing very close exposures for explosives.
- Large threshold shifts are not anticipated for these activities because of the unlikelihood that animals will remain within the ensonified area (due to the short duration of the majority of exercises, the speed of the vessels (relative to marine mammals swim speeds), and the short distance within which the animal would need to approach the sound source) at high levels for the duration necessary to induce larger threshold shifts.
- While the majority of takes are caused by exposure during ASW activities, the impacts from these exposures are not expected to have either significant or long-term effects because (and as discussed above):
  - ASW activities typically involve fast-moving assets (relative to marine mammal swim speeds) and individuals are not expected to be exposed either for long periods within a day or over many sequential days.
  - As discussed, the majority of the harassment takes result from hull-mounted sonar during MTEs. When

distance cutoffs are applied for odontocetes, this means that all of the takes from hull-mounted sonar (MF1) result from above exposure 154 dB. However, the majority (*e.g.,* 85 percent) of the takes results from exposures below 166 dB. The majority of the takes are not from higher level exposures from which more severe responses would be expected.

- As described in more detail above (Tables 77 and 78) for the stocks addressed in this section, the scale of the effects are such that individuals of most Hawaiian and SOCAL odontocete stocks are likely taken an average of 2–13 days per year, while killer whale, long-beaked common dolphin, and Risso's dolphin individuals that remain in the SOCAL action area could be taken an average of 17–27 days per year. Bottlenose dolphin (CA/OR/WA offshore stock) could be taken an average of 10–29 days per year. While some of the individuals in SOCAL may occasionally be taken in sequential days, because of the nature of the exposures and the other factors discussed above, any impacts to individual fitness would be limited and with the potential to accrue to no more than a limited number of individuals and would not be expected to affect rates of recruitment or survival. We further note that long-beaked common dolphin have an increasing population trend.
- The 4-Islands Region Mitigation Area provides partial protection for identified biologically important area for dolphin species (small and resident populations) by not using mid-frequency active anti-submarine warfare sensor MF1.
- The Navy's Hawaii Island Mitigation Area also provides additional protection for identified biologically important areas (small and resident populations) for endangered Main Hawaiian Islands insular false killer whales, pygmy killer whale, melon-headed whale, short-finned pilot whale, and dolphin species by limiting the use of mid-frequency MF1 and MF4 and not using explosives during testing and training.
- All odontocetes in the HSTT Study Area with the exception of endangered Main Hawaiian Islands Insular false killer whale are not depleted under the MMPA, nor are they listed under the ESA.

Consequently, the activities are not expected to adversely impact rates of recruitment or survival of any of the stocks of analyzed odontocete species (Table 74, above in this section).

Porpoise

In Table 79 below, for Dall's porpoise, we indicate the total annual mortality, Level A and Level B harassment, and a number indicating the instances of total take as a percentage of abundance. Overall, takes from Level A harassment (PTS and Tissue Damage) account for less than one percent of all total takes.

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Table 79: Annual takes of Level B and Level A harassment, mortality for porpoises in SOCAL in the HSTT study area and number indicating the instances of total take as a percentage of stock abundance.

		Instances of indicated types of incidental take (not all takes represent separate individuals, especially for disturbance)									
		Level B Harassment		Level A Harassment			Total Takes	Abundance		Instance of total take as percent of abundance	
Species	Stock	Behavioral Disturbance	TTS (may also include disturbance)	PTS	Tissue Damage	Mortality	TOTAL TAKES (entire Study Area)	NAVY abundance in Action Area SOCAL [1]	NMFS SARS Abundance [2]	Total take as percentage of total Navy abundance in Action Area	Total take as percentage of total SAR abundance
Dall's porpoise	CA/OR/WA	14482	29891	209	0	0	44582	2054	25750	2170	173

Note: For the SOCAL take estimates, because of the manner in which the Navy action area overlaps the ranges of many MMPA stocks (i.e., a stock may range far north to Washington state and beyond and abundance may only be predicted within the U.S. EEZ, while the Navy action area is limited to Southern California and northern Mexico, but extends beyond the U.S. EEZ), we compare predicted takes to both the abundance estimates for the action area, as well as the SARs.

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Nearly all takes annually for Dall's porpoises are from Level B harassment either behavioral or TTS. Less than 1 percent of all takes are Level A harassment (PTS) (Table 79 above). No injury (tissue damage) serious injury or mortalities are anticipated. Dall's porpoise are not listed under the ESA.

Most Level B harassments to Dall's porpoise from hull-mounted sonar (MF1) in the HSTT Study Area would result from received levels between 154 and 166 dB SPL (85 percent). Therefore, the majority of Level B takes are expected to be in the form of milder responses compared to higher level exposures. As mentioned earlier in this section, we anticipate more severe effects from takes when animals are exposed to higher received levels.

The majority of Level B takes are expected to be in the form of milder to moderate responses. As mentioned earlier in this section, we anticipate more severe effects from takes when animals are exposed to higher received levels.

For the total instances of all of the different types of takes, the numbers indicating the instances of total take for Dall's porpoise as a percentage of abundance is 173 when compared to the total abundance and 2,170 when compared to the abundance within the Navy action area, which is based on static density estimates (Table 79). This means that generally, Dall's porpoise might be expected to be taken on an average of 2 days per year, while some subset of individuals that might remain in the Navy SOCAL action area for extended periods of time could be taken on more like an average of 22 days per year. Occasional mild to moderate behavioral reactions are unlikely to cause long-term consequences for individual animals or populations, and because of the overall number of likely days taken and the nature of the operations, exposures are generally not expected to occur on many sequential days. Impacts to individual fitness that could affect survivorship or reproductive success are not anticipated.

Animals that experience hearing loss (TTS or PTS) may have reduced ability to detect relevant sounds such as predators, prey, or social vocalizations. Some porpoise vocalizations might overlap with the MFAS/HFAS TTS frequency range (2–20 kHz). Recovery from a threshold shift (TTS; partial hearing loss) can take a few minutes to a few days, depending on the exposure duration, sound exposure level, and the magnitude of the initial shift, with larger threshold shifts and longer exposure durations requiring longer recovery times (Finneran *et al.,* 2005; Mooney *et al.,* 2009a; Mooney *et al.,* 2009b; Finneran and Schlundt, 2010). More severe shifts may not fully recover and thus would be considered PTS. TTS and PTS thresholds for high-frequency cetaceans, including Dall's porpoises, are lower than for all other marine mammals, which leads to a higher number of estimated impacts relative to the number of animals exposed to the sound as compared to other hearing groups (*e.g.,* mid-frequency cetaceans). Dall's porpoises that do experience hearing loss (*i.e.,* TTS or PTS) from sonar sounds may have a reduced ability to detect biologically important sounds until their hearing recovers, but recovery time is not expected to be long for any small amount of TTS incurred from these activities, as described above. TTS would be recoverable and PTS would leave some residual hearing loss. During the period that a Dall's porpoise had hearing loss, biologically important sounds could be more difficult to detect or interpret. Odontocetes, including Dall's porpoises, use echolocation clicks to find and capture prey. These echolocation clicks are at frequencies above 100 kilohertz in Dall's porpoises. Therefore, echolocation is unlikely to be affected by a threshold shift at lower frequencies and should not affect a Dall's porpoise ability to locate prey or rate of feeding. The information available on harbor porpoise behavioral reactions to human disturbance (a closely related species) suggests that these species may be more sensitive and avoid human activity, and sound sources, to a longer range than most other odontocetes. This would make Dall's porpoises less susceptible to hearing loss; therefore, it is likely that the quantitative analysis over-predicted hearing loss impacts (*i.e.,* TTS and PTS) in Dall's porpoises.

Harbor porpoises (similar to Dall's porpoise) have been observed to be especially sensitive to human activity (Tyack *et al.,* 2011; Pirotta *et al.,* 2012). The information currently available regarding harbor porpoises suggests a very low threshold level of response for both captive (Kastelein *et al.,* 2000; Kastelein *et al.,* 2005) and wild (Johnston, 2002) animals. Southall *et al.* (2007) concluded that harbor porpoises are likely sensitive to a wide range of anthropogenic sounds at low received levels (~ 90 to 120 dB). Research and observations of harbor porpoises for other locations show that this species is wary of human activity and will display profound avoidance behavior for anthropogenic sound sources in many situations at levels down to 120 dB re 1 μPa (Southall, 2007). Harbor porpoises routinely avoid and swim away from large motorized vessels (Barlow *et al.,* 1988; Evans *et al.,* 1994; Palka and Hammond, 2001; Polacheck and Thorpe, 1990). Harbor porpoises may startle and temporarily leave the immediate area of the training or testing until after the event ends.

