DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 218

[Docket No. 200109–0005]

RIN 0648–BJ00

Taking and Importing Marine Mammals; Taking Marine Mammals Incidental to the U.S. Navy Training and Testing Activities in the Mariana Islands Training and Testing (MITT) 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) to take marine mammals incidental to training and testing activities conducted in the Mariana Islands Training and Testing (MITT) Study Area. Pursuant to the MMPA, NMFS is requesting comments on its proposal to issue regulations and subsequent Letter 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 LOA. Agency responses to public comments will be summarized in the notice of the final decision. 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 March 16, 2020.

ADDRESSES: You may submit comments on this document, identified by NOAA–NMFS–2020–0006, by any of the following methods:

- *Electronic submission:* Submit all electronic public comments via the Federal e-Rulemaking Portal. Go to *www.regulations.gov/#!docketDetail;D=NOAA-NMFS-2020-0006,* click the "Comment Now!" icon, complete the required fields, and enter or attach your comments.
- *Mail:* Submit written comments to Jolie Harrison, Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service, 1315 East West Highway, Silver Spring, MD 20910.

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

A copy of the Navy's application, NMFS' proposed and final rules and subsequent LOA for the existing regulations, and other supporting documents and documents cited herein 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 use the contact listed here (see **FOR FURTHER INFORMATION CONTACT**).

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

SUPPLEMENTARY INFORMATION:

Purpose of Regulatory Action

These proposed regulations, issued under the authority of the MMPA (16 U.S.C. 1361 *et seq.*), would provide the framework for authorizing the take of marine mammals incidental to the Navy's training and testing activities (which qualify as military readiness activities) from the use of sonar and other transducers and in-water detonations throughout the MITT Study Area. The Study Area includes the seas off the coasts of Guam and the Commonwealth of the Northern Mariana Islands (CNMI), the in-water areas around the Mariana Islands Range Complex (MIRC), the transit corridor between the MIRC and the Hawaii Range Complex (HRC), and select pierside and harbor locations. The transit corridor is outside the geographic boundaries of the MIRC and represents a great circle route across the high seas for Navy vessels transiting between the MIRC and the HRC. The proposed activities also include various activities in Apra Harbor such as sonar maintenance alongside Navy piers located in Inner Apra Harbor.

NMFS received an application from the Navy requesting seven-year regulations and an authorization to incidentally take individuals of multiple species of marine mammals ("Navy's rulemaking/LOA application" or "Navy's application"). Take is anticipated to occur by Level A and Level B harassment incidental to the Navy's training and testing activities, with no serious injury or mortality expected or proposed for authorization.

Background

The MMPA prohibits the "take" of marine mammals, with certain exceptions. Sections 101(a)(5)(A) and (D) of the MMPA 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, the public is provided with notice of the proposed incidental take authorization and provided the opportunity to review and 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 stocks and will not have an unmitigable adverse impact on the availability of the species or stocks for taking for subsistence uses (where relevant). Further, NMFS must prescribe the permissible methods of taking and other means of effecting the least practicable adverse impact on the affected species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of such species or stocks for taking for certain subsistence uses (referred to in this rule as "mitigation measures"); and requirements pertaining to the monitoring and reporting of such takings. The MMPA defines "take" to mean to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal. The *Preliminary Analysis and Negligible Impact Determination* section below discusses the definition of "negligible impact."

The NDAA for Fiscal Year 2004 (2004 NDAA) (Pub. L. 108–136) amended section 101(a)(5) of the MMPA to remove the "small numbers" and "specified geographical region" provisions indicated above and amended the definition of "harassment" as applied to a "military readiness activity." The definition of harassment for military readiness activities (section 3(18)(B) of the MMPA) is (i) Any act that injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild (Level A Harassment); or (ii) Any act that disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns, including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering, to a point where such behavioral patterns are abandoned or significantly altered (Level B harassment). In addition, the 2004 NDAA amended the MMPA as it relates to military readiness activities such that the least practicable adverse impact analysis shall include consideration of personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity.

More recently, section 316 of the NDAA for Fiscal Year 2019 (2019 NDAA) (Pub. L. 115–232), signed on August 13, 2018, amended the MMPA to allow incidental take rules for military readiness activities under section 101(a)(5)(A) to be issued for up to seven years. Prior to this amendment, all incidental take rules under section 101(a)(5)(A) were limited to five years.

Summary and Background of Request

On February 11, 2019, NMFS received an application from the Navy for authorization to take marine mammals by Level A and Level B harassment incidental to training and testing activities (categorized as military readiness activities) from the use of sonar and other transducers and in-water detonations in the MITT Study Area over a seven-year period beginning when the current authorization expires.

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 regulations and LOA (if authorized): Amphibious warfare (in-water detonations), anti-submarine warfare (sonar and other transducers, in-water detonations), surface warfare (in-water detonations), and other testing and training (sonar and other transducers). The activities would not include any pile driving/removal or use of air guns.

This will be the third time NMFS has promulgated incidental take regulations pursuant to the MMPA relating to similar military readiness activities in the MITT Study Area, following those effective from August 3, 2010, through August 3, 2015 (75 FR 45527; August 3, 2010) and from August 3, 2015 through August 3, 2020 (80 FR 46112; August 3, 2015). 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.

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. 8062), which requires 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 operations. The Navy's testing activities ensure naval forces are equipped with well-maintained systems that take advantage of the latest technological advances. The Navy's research and acquisition community conducts military readiness activities that involve testing. The Navy tests ships, aircraft, weapons, combat systems, sensors, and related equipment, and conducts scientific research activities to achieve and maintain military readiness.

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 (*e.g.,* organization of ships, submarines, aircraft, 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 MITT 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. These proposed regulations would cover training and testing activities that would occur for a seven-year period following the expiration of the current MMPA authorization for the MITT Study Area, which expires on August 3, 2020.