ASW training activities using hull mounted sonar proposed for the HSTT Study Area generally last for only a few hours. Some ASW exercises can generally last for 2–10 days, or as much as 21 days for an MTE-Large Integrated ASW (see Table 4). For these multi-day exercises there will be extended intervals of non-activity in between active sonar periods. In addition, the Navy does not generally conduct ASW activities in the same locations. Given the average length of ASW events (times of continuous sonar use) and typical vessel speed, combined with the fact that the majority of porpoises in the HSTT Study Area would not likely remain in an area for successive days, it is unlikely that an animal would be exposed to active sonar at levels likely to result in a substantive response (*e.g.,* interruption of feeding) that would then be carried on for more than one day or on successive days.

In summary and as described above, the following factors primarily support our preliminary determination that the impacts resulting from Navy's activities are not expected to adversely affect Dall's porpoise taken through effects on annual rates of recruitment or survival.

- As described above, any PTS that may occur is expected to be of a relatively smaller degree because of the unlikelihood that animals would be close enough for a long enough amount of time to incur more severe PTS (for sonar) and the anticipated effectiveness of mitigation in preventing very close exposures for explosives.
- Large threshold shifts are not anticipated for these activities because of the unlikelihood that animals will remain within the ensonified area (due to the short duration of the majority of exercises, the speed of the vessels (relative to marine mammals swim speeds), and the short distance within which the animal would need to approach the sound source) at high levels for the duration necessary to induce larger threshold shifts.
- While the majority of takes are caused by exposure during ASW activities, the impacts from these exposures are not expected to have either significant or long-term effects because (and as discussed above):
  - ASW activities typically involve fast-moving assets (relative to marine mammal swim speeds) and individuals are not expected to be exposed either for long periods within a day or over many sequential days. As discussed, the majority of the harassment takes result from hull-mounted sonar during MTEs. When distance cutoffs are applied for odontocetes, this means that all of the takes from hull-mounted sonar (MF1) result from above exposure 154 dB. However, the majority (*e.g.,* 85 percent) of the takes results from exposures below 166 dB. The majority of the takes are not from higher level exposures from which more severe responses would be expected.
- As described in detail above (Table 79), the scale of the effects are such that individuals of Dall's porpoise might be expected to be taken on an average of 2 days per year, while some subset of

individuals that might remain in the Navy SOCAL action area for extended periods of time could be taken on more like an average of 22 days per year. Because of the nature of the exposures and the other factors discussed above, any impacts to individual fitness would be limited and with the potential to accrue to no more than a limited number of individuals and would not be expected to affect rates of recruitment or survival.

• Dall's porpoise in the HSTT Study Area are not depleted under the MMPA, nor are they listed under the ESA.

Consequently, the activities are not expected to adversely impact rates of recruitment or survival of any of the Dall's porpoise stock (CA/OR/WA).

Pinnipeds

In Tables 80 and 81 below, for pinnipeds, we indicate the total annual mortality, Level A and Level B harassment, and a number indicating the instances of total take as a percentage of abundance. Overall, takes from Level A harassment (PTS and Tissue Damage) account for less than one percent of all total takes.

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Table 80. Annual takes of Level B and Level A harassment, mortality for pinnipeds in the HRC in the HSTT study area and number indicating the instances of total take as a percentage of stock abundance.

	Instances of indicated types of incidental take (not all takes represent separate individuals, especially for disturbance)										
	Level B Harassment		Level A Harassment		Mortality	Total Takes		Abundance		Instance of total take as percent of abundance	
Species Stock Navy EEZ location (HRC)	Behavioral Disturbance	TTS (may also include disturbance)	PTS	Tissue Damage		TOTAL TAKES (entire Study Area)	Takes (within NAVY EEZ)	Total Navy Abundance in and out EEZ (HRC)	Within Navy EEZ Abundance HRC	Total take as percentage of total Navy abundance (HRC)	EEZ take as percentage of EEZ abundance (HRC)
Hawaiian monk seal Hawaiian (HRC)	143	62	1	0	0	206	195	169	169	122	115

Note: For the HI take estimates, we compare predicted takes to abundance estimates generated from the same underlying density estimates, both in and outside of the U.S. EEZ. Because the portion of the Navy's action area inside the U.S. EEZ is generally concomitant with the study area used to generate the abundance estimates in the SARs, and the abundance predicted by the same underlying density estimates is the preferred abundance to use, there is no need to separately compare the take to the SARs abundance estimate.

Table 81. Annual takes of Level B and Level A harassment, mortality for pinnipeds for SOCAL in the HSTT study area and number indicating the instances of total take as a percentage of stock abundance.

		Instances of indicated types of incidental take (not all takes represent separate individuals, especially for disturbance)									
		Level B Harassment		Level A Harassment			Total Takes	Abundance		Instance of total take as percent of abundance	
Species	Stock	Behavioral Disturbance	TTS (may also include disturbance)	PTS	Tissue Damage	Mortality	TOTAL TAKES (entire Study Area)	NAVY abundance in Action Area SOCAL [1]	NMFS SARS Abundance [2]	Total take as percentage of total Navy abundance in Action Area	Total take as percentage of total SAR abundance
California sea lion	U.S.	113419	4789	87	9	1	118305	4085	296750	2896	40
Guadalupe fur seal	Mexico	1442	15	0	0	0	1457	1171	20000	124	7
Northern fur seal	California	15167	124	1	0	0	15292	886	14050	1726	109
Harbor seal	California	2450	2994	8	0	0	5452	321	30968	1698	18
Northern elephant seal	California	42916	17955	97	2	0	60970	4108	179000	1484	34

Note: For the SOCAL take estimates, because of the manner in which the Navy action area overlaps the ranges of many MMPA stocks (*i.e.*, a stock may range far north to Washington state and beyond and abundance may only be predicted within the U.S. EEZ, while the Navy action area is limited to Southern California and northern Mexico, but extends beyond the U.S. EEZ), we compare predicted takes to both the abundance estimates for the action area, as well as the SARs.

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Nearly all takes annually for pinnipeds are from Level B harassment either behavioral or TTS (less than 1 percent PTS) (Tables 80 and 81 above). No, injury, serious injury, or mortalities are anticipated. Hawaiian monk seal and Guadalupe fur seal are listed as endangered under the ESA and depleted under the MMPA. NMFS is currently engaged in an internal Section 7 consultation under the ESA and the outcome of that consultation will further inform our final decision. The UME for Guadalupe fur seal is ongoing. Separately, the UME for California sea lions, not an ESA-listed species, will be closed soon.

Most Level B harassments to pinnipeds from hull-mounted sonar (MF1) in the HSTT Study Area would result from received levels between 160 and 172 dB SPL (83 percent). Therefore, the majority of Level B takes are expected to be in the form of milder to moderate responses. As mentioned earlier in this section, we anticipate more severe effects from takes when animals are exposed to higher received levels.

For the total instances of all of the different types of takes, the numbers indicating the instances of total take for pinnipeds as a percentage of abundance ranges from 7 to 124 when compared to the total abundance (Tables 80 and 81). However, for most pinnipeds off SOCAL, the instance of total take as a percentage of abundance are between 1,484 and 2,896 when compared to the abundance within the Navy action area, which is based on static density estimates (Table 81). This means that generally, pinnipeds might be expected to be taken on an average of less than 2 days per year. However, some subset of individuals of the California sea lion, Northern fur seal, and harbor seal stocks that might remain in the Navy SOCAL action area for extended periods of time could be taken on more like an average of 29, 18, and 17 days per year, respectively. The majority of the takes are not from higher level exposures from which more severe responses would be expected. Given the numbers of days within the year that they are expected to be taken, some subset of individuals, particularly California sea lions will likely occasionally be taken across sequential days, however, given the milder to moderate nature of the majority of the anticipated exposures (*i.e.,* the received level and the fact that most individual exposures would be expected not to be of a long duration due to the nature of the operations and the moving animals), impacts to individual fitness that could affect survivorship or reproductive success are not anticipated. We note that for California sea lions there is an increasing population trend.

Research and observations show that pinnipeds in the water may be tolerant of anthropogenic noise and activity (a review of behavioral reactions by pinnipeds to impulsive and non-impulsive noise can be found in Richardson *et al.,* 1995 and Southall *et al.,* 2007). Available data, though limited, suggest that exposures between approximately 90 and 140 dB SPL do not appear to induce strong behavioral responses in pinnipeds exposed to non-pulse sounds in water (Jacobs and Terhune, 2002; Costa *et al.,* 2003; Kastelein *et al.,* 2006c). Based on the limited data on pinnipeds in the water exposed to multiple pulses (small explosives, impact pile driving, and seismic sources), exposures in the approximately 150 to 180 dB SPL range generally have limited potential to induce avoidance behavior in pinnipeds (Harris *et al.,* 2001; Blackwell *et al.,* 2004; Miller *et al.,* 2004). If pinnipeds are exposed to sonar or other active acoustic sources they may react in a number of ways depending on their experience with the sound source and what activity they are engaged in at the time of the acoustic exposure. Pinnipeds may not react at all until the sound source is approaching within a few hundred meters and then may alert, ignore the stimulus, change their behaviors, or avoid the immediate area by swimming away or diving. Effects on pinnipeds in the HSTT Study Area that are taken by Level B harassment, on the basis of reports in the literature as well as Navy monitoring from past activities, will likely be limited to reactions such as increased swimming speeds, increased surfacing time, or decreased foraging (if such activity were occurring). Most likely, individuals will simply move away from the sound source and be temporarily displaced from those areas, or not respond at all. In areas of repeated and frequent acoustic disturbance, some animals may habituate or learn to tolerate the new baseline or fluctuations in noise level. Habituation can occur when an animal's response to a stimulus wanes with repeated exposure, usually in the absence of unpleasant associated events (Wartzok *et al.,* 2003). While some animals may not return to an area, or may begin using an area differently due to training and testing activities, most animals are expected to return to their usual locations and behavior. Given their documented tolerance of anthropogenic sound (Richardson *et al.,* 1995 and Southall *et al.,* 2007), repeated exposures of individuals (*e.g.,* harbor seals) to levels of sound that may cause Level B harassment are unlikely to result in hearing impairment or to significantly disrupt foraging behavior. As stated above, pinnipeds may habituate to or become tolerant of repeated exposures over time, learning to ignore a stimulus that in the past has not accompanied any overt threat.

Thus, even repeated Level B harassment of some small subset of an overall stock is unlikely to result in any significant realized decrease in fitness to those individuals, and would not result in any adverse impact to the stock as a whole.

The Navy's testing and training activities do occur in areas of specific importance, critical habitat for Hawaiian monk seals. However, monk seals in the main Hawaiian islands have increased while the Navy has continued its activities. The Hawaiian monk seal overall population trend has been on a decline from 2004 through 2013, with the total number of Hawaiian monk seals decreasing by 3.4 percent per year (Carretta *et al.,* 2017). While the decline has been driven by the population segment in the northwestern Hawaiian Islands, the number of documented sightings and annual births in the main Hawaiian Islands has increased since the mid-1990s (Baker, 2004; Baker *et al.,* 2016). In the main Hawaiian Islands, the estimated population growth rate is 6.5 percent per year (Baker *et al.,* 2011; Carretta *et al.,* 2017). Of note, in the 2013 HRC Monitoring Report, tagged monk seals did not show any behavioral changes during periods of MFAS.

Generally speaking, most pinniped stocks in the HSTT Study Area are thought to be stable or increasing. In summary and as described above, the following factors primarily support our preliminary determination that the impacts resulting from the Navy's activities are not expected to adversely affect pinnipeds taken through effects on annual rates of recruitment or survival.

- As described in the ''Serious Injury or Mortality'' section (Table 68), 0.8 mortalities annually over five years is proposed for authorization for California sea lions. The proposed mortality for California falls below the insignificance threshold and, therefore, we consider the addition an insignificant incremental increase to human-caused mortality. No mortalities of other pinnipeds are proposed for authorization or anticipated to occur.
- As described above, any PTS that may occur is expected to be of a relatively smaller degree because of the unlikelihood that animals would be close enough for a long enough amount of time to incur more severe PTS (for sonar) and the anticipated effectiveness of mitigation in preventing very close exposures for explosives.
- While the majority of takes are caused by exposure during ASW activities, the impacts from these exposures are not expected to have either significant or long-term effects because (and as discussed above):
    - ASW activities typically involve fast-moving assets (relative to marine mammals swim speeds) and individuals are not expected to be exposed either for long periods within a day or over many sequential days.

○ As discussed, the majority of the harassment takes result from hull-mounted sonar during MTEs. When distance cutoffs are applied for pinnipeds, this means that all of the takes from hull-mounted sonar (MF1) result from above exposure 160 dB. However, the majority (*e.g.,* 83 percent) of the takes results from exposures below 172 dB. The majority of the takes have a relatively lower likelihood in have severe impacts.

• As described in detail above (Tables 80 and 81), the scale of the effects are such that pinnipeds are taken an average of less than 2 days per year. While some individuals of California sea lions, Northern fur seal, and harbor seals that might remain in the Navy SOCAL action area for extended periods of time could be taken on more, 17 to 29 days per year. These behavioral takes are not all expected to be of particularly high intensity and nor are they likely to occur over sequential days, which suggests that the overall scale of impacts for any individual would be relatively low. Some California sea lion individuals in SOCAL may occasionally be taken in sequential days, because of the nature of the exposures and the other factors discussed above, any impacts to individual fitness would be limited and with the potential to accrue to no more than a limited number of individuals and would not be expected to affect rates of recruitment or survival. We further note that California sea lions have an increasing population trend.

• The HSTT activities are expected to occur in an area/time of specific importance for reproductive, feeding, or other known critical behaviors for pinnipeds, particularly in critical habitat for ESA-listed Hawaiian monk seal; however, Navy's activities are not anticipated to affect critical habitat. Populations are increasing for monk seals on the main Hawaiian islands.

• Pinnipeds found in the HSTT Study Area are not depleted under the MMPA, nor are they listed under the ESA with the exception of the Hawaiian monk seal and Guadalupe fur seal which are listed as endangered under the ESA and depleted under the MMPA.

Consequently, the activities are not expected to adversely impact rates of recruitment or survival of any of the analyzed stocks of pinnipeds (Table 77 above in this section).

Preliminary Determination

Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the proposed monitoring and mitigation measures, NMFS preliminarily finds that the total marine mammal take from the Specified Activities will have a negligible impact on all affected marine mammal species or stocks.

Subsistence Harvest of Marine Mammals

There are no relevant subsistence uses of marine mammals implicated by this action. Therefore, NMFS has preliminarily determined that the total taking affecting species or stocks would not have an unmitigable adverse impact on the availability of such species or stocks for taking for subsistence purposes.

Endangered Species Act

There are nine marine mammal species under NMFS jurisdiction that are listed as endangered or threatened under the ESA with confirmed or possible occurrence in the Study Area: Blue whale (Eastern and Central North Pacific stocks), fin whale (CA/OR/WA and Hawaiian stocks), gray whale (Western North Pacific stock), humpback whale (Mexico and Central America DPSs), sei whale (Eastern North Pacific and Hawaiian stocks), sperm whale (CA/OR/WA and Hawaiian stocks), false killer whale (Main Hawaiian Islands Insular), Hawaiian monk seal (Hawaiian stock), and Guadalupe fur seal (Mexico to California). There is also critical habitat designated for Hawaiian monk seal and proposed critical habitat for Main Hawaiian Island insular false killer whales. The Navy will consult with NMFS pursuant to section 7 of the ESA, and NMFS will also consult internally on the issuance of LOAs under section 101(a)(5)(A) of the MMPA for HSTT activities. Consultation will be concluded prior to a determination on the issuance of the final rule and LOAs.

National Marine Sanctuaries Act

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

National Environmental Policy Act

To comply with the National Environmental Policy Act of 1969 (NEPA; 42 U.S.C. 4321 *et seq.*) and NOAA Administrative Order (NAO) 216–6A, NMFS must review its Specified Activities (*i.e.,* the issuance of an incidental take authorization) with respect to potential impacts on the human environment.

Accordingly, NMFS plans to adopt the Navy's EIS/OEIS for the HSTT Study Area provided our independent evaluation of the document finds that it includes adequate information analyzing the effects on the human environment of issuing regulations and LOAs. NMFS is a cooperating agency on the Navy's HSTT DEIS/OEIS and has worked extensively with the Navy in developing the document.

The Navy's HSTT DEIS/OEIS was made available for public comment at *https://hstteis.com/* on October 13, 2017.

We will review all comments submitted in response to this notice prior to concluding our NEPA process or making a final decision on the final rule and LOA requests.

Classification

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 would be affected by this rulemaking, and the Navy is not a small governmental jurisdiction, small organization, or small business, as defined by the RFA. Any requirements imposed by an LOA issued pursuant to these regulations, and any monitoring or reporting requirements imposed by these regulations, would be applicable only to the Navy. NMFS does not expect the issuance of these regulations or the associated LOA 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, Incidental take, Indians, Labeling, Marine mammals, Navy, Penalties, Reporting and recordkeeping requirements, Seafood, Sonar, Transportation.