Description of the Specified Activity

The Navy requests authorization to take marine mammals incidental to conducting training and testing activities. The Navy has determined that acoustic and explosive stressors are most likely to result in impacts on marine mammals that could rise to the level of harassment, and NMFS concurs with this determination. Detailed descriptions of these activities are provided in Chapter 2 of the 2019 MITT Draft Supplemental Environmental Impact Statement (SEIS)/Overseas EIS (OEIS) (MITT DSEIS/OEIS) and in the Navy's rule making/LOA application (*https://www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-military-readiness-activities*) and are summarized here.

Dates and Duration

The specified activities would occur at any time during the seven-year period of validity of the regulations. The proposed number of training and testing activities are described in the *Detailed Description of the Specified Activities* section (Tables 1 through 5).

Geographical Region

The MITT Study Area is comprised of three components: (1) The MIRC, (2) additional areas on the high seas, and (3) a transit corridor between the MIRC and the HRC as depicted in Figure 1 below. The MIRC includes the waters south of Guam to north of Pagan (CNMI), and from the Pacific Ocean east of the Mariana Islands to the Philippine Sea to the west, encompassing 501,873 square nautical miles (NM^2) of open ocean (Figure 1). For the additional areas of the high seas, this includes the area to the north of the MIRC that is within the U.S. Exclusive Economic Zone (EEZ) of the CNMI and the areas to the west of the MIRC. The transit corridor is outside the geographic boundaries of the MIRC and represents a great circle route (*i.e.,* the shortest distance) across the high seas for Navy ships transiting between the MIRC and the HRC. Although not part of any defined range complex, the transit corridor is important to the Navy in that it provides available air, sea, and undersea space where vessels and aircraft conduct training and testing while in transit. While in transit and along the corridor, vessels and aircraft would, at times, conduct basic and routine unit-level activities such as gunnery and sonar training. Ships also conduct sonar maintenance, which includes active sonar transmissions.

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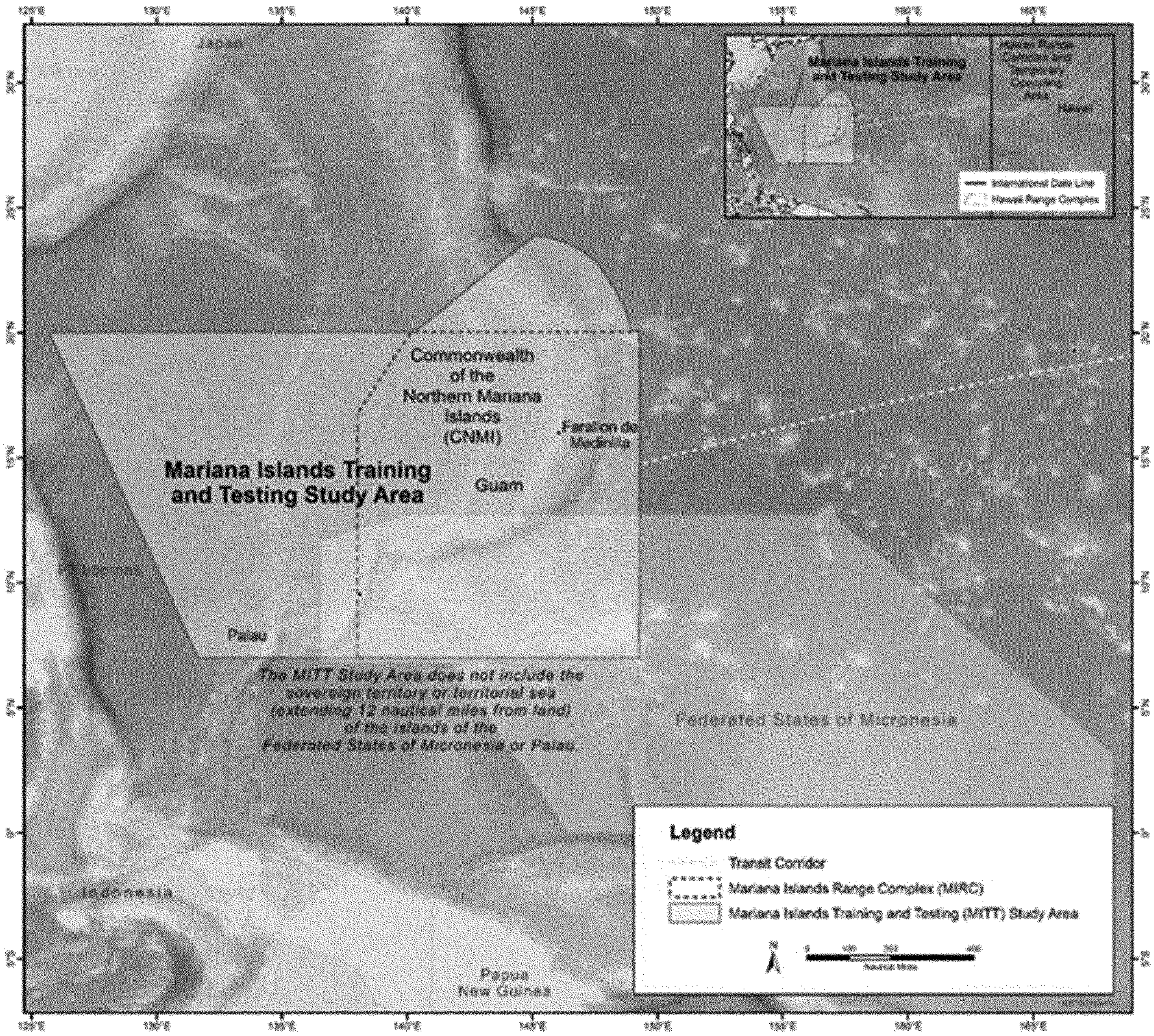

Figure 1. Map of the MITT Study Area

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Training and testing activities occur within the MITT Study Area, which is composed of a designated set of specifically bounded geographic areas encompassing a water component (above and below the surface), airspace, and for training a land component, such as Farallon de Medinilla (FDM). The MIRC includes established OPAREAs and special use airspace, which may be further divided to provide safety and better control of the area and activities being conducted.