Dated: June 14, 2018.

Samuel D. Rauch III,

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

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

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

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

■ 2. Revise subpart H to part 218 to read as follows:

Sec.
218.70 Specified activity and specified geographical region.
218.71 Effective dates.
218.72 Permissible methods of taking.
218.73 Prohibitions.
218.74 Mitigation requirements.
218.75 Requirements for monitoring and reporting.
218.76 Letters of Authorization.
218.77 Renewals and modifications of Letters of Authorization
218.78 [Reserved]
218.79 [Reserved]

Subpart H—Taking and Importing Marine Mammals; U.S. Navy's Hawaii-Southern California Training and Testing (HSTT)

§ 218.70 Specified activity and specified geographical region.

(a) Regulations in this subpart apply only to the U.S. Navy for the taking of marine mammals that occurs in the area outlined in paragraph (b) of this section and that occurs incidental to the activities described in paragraph (c) of this section.

(b) The taking of marine mammals by the Navy may be authorized in Letters of Authorization (LOAs) only if it occurs within the Hawaii-Southern California Training and Testing (HSTT) Study Area, which includes established operating and warning areas across the north-central Pacific Ocean, from the mean high tide line in Southern California west to Hawaii and the International Date Line. The Study Area includes the at-sea areas of three existing range complexes (the Hawaii Range Complex (HRC), the Southern California Range Complex (SOCAL), and the Silver Strand Training Complex, and overlaps a portion of the Point Mugu Sea Range (PMSR)). Also included in the Study Area are Navy pierside locations in Hawaii and Southern California, Pearl Harbor, San Diego Bay, and the transit corridor on the high seas where sonar training and testing may occur.

(c) The taking of marine mammals by the Navy is only authorized if it occurs incidental to the Navy's conducting training and testing activities. The Navy's use of sonar and other transducers, in-water detonations, air guns, pile driving/extraction, and vessel movements incidental to training and testing exercises may cause take by harassment, serious injury or mortality as defined by the MMPA through the various warfare mission areas in which the Navy would conduct including amphibious warfare, anti-submarine warfare, expeditionary warfare, surface warfare, mine warfare, and other activities (sonar and other transducers, pile driving and removal activities, air guns, vessel strike).

§ 218.71 Effective dates.

Regulations in this subpart are effective [*date 30 days after date of publication of the final rule in the* ***Federal Register***] through [*date 5 years and 30 days after date of publication of the final rule in the* ***Federal Register***].

§ 218.72 Permissible methods of taking.

Under LOAs issued pursuant to § 216.106 of this chapter and § 218.77, the Holder of the LOAs (hereinafter "Navy") may incidentally, but not intentionally, take marine mammals within the area described in § 218.70(b) by Level A harassment and Level B harassment associated with the use of active sonar and other acoustic sources and explosives as well as serious injury or mortality associated with vessel strikes provided the activity is in compliance with all terms, conditions, and requirements of these regulations in this subpart and the applicable LOAs.

§ 218.73 Prohibitions.

Notwithstanding takings contemplated in § 218.72 and authorized by LOAs issued under § 216.106 of this chapter and § 218.76, no person in connection with the activities described in § 218.72 may:

(a) Violate, or fail to comply with, the terms, conditions, and requirements of this subpart or an LOA issued under § 216.106 of this chapter and § 218.76;

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

(c) Take any marine mammal specified in such LOAs in any manner other than as specified;

(d) Take a marine mammal specified in such LOAs if NMFS determines such taking results in more than a negligible impact on the species or stocks of such marine mammal; or or

(e) Take a marine mammal specified in such LOAs if NMFS determines such taking results in an unmitigable adverse impact on the species or stock of such marine mammal for taking for subsistence uses.

§ 218.74 Mitigation requirements.

When conducting the activities identified in § 218.70(c), the mitigation measures contained in any LOAs issued under § 216.106 of this chapter and § 218.76 must be implemented. These mitigation measures shall include the following requirements, but are not limited to:

(a) *Procedural Mitigation.* Procedural mitigation is mitigation that the Navy shall implement whenever and wherever an applicable training or testing activity takes place within the HSTT Study Area for each applicable activity category or stressor category and includes acoustic stressors (*i.e.,* active sonar, air guns, pile driving, weapons firing noise), explosive stressors (*i.e.,* sonobuoys, torpedoes, medium-caliber and large-caliber projectiles, missiles and rockets, bombs, sinking exercises, mines, anti-swimmer grenades, and mat weave and obstacle loading), and physical disturbance and strike stressors (*i.e.,* vessel movement, towed in-water devices, small-, medium-, and large-caliber non-explosive practice munitions, non-explosive missiles and rockets, non-explosive bombs and mine shapes).

(1) *Environmental Awareness and Education.* Appropriate personnel involved in mitigation and training or testing activity reporting under the Specified Activities shall complete one or more modules of the U.S Navy Afloat Environmental Compliance Training Series, as identified in their career path training plan. Modules include: Introduction to the U.S. Navy Afloat Environmental Compliance Training Series, Marine Species Awareness Training, U.S. Navy Protective Measures Assessment Protocol, and U.S. Navy Sonar Positional Reporting System and Marine Mammal Incident Reporting. Additionally, to increase the environmental awareness of naval assets operating in designated areas to the potential seasonal presence of concentrations of large whales, including humpback whales, gray whales, blue whales, and fin whales, the Navy will issue seasonal awareness notification messages. These messages include:

(i) Humpback Whale Awareness Notification Message Area (November 15–April 15). The Navy shall issue a seasonal awareness notification message to alert ships and aircraft operating in the area to the possible presence of concentrations of large whales, including humpback whales. To maintain safety of navigation and to avoid interactions with large whales during transits, the Navy shall instruct vessels to remain vigilant to the presence of large whale species (including humpback whales), that when concentrated seasonally, may become vulnerable to vessel strikes. Lookouts shall use the information from the awareness notification message to assist their visual observation of applicable mitigation zones during training and testing activities and to aid in the implementation of procedural mitigation.

(ii) Blue Whale Awareness Notification Message Area (June 1–October 31). The Navy shall issue a seasonal awareness notification message to alert ships and aircraft operating in the area to the possible presence of concentrations of large whales, including blue whales. To maintain safety of navigation and to avoid interactions with large whales during transits, the Navy shall instruct vessels to remain vigilant to the presence of large whale species (including blue whales), that when concentrated seasonally, may become vulnerable to vessel strikes. Lookouts shall use the information from the awareness notification messages to assist their visual observation of applicable mitigation zones during training and testing activities and to aid in the implementation of procedural mitigation observation of applicable mitigation zones during training and testing activities and to aid in the implementation of procedural mitigation.

(iii) Gray Whale Awareness Notification Message Area (November 1–March 31). The Navy shall issue a seasonal awareness notification message to alert ships and aircraft operating in the area to the possible presence of concentrations of large whales, including gray whales. To maintain safety of navigation and to avoid interactions with large whales during transits, the Navy shall instruct vessels to remain vigilant to the presence of large whale species (including gray whales), that when concentrated seasonally, may become vulnerable to vessel strikes. Lookouts shall use the information from the awareness notification messages to assist their visual observation of applicable mitigation zones during training and testing activities and to aid in the implementation of procedural mitigation.

(iv) Fin Whale Awareness Notification Message Area (November 1–May 31). The Navy shall issue a seasonal awareness notification message to alert ships and aircraft operating in the area to the possible presence of concentrations of large whales, including fin whales. To maintain safety of navigation and to avoid interactions with large whales during transits, the Navy shall instruct vessels to remain vigilant to the presence of large whale species (including fin whales), that when concentrated seasonally, may become vulnerable to vessel strikes. Lookouts shall use the information from the awareness notification messages to assist their visual observation of applicable mitigation zones during training and testing activities and to aid in implementation of procedural mitigation.

(2) *Active Sonar.* Active sonar includes low-frequency active sonar, mid-frequency active sonar, and high-frequency active sonar. For vessel-based active sonar activities, mitigation applies only to sources that are positively controlled and deployed from manned surface vessels (*e.g.,* sonar sources towed from manned surface platforms). For aircraft-based active sonar activities, mitigation applies to sources that are positively controlled and deployed from manned aircraft that do not operate at high altitudes (*e.g.,* rotary-wing aircraft). Mitigation does not apply to active sonar sources deployed from unmanned aircraft or aircraft operating at high altitudes (*e.g.,* maritime patrol aircraft).

(i) Number of Lookouts and Observation Platform—(A) Hull-mounted sources: Two lookouts at the forward part of the ship for platforms without space or manning restrictions while underway; One lookout at the forward part of a small boat or ship for platforms with space or manning restrictions while underway; and One lookout for platforms using active sonar while moored or at anchor (including pierside).