The MIRC includes approximately 40,000 NM^2 of special use airspace. This airspace is almost entirely over the ocean (except W13A) and includes warning areas, and restricted areas (R) (see the MITT Draft SEIS/OEIS, Figure 2.1–2 and Figure 2.1–3, for details). Warning Areas (W)–517 and W–12 include approximately 11,800 NM^2 of special use airspace; W–11 (A/B) is approximately 10,500 NM^2 of special use airspace, and W–13 (A/B/C) is approximately 18,000 NM^2 of special use airspace. The restricted area airspace over or near land areas within the MIRC includes approximately 2,463 NM^2 of special use airspace and restricted areas (R) 7201 and R7201A, which extends in a 12 NM radius around FDM.

The MIRC includes the sea and undersea space from the ocean surface to the ocean floor. The MIRC also consists of designated sea and undersea space training areas, which include designated drop zones; underwater demolition and floating mine exclusion zones; danger zones associated with live-fire ranges; and training areas associated with military controlled beaches, harbors, and littoral areas.

Additionally, the MITT Study Area includes pierside locations in the Apra Harbor Naval Complex where surface ship and submarine sonar maintenance and testing occur. Activities in Apra Harbor include channels and routes to and from the Navy port in the Apra Harbor Naval Complex, and associated wharves and facilities within the Navy port.

Primary Mission Areas

The Navy categorizes its at-sea activities into functional warfare areas called primary mission areas. These activities generally fall into the following eight primary mission areas: Air warfare; amphibious warfare; anti-submarine warfare (ASW); electronic warfare; expeditionary warfare; mine warfare (MIW); strike warfare; and surface warfare (SUW). Most activities addressed in the MITT Study Area are categorized under one of the primary mission areas. Activities that do not fall within one of these areas are listed as ''other activities.'' Each warfare community (surface, subsurface, aviation, and expeditionary 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. A description of the sonar, munitions, targets, systems, and other material used during training and testing activities within these primary mission areas is provided in the 2019 MITT DSEIS/OEIS Appendix A (*Training and Testing Activities Descriptions*).

The Navy describes and analyzes the effects of its activities within the 2019 MITT DSEIS/OEIS (U.S. Department of the Navy, 2019). In its assessment, the Navy concluded that sonar and other transducers and in-water detonations were the stressors that would result in impacts on marine mammals that could rise to the level of harassment as defined under the MMPA. Therefore, 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. Those mission areas include the following:

- Amphibious warfare (underwater detonations)
- ASW (sonar and other transducers, underwater detonations)
- MIW (sonar and other transducers, underwater detonations)
- SUW (underwater detonations)
- Other training and testing activities (sonar and other transducers)

The Navy's training and testing activities in air warfare, electronic warfare, and expeditionary warfare do not involve sonar and other transducers, underwater detonations, or any other stressors that could result in harassment, serious injury, or mortality of marine mammals. Therefore, the activities in air, electronic, and expeditionary warfare areas are not discussed further in this proposed rule, but are analyzed fully in the Navy's 2019 MITT DSEIS/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 spans 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 are often integrated into training activities and, in most cases, the systems are used in the same manner in which they are used for 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.

ASW

The mission of anti-submarine warfare is to locate, neutralize, and defeat hostile submarine forces that threaten Navy surface forces. Anti-submarine warfare can involve various assets such as aircraft, ships, and submarines, which 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.

Anti-submarine warfare 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 anti-submarine warfare from detecting and tracking a submarine to attacking a target using either exercise torpedoes (*i.e.,* torpedoes that do not contain an explosive warhead) or simulated weapons. These integrated anti-submarine warfare training exercises are conducted in coordinated, at-sea training events involving submarines, ships, and aircraft.

Testing of anti-submarine warfare 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 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 personnel in the use of new or newly enhanced systems during a large scale, complex exercise.

MIW

The mission of mine warfare 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. Mine warfare also includes training and testing in offensive mine laying. Naval mines can be laid by ships, submarines, or aircraft.

Mine warfare 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 mine warfare 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. Mine warfare testing and development fall into two primary categories: Mine detection and classification, and mine countermeasure and neutralization testing. Mine detection and classification testing involves the use of air, surface, and subsurface vessels and uses sonar, including towed and side scan 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 and uses tracking devices and countermeasure and neutralization systems to evaluate the effectiveness of neutralizing mine threats. Most neutralization tests use mine shapes, or non-explosive practice mines, to accomplish the requirements of the activity. 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.

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

SUW

The mission of surface warfare is to obtain control of sea space from which naval forces may operate, which entails offensive action against surface targets while also defending against aggressive actions by enemy forces. In the conduct of surface warfare, aircraft use guns, air-launched cruise missiles, or other precision-guided munitions; ships employ naval guns and surface-to-surface missiles; and submarines attack surface ships using torpedoes or submarine-launched, anti-ship cruise missiles.

Surface warfare training includes surface-to-surface gunnery and missile exercises, air-to-surface gunnery and missile exercises, submarine missile or torpedo launch activities, and other munitions against surface targets.

Testing of weapons used in surface warfare 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 activities 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 training activities.

Other Activities

Naval forces conduct additional training, testing and maintenance activities that do not fit into the primary mission areas that are listed above. The 2019 MITT DSEIS/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 acoustic and oceanographic research. These activities include the use of various sonar systems.

Overview of Major Training Activities and Exercises Within the MITT Study Area

A major training exercise (MTE) for purposes of this rulemaking is comprised of several unit-level activities conducted by several units operating together, commanded and controlled by a single Commander, and typically generating more than 100 hours of active sonar. These exercises typically employ an exercise scenario developed to train and evaluate the exercise participants in tactical and operational tasks. In an MTE, most of the activities being directed and coordinated by the Commander in charge of the exercise 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.

Exercises may also be categorized as integrated or coordinated ASW exercises. The distinction between integrated and coordinated ASW exercises is how the units are being controlled. Integrated ASW exercises are controlled by an existing command structure, and generally occur during the Integrated Phase of the training cycle. Coordinated exercises may have a command structure stood up solely for the event; for example, the commanding officer of a ship may be placed in tactical command of other ships for the duration of the exercise. Not all integrated ASW exercises are considered MTEs, due to their scale, number of participants, duration, and amount of active sonar. The distinction between large, medium, and small integrated or coordinated exercises is based on the scale of the exercise *(i.e.,* number of ASW units participating), the length of the exercise, and the total number of active sonar hours. 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 MITT Study Area

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 (missiles, radar, and sonar) and platforms (surface ships, submarines, and aircraft); and acquisition of systems and platforms. The individual commands within the research and acquisition community include Naval Air Systems Command, Naval Sea Systems Command, and Office of Naval Research.

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 following subsections describe the acoustic and explosive stressors for marine mammals and their habitat (including prey species) within the MITT Study Area. Because of the complexity of analyzing sound propagation in the ocean environment, the Navy relies on acoustic models in its environmental analyses and rulemaking/LOA application that consider sound source characteristics and varying ocean conditions across the MITT Study Area. Stressor/resource interactions that were determined to have de minimis or no impacts (*i.e.,* vessel, aircraft, or weapons noise, and explosions in air) were not carried forward for analysis in the Navy's rulemaking/LOA application. NMFS reviewed the Navy's analysis and conclusions on de minimis sources and finds them complete and supportable.

Acoustic Stressors

Acoustic stressors include acoustic signals emitted into the water for a specific purpose, such as sonar and other transducers (devices that convert energy from one form to another—in this case, into sound waves), as well as incidental sources of broadband sound produced as a byproduct of vessel movement and use of weapons or other deployed objects. 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 sonar and other transducers 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 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, navigate safely, 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 this proposed rule, the terms sonar and other transducers will be 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 (greater than 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.

The sound sources and platforms typically used in naval activities analyzed in the Navy's rulemaking/LOA application are described in Appendix A (*Training and Testing Activities Descriptions*) of the 2019 MITT DSEIS/OEIS. The effects of these factors are explained in Appendix H (Acoustic and Explosive Concepts) of the MITT 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.

ASW

Sonar used during ASW training and testing would impart the greatest amount of acoustic energy of any category of sonar and other transducers analyzed in this proposed rule. Types of sonars used to detect vessels include hull-mounted, towed, line array, sonobuoy, helicopter dipping, and torpedo sonars. In addition, acoustic targets and torpedo 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 can vary widely, from rarely used to continuously active. The beam pattern 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 beyond 12 NM from shore. Exceptions include use of dipping sonar by helicopters, maintenance of systems while in Apra Harbor, and system checks while transiting to or from Apra Harbor.

Mine Warfare, Small Object Detection and Imaging

Sonars used to locate mines and other small objects, similar to those used in imaging, are typically high frequency or very high frequency. Higher frequencies allow for greater resolution and, 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. Hull-mounted anti-submarine sonars can also be used in an object detection mode known as ''Kingfisher'' mode. 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 MITT Study Area.

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 training and testing minefields, temporary minefields close to strategic ports and harbors, or at targets of opportunity such as navigation buoys.

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 MITT 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. As detailed below, 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. Unless stated otherwise, a reference distance of 1 meter (m) is used for sonar and other transducers.

- 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 MITT 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 IN THE MITT STUDY AREA

Source class category	Bin	Description
Low-Frequency (LF): Sources that produce signals less than 1 kHz.	LF4	LF sources equal to 180 dB and up to 200 dB.
	LF5	LF sources less than 180 dB.
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–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	Underwater sound signal devices (*e.g.,* MK 84 SUS).
	MF9	Sources (equal to 180 dB and up to 200 dB) not otherwise binned.
	MF11	Hull-mounted surface ship sonars with an active duty cycle greater than 80 percent.
	MF12	Towed array surface ship sonars with an active duty cycle greater than 80 percent.
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).
	HF3	Other hull-mounted submarine sonars (classified).
	HF4	Mine detection, classification, and neutralization sonar (*e.g.,* AN/SQS–20).
	HF6	Sources (equal to 180 dB and up to 200 dB) not otherwise binned.
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.
	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): 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): Sources used to transmit data	M3	MF acoustic modems (greater than 190 dB).
Synthetic Aperture Sonars (SAS): Sonars used to form high-resolution images of the seafloor.	SAS2	HF SAS systems.
	SAS4	MF to HF broadband mine countermeasure sonar.

Explosive Stressors

This section describes the characteristics of explosions during naval training and testing. The activities analyzed in Navy's rulemaking/LOA application that use explosives are described in Appendix A (*Training and Testing Activities Descriptions*) of the 2019 MITT DSEIS/OEIS. Explanations of the terminology and metrics used when describing explosives in the Navy's rule making/LOA application are also in Appendix H (*Acoustic and Explosive Concepts*) of the 2019 MITT DSEIS/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 in the warhead, the type of explosive material, the boundaries and characteristics of the propagation medium, and, in water, the detonation depth and the depth of the receiver (*i.e.,* marine mammal). The net explosive weight, which is 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 H (*Acoustic and Explosive Concepts*) of the 2019 MITT DSEIS/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 NM from shore, with the exception of three existing mine warfare areas (Outer Apra Harbor, Piti, and Agat Bay). Nearshore small explosive charges only occur at the three mine warfare areas. Piti and Agat Bay, while nearshore, are in very deep water and used for floating mine neutralization activities. 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 discussed above and 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 MITT Study Area are shown in Table 2 below.