(B) Non-hull mounted sources: One lookout on the ship or aircraft conducting the activity.

(ii) Mitigation Zone and Requirements—(A) Prior to the start of the activity the Navy shall observe for floating vegetation and marine mammals; if resource is observed, the Navy shall not commence use of active sonar.

(B) During low-frequency active sonar at or above 200 decibel (dB) and hull-mounted mid-frequency active sonar the Navy shall observe for marine mammals and power down active sonar transmission by 6 dB if resource is observed within 1,000 yards (yd) of the sonar source; power down by an additional 4 dB (10 dB total) if resource is observed within 500 yd of the sonar source; and cease transmission if resource is observed within 200 yd of the sonar source.

(C) During low-frequency active sonar below 200 dB, mid-frequency active sonar sources that are not hull mounted, and high-frequency active sonar the Navy shall observe for marine mammals and cease active sonar transmission if resource is observed within 200 yd of the sonar source.

(D) To allow an observed marine mammal to leave the mitigation zone, the Navy shall not recommence active sonar transmission until one of the recommencement conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the sonar source; the mitigation zone has been clear from any additional sightings for 10 min for aircraft-deployed sonar sources or 30 min for vessel-deployed sonar sources; for mobile activities, the active sonar source has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting; or for activities using hull-mounted sonar, the lookout concludes that dolphins are deliberately closing in on the ship to ride the ship's bow wave, and are therefore out of the main transmission axis of the sonar (and there are no other marine mammal sightings within the mitigation zone).

(3) *Air Guns.* (i) Number of Lookouts and Observation Platform—One lookout positioned on a ship or pierside.

(ii) Mitigation Zone and Requirements—150 yd around the air gun.

(A) Prior to the start of the activity (*e.g.,* when maneuvering on station), the Navy shall observe for floating vegetation, and marine mammals; if resource is observed, the Navy shall not commence use of air guns.

(B) During the activity, the Navy shall observe for marine mammals; if resource is observed, the Navy shall cease use of air guns.

(C) To allow an observed marine mammal to leave the mitigation zone, the Navy shall not recommence the use of air guns until one of the recommencement conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the air gun; the mitigation zone has been clear from any additional sightings for 30 min; or for mobile activities, the air gun has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting.

(4) *Pile Driving.* Pile driving and pile extraction sound during Elevated Causeway System training.

(i) Number of Lookouts and Observation Platform—One lookout positioned on the shore, the elevated causeway, or a small boat.

(ii) Mitigation Zone and Requirements—100 yd around the pile driver.

(A) Thirty minutes prior to the start of the activity, the Navy shall observe for floating vegetation and marine mammals; if resource is observed, the Navy shall not commence impact pile driving or vibratory pile extraction.

(B) During the activity, the Navy shall observe for marine mammals; if resource is observed, the Navy shall cease impact pile driving or vibratory pile extraction.

(C) To allow an observed marine mammal to leave the mitigation zone, the Navy shall not recommence pile driving until one of the recommencement conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the pile driving location; or the mitigation zone has been clear from any additional sightings for 30 min.

(5) *Weapons Firing Noise.* Weapons firing noise associated with large-caliber gunnery activities.

(i) Number of Lookouts and Observation Platform—One lookout shall be positioned on the ship conducting the firing. Depending on the activity, the lookout could be the same as the one described in Explosive Medium-Caliber and Large-Caliber Projectiles or in Small-, Medium-and Large-Caliber Non-Explosive Practice Munitions.

(ii) Mitigation Zone and Requirements—Thirty degrees on either side of the firing line out to 70 yd from the muzzle of the weapon being fired.

(A) Prior to the start of the activity, the Navy shall observe for floating vegetation, and marine mammals; if resource is observed, the Navy shall not commence weapons firing.

(B) During the activity, the Navy shall observe for marine mammals; if resource is observed, the Navy shall cease weapons firing.

(C) To allow an observed marine mammal to leave the mitigation zone, the Navy shall not recommence weapons firing until one of the recommencement conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the firing ship; the mitigation zone has been clear from any additional sightings for 30 min; or for mobile activities, the firing ship has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting.

(6) *Explosive Sonobuoys.* (i) Number of Lookouts and Observation Platform—One lookout positioned in an aircraft or on small boat.

(ii) Mitigation Zone and Requirements—600 yd around an explosive sonobuoy.

(A) Prior to the start of the activity (*e.g.,* during deployment of a sonobuoy field, which typically lasts 20–30 min), the Navy shall conduct passive acoustic monitoring for marine mammals, and observe for floating vegetation and marine mammals; if resource is visually observed, the Navy shall not commence sonobuoy or source/receiver pair detonations.

(B) During the activity, the Navy shall observe for marine mammals; if resource is observed, the Navy shall cease sonobuoy or source/receiver pair detonations.

(C) To allow an observed marine mammal to leave the mitigation zone, the Navy shall not recommence the use of explosive sonobuoys until one of the recommencement conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the sonobuoy; or the mitigation zone has been clear from any additional sightings for 10 min when the activity involves aircraft that have fuel constraints, or 30 min when the activity involves aircraft that are not typically fuel constrained.

(7) *Explosive Torpedoes.* (i) Number of Lookouts and Observation Platform—One lookout positioned in an aircraft.

(ii) Mitigation Zone and Requirements—2,100 yd around the intended impact location.

(A) Prior to the start of the activity (*e.g.,* during deployment of the target), the Navy shall conduct passive acoustic monitoring for marine mammals, and observe for floating vegetation, jellyfish aggregations, and marine mammals; if resource is visually observed, the Navy shall not commence firing.

(B) During the activity, the Navy shall observe for marine mammals and jellyfish aggregations; if resource is observed, the Navy shall cease firing.

(C) To allow an observed marine mammal to leave the mitigation zone, the Navy shall not recommence firing until one of the recommencement conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended impact location; or the mitigation zone has been clear from any additional sightings for 10 min when the activity involves aircraft that have fuel constraints, or 30 min when the activity involves aircraft that are not typically fuel constrained. After completion of the activity, the Navy shall observe for marine mammals; if any injured or dead resources are observed, the Navy shall follow established incident reporting procedures.

(8) *Explosive Medium-Caliber and Large-Caliber Projectiles.* Gunnery activities using explosive medium-caliber and large-caliber projectiles. Mitigation applies to activities using a surface target.

(i) Number of Lookouts and Observation Platform—One Lookout on the vessel or aircraft conducting the activity. For activities using explosive large-caliber projectiles, depending on the activity, the Lookout could be the same as the one described in Weapons Firing Noise in paragraph (a)(5)(i) of this section.

(ii) Mitigation Zone and Requirements—(A) 200 yd around the intended impact location for air-to-surface activities using explosive medium-caliber projectiles,

(B) 600 yd around the intended impact location for surface-to-surface activities using explosive medium-caliber projectiles, or

(C) 1,000 yd around the intended impact location for surface-to-surface activities using explosive large-caliber projectiles.

(D) Prior to the start of the activity (*e.g.,* when maneuvering on station), the Navy shall observe for floating vegetation and marine mammals; if resource is observed, the Navy shall not commence firing.

(E) During the activity, observe for marine mammals; if resource is observed, the Navy shall cease firing.

(F) To allow an observed marine mammal to leave the mitigation zone, the Navy shall not recommence firing until one of the recommencement conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended impact location; the mitigation zone has been clear from any additional sightings for 10 min for aircraft-based firing or 30 min for vessel-based firing; or for activities using mobile targets, the intended impact location has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting.

(9) *Explosive Missiles and Rockets.* Aircraft-deployed explosive missiles and rockets. Mitigation applies to activities using a surface target.

(i) Number of Lookouts and Observation Platform—One lookout positioned in an aircraft.

(ii) Mitigation Zone and Requirements—(A) 900 yd around the intended impact location for missiles or rockets with 0.6–20 lb net explosive weight, or

(B) 2,000 yd around the intended impact location for missiles with 21–500 lb net explosive weight.

(C) Prior to the start of the activity (*e.g.,* during a fly-over of the mitigation zone), the Navy shall observe for floating vegetation and marine mammals; if resource is observed, the Navy shall not commence firing.

(D) During the activity, the Navy shall observe for marine mammals; if resource is observed, the Navy shall cease firing.

(E) To allow an observed marine mammal to leave the mitigation zone, the Navy shall not recommence firing until one of the recommencement conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended impact location; or the mitigation zone has been clear from any additional sightings for 10 min when the activity involves aircraft that have fuel constraints, or 30 min when the activity involves aircraft that are not typically fuel constrained.

(10) *Explosive Bombs.* (i) Number of Lookouts and Observation Platform—One lookout positioned in an aircraft conducting the activity.

(ii) Mitigation Zone and Requirements—2,500 yd around the intended target.

(A) Prior to the start of the activity (*e.g.,* when arriving on station), the Navy shall observe for floating vegetation and marine mammals; if resource is observed, the Navy shall not commence bomb deployment.

(B) During target approach, the Navy shall observe for marine mammals; if resource is observed, the Navy shall cease bomb deployment.

(C) To allow an observed marine mammal to leave the mitigation zone, the Navy shall not recommence bomb deployment until one of the recommencement conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended target; the mitigation zone has been clear from any additional sightings for 10 min; or for activities using mobile targets, the intended target has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting.

(11) *Sinking Exercises.* (i) Number of Lookouts and Observation Platform—Two lookouts (one positioned in an aircraft and one on a vessel).

(ii) Mitigation Zone and Requirements—2.5 nmi around the target ship hulk.

(A) 90 min prior to the first firing, the Navy shall conduct aerial observations for floating vegetation, jellyfish aggregations, and marine mammals; if resource is observed, the Navy shall not commence firing.

(B) During the activity, the Navy shall conduct passive acoustic monitoring and visually observe for marine mammals from the vessel; if resource is visually observed, the Navy shall cease firing.

(C) Immediately after any planned or unplanned breaks in weapons firing of longer than 2 hrs, the Navy shall observe for marine mammals from the aircraft and vessel; if resource is observed, the Navy shall not commence firing.

(D) To allow an observed marine mammal to leave the mitigation zone, the Navy shall not recommence firing until one of the recommencement conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the target ship hulk; or the mitigation zone has been clear from any additional sightings for 30 min.

(E) For 2 hrs after sinking the vessel (or until sunset, whichever comes first), the Navy shall observe for marine mammals; if any injured or dead resources are observed, the Navy shall follow established incident reporting procedures.

(12) *Explosive Mine Countermeasure and Neutralization Activities.*

(i) Number of Lookouts and Observation Platform—(A) One lookout positioned on a vessel or in an aircraft when using up to 0.1–5 lb net explosive weight charges.

(B) Two lookouts (one in an aircraft and one on a small boat) when using up to 6–650 lb net explosive weight charges.

(ii) Mitigation Zone and Requirements—(A) 600 yd around the detonation site for activities using 0.1–5 lb net explosive weight, or

(B) 2,100 yd around the detonation site for activities using 6–650 lb net explosive weight (including high explosive target mines).

(C) Prior to the start of the activity (*e.g.,* when maneuvering on station; typically, 10 min when the activity involves aircraft that have fuel constraints, or 30 min when the activity involves aircraft that are not typically fuel constrained), the Navy shall observe for floating vegetation and marine mammals; if resource is observed, the Navy shall not commence detonations.

(D) During the activity, the Navy shall observe for marine mammals; if resource is observed, the Navy shall cease detonations.

(E) To allow an observed marine mammal to leave the mitigation zone, the Navy shall not recommence detonations until one of the recommencement conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to detonation site; or the mitigation zone has been clear from any additional sightings for 10 min when the activity involves aircraft that have fuel constraints, or 30 min when the activity involves aircraft that are not typically fuel constrained.

(F) After completion of the activity, the Navy shall observe for marine mammals and sea turtles (typically 10 min when the activity involves aircraft that have fuel constraints, or 30 min. when the activity involves aircraft that are not typically fuel constrained); if any injured or dead resources are observed, the Navy shall follow established incident reporting procedures.

(13) *Explosive Mine Neutralization Activities Involving Navy Divers.*

(i) Number of Lookouts and Observation Platform—(A) Two lookouts (two small boats with one Lookout each, or one Lookout on a small boat and one in a rotary-wing aircraft) when implementing the smaller mitigation zone.

(B) Four lookouts (two small boats with two Lookouts each), and a pilot or member of an aircrew shall serve as an additional Lookout if aircraft are used during the activity, when implementing the larger mitigation zone.

(ii) Mitigation Zone and Requirements—(A) The Navy shall not set time-delay firing devices (0.1–29 lb net explosive weight) to exceed 10 min.

(B) 500 yd around the detonation site during activities under positive control using 0.1–20 lb net explosive weight, or

(C) 1,000 yd around the detonation site during all activities using time-delay fuses (0.1–29 lb net explosive weight) and during activities under positive control using 21–60 lb net explosive weight charges.

(D) Prior to the start of the activity (*e.g.,* when maneuvering on station for activities under positive control; 30 min for activities using time-delay firing devices), the Navy shall observe for floating vegetation and marine mammals; if resource is observed, the Navy shall not commence detonations or fuse initiation.

(E) During the activity, the Navy shall observe for marine mammals; if resource is observed, the Navy shall cease detonations or fuse initiation. All divers placing the charges on mines shall support the Lookouts while performing their regular duties and shall report all marine mammal sightings to their supporting small boat or Range Safety Officer. To the maximum extent practicable depending on mission requirements, safety, and environmental conditions, boats shall position themselves near the mid-point of the mitigation zone radius (but outside of the detonation plume and human safety zone), shall position themselves on opposite sides of the detonation location (when two boats are used), and shall travel in a circular pattern around the detonation location with one Lookout observing inward toward the detonation site and the other observing outward toward the perimeter of the mitigation zone. If used, aircraft shall travel in a circular pattern around the detonation location to the maximum extent practicable.

(F) To allow an observed marine mammal to leave the mitigation zone, the Navy shall not recommence detonations or fuse initiation until one of the recommencement conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the detonation site; or the mitigation zone has been clear from any additional sightings for 10 min during activities under positive control with aircraft that have fuel constraints, or 30 min during activities under positive control with aircraft that are not typically fuel constrained and during activities using time-delay firing devices.

(G) After completion of an activity using time-delay firing devices, the Navy shall observe for marine mammals for 30 min; if any injured or dead resources are observed, the Navy follow established incident reporting procedures.

(14) *Maritime Security Operations—Anti-Swimmer Grenades.* (i) Number of Lookouts and Observation Platform—One lookout positioned on the small boat conducting the activity.

(ii) Mitigation Zone and Requirements—200 yd around the intended detonation location.

(A) Prior to the start of the activity (*e.g.,* when maneuvering on station), the Navy shall observe for floating vegetation and marine mammals; if resource is observed, the Navy shall not commence detonations.

(B) During the activity, the Navy shall observe for marine mammals; if resource is observed, the Navy shall cease detonations.

(C) To allow an observed marine mammal to leave the mitigation zone, the Navy shall not recommence detonations until one of the recommencement conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended detonation location; the mitigation zone has been clear from any additional sightings for 30 min; or the intended detonation location has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting.

(15) *Under Demolition Multiple Charge—Mat Weave and Obstacle Loading.* (i) Number of Lookouts and Observation Platform—Two Lookouts (one positioned on a small boat and one positioned on shore from an elevated platform).

(ii) Mitigation Zone and Requirements—700 yd around the intended detonation site.

(A) For 30 min prior to the first detonation, the Lookout positioned on a small boat shall observe for floating vegetation and marine mammals; if resource is observed, the Navy shall not commence the initial detonation.

(B) For 10 min prior to the first detonation, the Lookout positioned on shore shall use binoculars to observe for marine mammals; if resource is observed, the Navy shall not commence the initial detonation until the mitigation zone has been clear of any additional sightings for a minimum of 10 min.

(C) During the activity, the Navy shall observe for marine mammals; if resource is observed, the Navy shall cease detonations.

(D) To allow an observed marine mammal to leave the mitigation zone, the Navy shall not recommence detonations until one of the recommencement conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the detonation site; or the mitigation zone has been clear from any additional sightings for 10 min (as determined by the shore observer).

(E) After completion of the activity, the Lookout positioned on a small boat shall observe for marine mammals for 30 min; if any injured or dead resources are observed, the Navy shall follow established incident reporting procedures.

(16) *Vessel Movement.* The mitigation shall not be applied if: The vessel's safety is threatened; the vessel is restricted in its ability to maneuver (*e.g.,* during launching and recovery of aircraft or landing craft, during towing activities, when mooring, etc.); the vessel is operated autonomously; or when impracticable based on mission requirements (*e.g.,* during Amphibious Assault—Battalion Landing exercise).

(i) Number of Lookouts and Observation Platform—One lookout on the vessel that is underway.

(ii) Mitigation Zone and Requirements—(A) 500 yd around whales—When underway, the Navy shall observe for marine mammals; if a whale is observed, the Navy shall maneuver to maintain distance.