TABLE 2—EXPLOSIVES ANALYZED IN THE MITT STUDY AREA

Bin	Net explosive weight (lb)	Example explosive source	Modeled detonation depths (ft)
E1	0.1–0.25	Medium-caliber projectiles	0.3, 60.
E2	>0.25–0.5	Anti-swimmer grenade	0.3.
E3	>0.5–2.5	57 mm projectile	0.3, 60.
E4	>2.5–5	Mine neutralization charge	33, 197.
E5	>5–10	5 in projectiles	0.3, 10, 98.
E6	>10–20	Hellfire missile	0.3, 98.
E8	>60–100	250 lb. bomb; Lightweight torpedo	0.3, 150.
E9	>100–250	500 lb bomb	0.3.
E10	>250–500	1,000 lb bomb	0.3.
E11	>500–650	Heavyweight torpedo	150, 300.
E12	>650–1,000	2,000 lb bomb	0.3.

Notes: (1) Net Explosive Weight refers to the equivalent amount of TNT. The actual weight of a munition may be larger due to other components; (2) in = inch(es), lb = pound(s), ft = feet.

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 H (*Acoustic and Explosive Concepts*) of the 2019 MITT DSEIS/OEIS explains the characteristics of explosive detonations and how the above factors affect the propagation of explosive energy in the water.

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 thresholds for assessing the likelihood of harassment from a blast, which are also used to inform mitigation zones, are assumed to encompass risk due to fragmentation.

Other Stressor—Vessel Strike

NMFS also considered the chance that a vessel utilized in training or testing activities could strike a marine mammal. 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 are a limited, sporadic, and incidental result of Navy vessel movement within a 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 both the potential likelihood and 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.

Navy vessels transit at speeds that are optimal for fuel conservation and to meet training and testing requirements. Vessels used as part of the proposed 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). 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 to 13 kn, while a few specialized vessels can travel at faster speeds. Small craft (for purposes of this analysis, less than 18 m in length) have much more variable speeds (0 to 50+ kn, dependent on the activity), but generally range from 10 to 14 kn. From unpublished Navy data, average median speed for large Navy ships in the other Navy ranges from 2011–2015 varied from 5 to 10 kn with variations by ship class and location (*i.e.,* slower speeds close to the coast). Similar patterns would occur in the MITT Study Area. A full description of Navy vessels that are used during training and testing activities can be found in Chapter 2 (Description of Proposed Action and Alternatives) of the 2019 MITT DSEIS/OEIS.

While these speeds are representative of most events, some vessels need to temporarily 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.

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.

Detailed Description of the Specified Activities

Proposed Training and Testing Activities

The Navy's Operational Commands and various System Commands have identified activity levels that are needed in the MITT Study Area to ensure naval forces have sufficient training, maintenance, and new technology to meet Navy missions in the Pacific. Training prepares Navy personnel to be proficient in safely operating and maintaining equipment, weapons, and systems to conduct assigned missions. Navy research develops new science and technology followed by concept testing relevant to future Navy needs. Unlike other Navy range complexes, training and testing in the MITT Study Area is more episodic as transiting strike groups or individual units travel through on the way to and from the Western Pacific, or forward deployed assets temporarily travel to the MITT Study Area for individual or group activities. This section analyzes a maximum number of activities that could occur each year and then a maximum total of activities that could occur for seven years. One activity, Torpedo (Explosive) Testing, does not occur every year, but the maximum times it could occur over one year and seven years was analyzed.

The training and testing activities that the Navy proposes to conduct in the MITT Study Area are summarized in Table 3. The table is organized according to primary mission areas and includes the activity name, associated stressors of Navy's activities, description of the activity, sound source bin, the locations of those activities in the MITT 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 (*Training and Testing Activities Descriptions*) of the 2019 MITT DSEIS/OEIS.

TABLE 3—PROPOSED TRAINING AND TESTING ACTIVITIES ANALYZED FOR SEVEN-YEAR PERIOD IN THE MITT STUDY AREA

Stressor category	Activity	Description	Typical duration of event	Source bin [1]	Location	Annual # of events	7-Year # of events
Major Training Event—Large Integrated Anti-Submarine Warfare Training (ASW)							
Acoustic	Joint Multi-Strike Group Exercise.	Typically a 10-day Joint exercise, in which up to three carrier strike groups would conduct training exercises simultaneously.	10 days	ASW2, ASW3, ASW4, HF1, MF1, MF11, MF3, MF4, MF5, MF12, TORP1.	Study Area; MIRC	1	4
Major Training Event—Medium Integrated ASW							
Acoustic	Joint Expeditionary Exercise.	Typically a 10-day exercise that could include a Carrier Strike Group and Expeditionary Strike Group, Marine Expeditionary Units, Army Infantry Units, and Air Force aircraft together in a joint environment that includes planning and execution efforts as well as military training activities at sea, in the air, and ashore.	10 days	ASW2, ASW3, MF1, MF4, MF5, MF12.	Study Area; Apra Harbor.	1	7

TABLE 3—PROPOSED TRAINING AND TESTING ACTIVITIES ANALYZED FOR SEVEN-YEAR PERIOD IN THE MITT STUDY AREA—Continued

Stressor category	Activity	Description	Typical duration of event	Source bin [1]	Location	Annual # of events	7-Year # of events
			Medium Coordinated ASW				
Acoustic	Marine Air Ground Task Force Exercise (Amphibious)—Battalion.	Typically a 10-day exercise that conducts over the horizon, ship to objective maneuver for the elements of the Expeditionary Strike Group and the Amphibious Marine Air Ground Task Force. The exercise utilizes all elements of the Marine Air Ground Task Force (Amphibious), conducting training activities ashore with logistic support of the Expeditionary Strike Group and conducting amphibious landings.	10 days	ASW3, MF1, MF4, MF12.	Study Area to nearshore; MIRC; Tinian; Guam; Rota; Saipan; FDM.	4	28
			ASW				
Acoustic	Tracking Exercise—Helicopter (TRACKEX—Helo).	Helicopter crews search for, detect, and track submarines.	2–4 hours	MF4, MF5	Study Area > 3 NM from land; Transit Corridor.	10	70
Acoustic	Torpedo Exercise—Helicopter (TORPEX—Helo).	Helicopter crews search for, detect, and track submarines. Recoverable air launched torpedoes are employed against submarine targets.	2–5 hours	MF4, MF5, TORP1	Study Area > 3 NM from land.	6	42
Acoustic	Tracking Exercise—Maritime Patrol Aircraft (TRACKEX—Maritime Patrol Aircraft).	Maritime patrol aircraft crews search for, detect, and track submarines.	2–8 hours	MF5	Study Area > 3 NM from land.	36	252
Acoustic	Torpedo Exercise—Maritime Patrol Aircraft (TORPEX—Maritime Patrol Aircraft).	Maritime patrol aircraft crews search for, detect, and track submarines. Recoverable air launched torpedoes are employed against submarine targets.	2–8 hours	MF5, TORP1	Study Area > 3 NM from land.	6	42
Acoustic	Tracking Exercise—Surface (TRACKEX—Surface).	Surface ship crews search for, detect, and track submarines.	2–4 hours	ASW1, ASW3, MF1, MF11, MF12.	Study Area > 3 NM from land.	91	637
Acoustic	Torpedo Exercise—Surface (TORPEX—Surface).	Surface ship crews search for, detect, and track submarines. Exercise torpedoes are used during this event.	2–5 hours	ASW3, MF1, MF5, TORP1.	Study Area > 3 NM from land.	6	42
Acoustic	Tracking Exercise—Submarine (TRACKEX—Sub).	Submarine crews search for, detect, and track submarines.	8 hours	ASW4, HF1, HF3, MF3.	Study Area > 3 NM from land; Transit Corridor.	4	28
Acoustic	Torpedo Exercise—Submarine (TORPEX—Sub).	Submarine crews search for, detect, and track submarines. Recoverable exercise torpedoes are used during this event.	8 hours	ASW4, HF1, MF3, TORP2.	Study Area > 3 NM from land.	9	63
Acoustic	Small Joint Coordinated ASW exercise (Multi-Sail/GUAMEX).	Typically, a 5-day exercise with multiple ships, aircraft and submarines integrating the use of their sensors, including sonobuoys, to search, detect, and track threat submarines.	5 days	ASW2, ASW3, ASW4, HF1, MF1, MF3, MF4, MF5, MF11, MF12.	Study Area > 3 NM from land.	3	21
			Mine Warfare				
Acoustic	Civilian Port Defense.	Maritime security personnel train to protect civilian ports and harbors against enemy efforts to interfere with access to those ports.	Multiple days	HF4, SAS2	MIRC, Mariana littorals, Inner and Outer Apra Harbor.	1	7

TABLE 3—PROPOSED TRAINING AND TESTING ACTIVITIES ANALYZED FOR SEVEN-YEAR PERIOD IN THE MITT STUDY AREA—Continued

Stressor category	Activity	Description	Typical duration of event	Source bin [1]	Location	Annual # of events	7-Year # of events
Explosive	Mine Neutralization—Remotely Operated Vehicle Sonar (ASQ–235 [AQS–20], SLQ–48).	Ship, small boat, and helicopter crews locate and disable mines using remotely operated underwater vehicles	1–4 hours	E4	Study Area, Mariana littorals, and Outer Apra Harbor.	4	28
Acoustic	Mine Countermeasure Exercise—Surface Ship Sonar (SQQ–32, MCM).	Ship crews detect, locate, identify, and avoid mines while navigating restricted areas or channels, such as while entering or leaving port.	1–4 hours	HF4	Study Area, Apra Harbor.	4	28
Acoustic	Mine Countermeasure Exercise—Towed Sonar (AQS–20).	Surface ship crews detect and avoid mines while navigating restricted areas or channels using towed active sonar systems.	1–4 hours	HF4	Study Area, Apra Harbor.	4	28
Explosive	Mine Neutralization—Explosive Ordnance Disposal.	Personnel disable threat mines using explosive charges.	Up to 4 hours	E5, E6	Agat Bay site, Piti, and Outer Apra Harbor.	20	140
Acoustic	Submarine Mine Exercise.	Submarine crews practice detecting mines in a designated area.	Varies	HF1	Study Area, Mariana Littorals, Inner/Outer Apra Harbor.	1	7
Explosive	Underwater Demolition Qualification/Certification.	Navy divers conduct various levels of training and certification in placing underwater demolition charges.	Varies	E5, E6	Agat Bay site, Piti, and Outer Apra Harbor.	45	315
Surface Warfare (SUW)							
Explosive	Bombing Exercise (Air-to-Surface).	Fixed-wing aircrews deliver bombs against stationary surface targets.	1 hour	E9, E10, E12	Study Area, Special Use Airspace.	37	259
Explosive	Gunnery Exercise (GUNEX) (Air-to-Surface)—Medium-caliber.	Fixed-wing and helicopter aircrews fire medium-caliber guns at surface targets.	1 hour	E1, E2	Study Area > 12 NM from land, Special Use Airspace.	120	840
Explosive	GUNEX (Surface-to-Surface) Boat—Medium-caliber.	Small boat crews fire medium-caliber guns at surface targets.	1 hour	E2	Study Area > 12 NM from land, Special Use Airspace.	20	140
Explosive	GUNEX (Surface-to-Surface) Ship—Large-caliber.	Surface ship crews fire large-caliber guns at surface targets.	Up to 3 hours	E5	Study Area > 12 NM from land, Special Use Airspace.	255	1,785
Explosive	GUNEX (Surface-to-Surface) Ship—Small- and Medium-caliber.	Surface ship crews fire medium and small-caliber guns at surface targets.	2–3 hours	E1	Study Area > 12 NM from land, Special Use Airspace.	234	1,638
Explosive	Maritime Security Operations.	Helicopter, surface ship, and small boat crews conduct a suite of maritime security operations at sea, to include visit, board, search and seizure, maritime interdiction operations, force protection, and anti-piracy operations.	Up to 3 hours	E2	Study Area; MIRC	40	280
Explosive	Missile Exercise (Air-to-Surface) (MISSILEX [A–S]).	Fixed-wing and helicopter aircrews fire air-to-surface missiles at surface targets.	2 hours	E6, E8, E10	Study Area > 12 NM from land, Special Use Airspace.	10	70
Explosive	Missile Exercise (Air-to-Surface)—Rocket (MISSILEX [A–S]—Rocket).	Helicopter aircrews fire both precision-guided and unguided rockets at surface targets.	1 hour	E3	Study Area > 12 NM from land, Special Use Airspace.	110	770
Explosive	Missile Exercise (Surface-to-Surface) (MISSILEX [S–S]).	Surface ship crews defend against surface threats (ships or small boats) and engage them with missiles.	2–5 hours	E6, E10	Study Area > 50 NM from land, Special Use Airspace.	28	196