(B) 200 yd around all other marine mammals (except bow-riding dolphins and pinnipeds hauled out on man-made navigational structures, port structures, and vessels)—When underway, the Navy shall observe for marine mammals; if a marine mammal other than a whale, bow-riding dolphin, or hauled-out pinniped is observed, the Navy shall maneuver to maintain distance.

(17) *Towed In-water Devices.* Mitigation applies to devices that are towed from a manned surface platform or manned aircraft. The mitigation shall not be applied if the safety of the towing platform or in-water device is threatened.

(i) Number of Lookouts and Observation Platform—One lookout positioned on a manned towing platform.

(ii) Mitigation Zone and Requirements—250 yd around marine mammals. When towing an in-water device, the Navy shall observe for marine mammals; if resource is observed, the Navy shall maneuver to maintain distance.

(18) *Small-, Medium-, and Large-Caliber Non-Explosive Practice Munitions.* Mitigation applies to activities using a surface target.

(i) Number of Lookouts and Observation Platform—One Lookout positioned on the platform conducting the activity. Depending on the activity, the Lookout could be the same as the one described for Weapons Firing Noise in paragraph (a)(5)(i) of this section.

(ii) Mitigation Zone and Requirements—200 yd around the intended impact location.

(A) Prior to the start of the activity (*e.g.,* when maneuvering on station), the Navy shall observe for floating vegetation and marine mammals; if resource is observed, the Navy shall not commence firing.

(B) During the activity, the Navy shall observe for marine mammals; if resource is observed, the Navy shall cease firing.

(C) To allow an observed marine mammal to leave the mitigation zone, the Navy shall not recommence firing until one of the recommencement conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended impact location; the mitigation zone has been clear from any additional sightings for 10 min for aircraft-based firing or 30 min for vessel-based firing; or for activities using a mobile target, the intended impact location has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting.

(19) *Non-Explosive Missiles and Rockets.* Aircraft-deployed non-explosive missiles and rockets. Mitigation applies to activities using a surface target.

(i) Number of Lookouts and Observation Platform—One Lookout positioned in an aircraft.

(ii) Mitigation Zone and Requirements—900 yd around the intended impact location.

(A) Prior to the start of the activity (*e.g.,* during a fly-over of the mitigation zone), the Navy shall observe for floating vegetation and marine mammals; if resource is observed, the Navy shall not commence firing.

(B) During the activity, the Navy shall observe for marine mammals; if resource is observed, the Navy shall cease firing.

(C) To allow an observed marine mammal to leave the mitigation zone, the Navy shall not recommence firing until one of the recommencement conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended impact location; or the mitigation zone has been clear from any additional sightings for 10 min when the activity involves aircraft that have fuel constraints, or 30 min when the activity involves aircraft that are not typically fuel constrained.

(20) *Non-Explosive Bombs and Mine Shapes.* Non-explosive bombs and non-explosive mine shapes during mine laying activities.

(i) Number of Lookouts and Observation Platform—One Lookout positioned in an aircraft.

(ii) Mitigation Zone and Requirements—1,000 yd around the intended target.

(A) Prior to the start of the activity (*e.g.,* when arriving on station), the Navy shall observe for floating vegetation and marine mammals; if resource is observed, the Navy shall not commence bomb deployment or mine laying.

(B) During approach of the target or intended minefield location, the Navy shall observe for marine mammals; if resource is observed, the Navy shall cease bomb deployment or mine laying.

(C) To allow an observed marine mammal to leave the mitigation zone, the Navy shall not recommence bomb deployment or mine laying until one of the recommencement conditions has been met: the animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended target or minefield location; the mitigation zone has been clear from any additional sightings for 10 min; or for activities using mobile targets, the intended target has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting.

(b) *Mitigation Areas.* In addition to procedural mitigation, the Navy shall implement mitigation measures within mitigation areas to avoid or reduce potential impacts on marine mammals.

(1) *Mitigation Areas Marine Mammals in the Hawaii Range Complex f*or sonar, explosives, and strikes.

(i) Mitigation Area Requirements—(A) Hawaii Island Mitigation Area (year-round):

(*1*) The Navy shall not exceed 300 hours of MFAS sensor MF1 (MF1) and 20 hours of MFAS sensor MF4 (MF4) annually.

(*2*) Should national security present a requirement to conduct more than 300 hrs of MF1 or 20 hrs of MF4 per year, naval units will obtain permission from the appropriate designated Command authority prior to commencement of the activity. The Navy will provide NMFS with advance notification and include the information (*e.g.,* hours of sonar usage) in its annual activity reports.

(*3*) The Navy shall not use explosives during training or testing activities. Explosive restrictions within the Hawaii Island Mitigation Area apply only to those activities for which the Navy seeks MMPA authorization (*e.g.,* surface-to-surface or air-to-surface missile and gunnery events, BOMBEX, and mine neutralization).

(*4*) Should national security present a requirement for the use of explosives in the area, naval units will obtain permission from the appropriate designated Command authority prior to commencement of the activity. The Navy will provide NMFS with advance notification and include the information (*e.g.,* explosives usage) in its annual activity reports.

(B) 4-Islands Region Mitigation Area (November 15–April 15):

(*1*) The Navy shall not use MFAS sensor MF1 during training or testing activities from November 15–April 15.

(*2*) Should national security present a requirement for the use of MF1 in the area from November 15–April 15, naval units will obtain permission from the appropriate designated Command authority prior to commencement of the activity. The Navy will provide NMFS with advance notification and include the information (*e.g.,* hours of sonar usage) in its annual activity reports.

(ii) [Reserved]

(2) *Mitigation Areas Marine Mammals in the Southern California Portion of the Study Area* for sonar, explosives, and strikes.

(i) Mitigation Area Requirements—(A) San Diego Arc Mitigation Area (June 1–October 31):

(*1*) The Navy shall not exceed 200 hours of MFAS sensor MF1 (with the exception of active sonar maintenance and systems checks) per season annually.

(*2*) Should national security present a requirement to conduct more than 200 hrs of MF1 (with the exception of active sonar maintenance and systems checks) per year from June 1–October 31, naval units will obtain permission from the appropriate designated Command authority prior to commencement of the activity. The Navy will provide NMFS with advance notification and include the information (*e.g.,* hours of sonar usage) in its annual activity reports.

(*3*) The Navy shall not use explosives during large-caliber gunnery, torpedo, bombing, and missile (including 2.75

inch rockets) activities during training or testing activities.

(*4*) Should national security present a requirement to conduct large-caliber gunnery, torpedo, bombing, and missile (including 2.75 inch rockets) activities using explosives, naval units will obtain permission from the appropriate designated Command authority prior to commencement of the activity. The Navy will provide NMFS with advance notification and include the information (*e.g.,* explosives usage) in its annual activity reports.

(B) Santa Barbara Island Mitigation Area (year-round):

(*1*) The Navy shall not use MFAS sensor MF1 and explosives used in small-, medium-, and large-caliber gunnery; torpedo; bombing; and missile (including 2.75 inch rockets) activities during unit-level training or MTEs.

(*2*) Should national security present a requirement for the use of mid-frequency active anti-submarine warfare sensor MF1 or explosives in small-, medium-, and large-caliber gunnery; torpedo; bombing; and missile (including 2.75 inch rockets) activities during unit-level training or major training exercises for national security, naval units will obtain permission from the appropriate designated Command authority prior to commencement of the activity. The Navy will provide NMFS with advance notification and include the information in its annual activity reports.

(ii) [Reserved]

§ 218.75 Requirements for monitoring and reporting.

(a) The Navy must notify NMFS immediately (or as soon as operational security considerations allow) if the specified activity identified in § 218.70 is thought to have resulted in the mortality or injury of any marine mammals, or in any take of marine mammals not identified in this subpart.

(b) The Navy must conduct all monitoring and required reporting under the LOAs, including abiding by the HSTT Study Area monitoring program. Details on program goals, objectives, project selection process, and current projects available at *www.navymarinespeciesmonitoring.us.*

(c) Notification of injured, live stranded, or dead marine mammals. The Navy shall abide by the Notification and Reporting Plan, which sets out notification, reporting, and other requirements when dead, injured, or live stranded marine mammals are detected.