TABLE 3—PROPOSED TRAINING AND TESTING ACTIVITIES ANALYZED FOR SEVEN-YEAR PERIOD IN THE MITT STUDY AREA—Continued

Stressor category	Activity	Description	Typical duration of event	Source bin [1]	Location	Annual # of events	7-Year # of events
Explosive	Sinking Exercise	Aircraft, ship, and submarine crews 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 ordnance.	4–8 hours, possibly over. 1–2 days	E5, E8, E10, E11, E12, TORP2.	Study Area > 50 NM from land and > 1,000 fathoms depth.	1	4
Other Training Activities							
Acoustic	Submarine Navigation.	Submarine crews operate sonar for navigation and detection while transiting into and out of port during reduced visibility.	Up to 2 hours	HF1, MF3	Study Area, Apra Harbor, and Mariana littorals.	8	56
Acoustic	Submarine Sonar Maintenance.	Maintenance of submarine sonar and other system checks are conducted pierside or at sea.	Up to 1 hour	MF3	Study Area; Apra Harbor and Mariana littorals.	86	602
Acoustic	Surface Ship Sonar Maintenance.	Maintenance of surface ship sonar and other system checks are conducted pierside or at sea.	Up to 4 hours	MF1	Study Area; Apra Harbor and Mariana littorals.	44	308
Acoustic	Unmanned Underwater Vehicle Training.	Units conduct training with unmanned underwater vehicles from a variety of platforms, including surface ships, small boats, and submarines.	Up to 24 hours	FLS2, M3, SAS2, SAS4.	MIRC; Apra Harbor and Mariana littorals.	64	448
Testing Activities—ASW							
Acoustic; Explosive	Anti-Submarine Warfare Tracking Test—Maritime Patrol Aircraft (Sonobuoys).	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.	8 hours	ASW2, ASW5, E1, E3, MF5, MF6.	Study Area > 3 NM from land.	26	182
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.	2–6 flight hours	MF5, TORP1	Study Area > 3 NM from land.	20	140
Acoustic	Anti-Submarine Warfare Mission Package Testing.	Ships and their supporting platforms (*e.g.*, helicopters and unmanned aerial systems) detect, localize, and prosecute submarines.	1–2 weeks, with 4–8 hours of active sonar use with intervals of non-activity in between.	ASW1, ASW2, ASW3, ASW5, MF12, MF4, MF5, TORP1.	Mariana Island Range Complex.	100	700
Acoustic	At-Sea Sonar Testing.	At-sea testing to ensure systems are fully functional in an open ocean environment	From 4 hours to 11 days.	HF1, HF6, M3, MF3, MF9.	Study Area	7	49
Acoustic; Explosive	Torpedo (Explosive) Testing.	Air, surface, or submarine crews employ explosive and non-explosive torpedoes against artificial targets.	1–2 days during daylight hours.	ASW3, HF1, HF6, MF1, MF3, MF4, MF5, MF6, TORP1, TORP2, E8, E11.	Mariana Island Range Complex.	3	9
Acoustic	Torpedo (Non-explosive) Testing.	Air, surface, or submarine crews employ non-explosive torpedoes against submarines or surface vessels.	Up to 2 weeks	ASW3, ASW4, HF1, HF6, LF4, MF1, MF3, MF4, MF5, MF6, TORP1, TORP2, TORP3.	Mariana Island Range Complex.	7	49

TABLE 3—PROPOSED TRAINING AND TESTING ACTIVITIES ANALYZED FOR SEVEN-YEAR PERIOD IN THE MITT STUDY AREA—Continued

Stressor category	Activity	Description	Typical duration of event	Source bin [1]	Location	Annual # of events	7-Year # of events
Mine Warfare							
Acoustic; Explosive	Mine Countermeasure and Neutralization Testing.	Air, surface, and subsurface vessels neutralize threat mines and mine-like objects.	1–10 days, with intermittent use of countermeasure/neutralization systems during this period.	HF4, E4	MIRC; nearshore and littorals.	3	21
Vessel Evaluation							
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.	Up to 10 days	HF4, MF1, MF4, MF5, TORP1.	MIRC	1	7

[1] Additional activities utilizing sources not listed in the Major Training Event and coordinated exercise bins above may occur during these exercises. All acoustic sources which may be used during training and testing activities have been accounted for in the modeling and analysis presented in this application and in the 2019 MITT DSEIS/OEIS.