(d) Annual HSTT Study Area marine species monitoring report. The Navy shall submit an annual report of the HSTT Study Area monitoring describing the implementation and results from the previous calendar year. Data collection methods shall be standardized across range complexes and study areas to allow for comparison in different geographic locations. The report shall be submitted either three months after the calendar year, or three months after the conclusion of the monitoring year to be determined by the Adaptive Management process to the Director, Office of Protected Resources, NMFS. Such a report would describe progress of knowledge made with respect to intermediate scientific objectives within the HSTT Study Area associated with the Integrated Comprehensive Monitoring Program. Similar study questions shall be treated together so that progress on each topic shall be summarized across all Navy ranges. The report need not include analyses and content that does not provide direct assessment of cumulative progress on the monitoring plan study questions. As an alternative, the Navy may submit a multi-Range Complex annual Monitoring Plan report to fulfill this requirement. Such a report would describe progress of knowledge made with respect to monitoring study questions across multiple Navy ranges associated with the ICMP. Similar study questions shall be treated together so that progress on each topic shall be summarized across multiple Navy ranges. The report need not include analyses and content that does not provide direct assessment of cumulative progress on the monitoring study question. This will continue to allow Navy to provide a cohesive monitoring report covering multiple ranges (as per ICMP goals), rather than entirely separate reports for the HSTT, Gulf of Alaska, Mariana Islands, and the Northwest Study Areas, etc.

(e) Annual HSTT Training Exercise Report and Testing Activity Report. Each year, the Navy shall submit two preliminary reports (Quick Look Report) detailing the status of authorized sound sources within 21 days after the anniversary of the date of issuance of each LOA to the Director, Office of Protected Resources, NMFS. Each year, the Navy shall submit detailed reports to the Director, Office of Protected Resources, NMFS within 3 months after the anniversary of the date of issuance of the LOA. The HSTT annual Training Exercise Report and Testing Activity reports can be consolidated with other exercise reports from other range complexes in the Pacific Ocean for a single Pacific Exercise Report, if desired. The annual reports shall contain information on MTEs, Sinking Exercise (SINKEX) events, and a summary of all sound sources used, as described in paragraph (e)(3) of this section. The analysis in the detailed reports shall be based on the accumulation of data from the current year's report and data collected from previous reports. The detailed reports shall contain information identified in paragraphs (e)(1) through (5) of this section.

(1) MTEs—This section shall contain the following information for MTEs conducted in the HSTT Study Area.

(i) Exercise Information (for each MTE):

(A) Exercise designator;

(B) Date that exercise began and ended;

(C) Location;

(D) Number and types of active sonar sources used in the exercise;

(E) Number and types of passive acoustic sources used in exercise;

(F) Number and types of vessels, aircraft, etc., participating in exercise;

(G) Total hours of observation by lookouts;

(H) Total hours of all active sonar source operation;

(I) Total hours of each active sonar source bin; and

(J) Wave height (high, low, and average during exercise).

(ii) Individual marine mammal sighting information for each sighting in each exercise when mitigation occurred:

(A) Date/Time/Location of sighting;

(B) Species (if not possible, indication of whale/dolphin/pinniped);

(C) Number of individuals;

(D) Initial Detection Sensor;

(E) Indication of specific type of platform observation made from (including, for example, what type of surface vessel or testing platform);

(F) Length of time observers maintained visual contact with marine mammal;

(G) Sea state;

(H) Visibility;

(I) Sound source in use at the time of sighting;

(J) Indication of whether animal is <200 yd, 200 to 500 yd, 500 to 1,000 yd, 1,000 to 2,000 yd, or >2,000 yd from sonar source;

(K) Mitigation implementation. Whether operation of sonar sensor was delayed, or sonar was powered or shut down, and how long the delay was;

(L) If source in use is hull-mounted, true bearing of animal from ship, true direction of ship's travel, and estimation of animal's motion relative to ship (opening, closing, parallel); and

(M) Observed behavior. Lookouts shall report, in plain language and without trying to categorize in any way, the observed behavior of the animals (such as animal closing to bow ride, paralleling course/speed, floating on surface and not swimming, etc.) and if any calves present. (iii) An evaluation (based on data gathered during all of the MTEs) of the effectiveness of mitigation measures designed to minimize the received level to which marine mammals may be exposed. This evaluation shall identify the specific observations that support any conclusions the Navy reaches about the effectiveness of the mitigation.

(2) SINKEXs. This section shall include the following information for each SINKEX completed that year.

(i) Exercise information (gathered for each SINKEX);

(A) Location;

(B) Date and time exercise began and ended;

(C) Total hours of observation by lookouts before, during, and after exercise;

(D) Total number and types of explosive source bins detonated;

(E) Number and types of passive acoustic sources used in exercise;

(F) Total hours of passive acoustic search time;

(G) Number and types of vessels, aircraft, etc., participating in exercise;

(H) Wave height in feet (high, low, and average during exercise); and

(J) Narrative description of sensors and platforms utilized for marine mammal detection and timeline illustrating how marine mammal detection was conducted.

(ii) Individual marine mammal observation (by Navy lookouts) information (gathered for each marine mammal sighting) for each sighting where mitigation was implemented.

(A) Date/Time/Location of sighting;

(B) Species (if not possible, indicate whale, dolphin, or pinniped);

(C) Number of individuals;

(D) Initial detection sensor;

(E) Length of time observers maintained visual contact with marine mammal;

(F) Sea state;

(G) Visibility;

(H) Whether sighting was before, during, or after detonations/exercise, and how many minutes before or after;

(I) Distance of marine mammal from actual detonations—200 yd, 200 to 500 yd, 500 to 1,000 yd, 1,000 to 2,000 yd, or >2,000 yd (or target spot if not yet detonated);

(J) Observed behavior. Lookouts shall report, in plain language and without trying to categorize in any way, the observed behavior of the animal(s) (such as animal closing to bow ride, paralleling course/speed, floating on surface and not swimming etc.), including speed and direction and if any calves present;

(K) Resulting mitigation implementation. Indicate whether explosive detonations were delayed, ceased, modified, or not modified due to marine mammal presence and for how long; and

(L) If observation occurs while explosives are detonating in the water, indicate munition type in use at time of marine mammal detection.

(3) Summary of sources used. This section shall include the following information summarized from the authorized sound sources used in all training and testing events:

(i) Total annual hours or quantity (per the LOA) of each bin of sonar or other acoustic sources (pile driving and air gun activities);

(ii) Total annual expended/detonated rounds (missiles, bombs, sonobuoys, etc.) for each explosive bin.

(4) Humpback Whale Special Reporting Area (December 15–April 15). The Navy shall report the total hours of operation of surface ship hull-mounted mid-frequency active sonar used in the special reporting area.

(5) HSTT Mitigation Areas. The Navy shall report any use that occurred as specifically described in these areas. Information included in the classified annual reports may be used to inform future adaptive management of activities within the HSTT Study Area.

(6) Geographic information presentation. The reports shall present an annual (and seasonal, where practical) depiction of training and testing events and bin usage (as well as pile driving activities) geographically across the HSTT Study Area.

§ 218.76 Letters of Authorization.

(a) To incidentally take marine mammals pursuant to these regulations in this subpart, the Navy must apply for and obtain Letters of Authorization (LOAs) in accordance with § 216.106 of this subpart, conducting the activity identified in § 218.70(c).

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

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

(d) In the event of projected changes to the activity or to mitigation, monitoring, reporting (excluding changes made pursuant to the adaptive management provision of § 218.77(c)(1)) required by an LOA, the Navy must apply for and obtain a modification of LOAs as described in § 218.77.

(e) Each LOA shall set forth:

(1) Permissible methods of incidental taking;

(2) Authorized geographic areas for incidental taking;

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

(4) Requirements for monitoring and reporting.

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

(g) Notice of issuance or denial of the LOA(s) shall be published in the **Federal Register** within 30 days of a determination.

§ 218.77 Renewals and modifications of Letters of Authorization.

(a) An LOA issued under § 216.106 of this subchapter and § 218.76 for the activity identified in § 218.70(c) shall be renewed or modified upon request by the applicant, provided that:

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

(2) NMFS determines that the mitigation, monitoring, and reporting measures required by the previous LOA(s) under these regulations in this subpart were implemented.

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

(c) An LOA issued under § 216.106 of this subchapter and § 218.76 for the activity identified in § 218.70(c) may be modified by NMFS under the following circumstances:

(1) Adaptive Management—After consulting with the Navy regarding the

practicability of the modifications, NMFS may modify (including adding or removing measures) the existing mitigation, monitoring, or reporting measures if doing so creates a reasonable likelihood of more effectively accomplishing the goals of the mitigation and monitoring set forth in this subpart.

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

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

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

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

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

(2) Emergencies—If NMFS determines that an emergency exists that poses a significant risk to the well-being of the species or stocks of marine mammals specified in LOAs issued pursuant to § 216.106 of this chapter and § 217.86, an LOA may be modified without prior notice or opportunity for public comment. Notice would be published in the **Federal Register** within thirty days of the action.

§§ 218.78–218.79 [Reserved]

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