Summary of Acoustic and Explosive Sources Analyzed for Training and Testing

Tables 4 and 5 show the acoustic and explosive source classes, bins and quantity used in either hours or counts associated with the Navy's proposed training and testing activities over a seven-year period in the MITT Study Area that were analyzed in the Navy's rulemaking/LOA application. Table 4 describes the acoustic source classes (*i.e.,* low-frequency (LF), mid-frequency (MF), and high-frequency (HF)) that could occur over seven years under the proposed training and testing activities. Acoustic source bin use in the proposed activities would vary annually. The seven-year totals for the proposed training and testing activities take into account that annual variability.

TABLE 4—ACOUSTIC SOURCE CLASSES ANALYZED AND NUMBER USED FOR SEVEN-YEAR PERIOD FOR TRAINING AND TESTING ACTIVITIES IN THE MITT STUDY AREA

Source class category	Bin	Description	Unit	Annual	7-year total
Low-Frequency (LF): Sources that produce signals less than 1 kHz.	LF4	LF sources equal to 180 dB and up to 200 dB	H	1	7
	LF5	LF sources less than 180 dB	H	10	65
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–60).	H	1,818	9,051
	MF1K	Kingfisher mode associated with MF1 sonars	H	3	21
	MF3	Hull-mounted submarine sonars (*e.g.,* AN/BQQ–10).	H	227	1,589
	MF4	Helicopter-deployed dipping sonars (*e.g.,* AN/AQS–22).	H	185	1,295
	MF5	Active acoustic sonobuoys (*e.g.,* DICASS)	C	2,094	14,658
	MF6	Active underwater sound signal devices (*e.g.,* MK 84 SUS).	C	74	518
	MF9	Active sources (equal to 180 dB and up to 200 dB) not otherwise binned.	H	29	203
	MF11	Hull-mounted surface ship sonars with an active duty cycle greater than 80%.	H	304	2.128
+	MF12	Towed array surface ship sonars with an active duty cycle greater than 80%.	H	616	4,312
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	73	511
	HF3	Other hull-mounted submarine sonars (classified).	H	4	28
	HF4	Mine detection, classification, and neutralization sonar (*e.g.,* AN/SQS–20).	H	1,472	10,304
	HF6	Active sources (equal to 180 dB and up to 200 dB) not otherwise binned.	H	309	2,163

TABLE 4—ACOUSTIC SOURCE CLASSES ANALYZED AND NUMBER USED FOR SEVEN-YEAR PERIOD FOR TRAINING AND TESTING ACTIVITIES IN THE MITT STUDY AREA—Continued

Source class category	Bin	Description	Unit	Annual	7-year total
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	192	1,344
	ASW2	MF Multistatic Active Coherent sonobuoy (*e.g.,* AN/SSQ–125).	C	554	3,808
	ASW3	MF towed active acoustic countermeasure systems (*e.g.,* AN/SLQ–25).	H	3,124	21,868
	ASW4	MF expendable active acoustic device countermeasures (*e.g.,* MK 3).	C	332	2,324
	ASW5	MF sonobuoys with high duty cycles	H	50	350
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).	C	71	485
	TORP2	Heavyweight torpedo (*e.g.,* MK 48)	C	62	434
	TORP3	Heavyweight torpedo test (*e.g.,* MK 48)	C	6	42
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	4	28
Acoustic Modems (M): Systems used to transmit data through the water.	M3	MF acoustic modems (greater than 190 dB)	H	31	217
Synthetic Aperture Sonars (SAS): Sonars in which active acoustic signals are post-processed to form high-resolution images of the seafloor.	SAS2	HF SAS systems	H	449	3,143
	SAS4	MF to HF broadband mine countermeasure sonar.	H	6	42

Notes: H= hours; C = count.

Table 5 describes the number of in-water explosives that could be used in any year under the proposed training and testing activities. Under the proposed activities bin use would vary annually, and the seven-year totals for the proposed training and testing activities take into account that annual variability.

TABLE 5—EXPLOSIVE SOURCE BINS ANALYZED AND NUMBER USED FOR SEVEN-YEAR PERIOD FOR TRAINING AND TESTING ACTIVITIES WITHIN THE MITT STUDY AREA

Bin	Net explosive weight (lb)	Example explosive source	Modeled detonation depths (ft)	Annual	7-year total
E1	0.1–0.25	Medium-caliber projectiles	0.3, 60	768	5,376
E2	>0.25–0.5	Anti-swimmer grenade	0.3	400	2,800
E3	>0.5–2.5	57 mm projectile	0.3, 60	683	4,591
E4	>2.5–5	Mine neutralization charge	33, 197	44	308
E5	>5–10	5 in projectiles	0.3, 10, 98	1,221	8,547
E6	>10–20	15 lb shaped charge	0.3, 98	29	203
E8	>60–100	250 lb bomb; Light weight torpedo	0.3, 150	134	932
E9	>100–250	500 lb bomb	0.3	110	770
E10	>250–500	1,000 lb bomb	0.3	78	546
E11	>500–650	Heavy weight torpedo	150,300	5	17
E12	>650–1,000	2,000 lb bomb	0.3	48	336

Notes: (1) net explosive weight refers to the equivalent amount of TNT. The actual weight of a munition may be larger due to other components. (2) in = inch(es), lb = pound(s), ft = feet.

Vessel Movement

In the MITT Study Area, there is one port on Guam as well as Naval Base Guam. There are three ports within the CNMI including Port of Rota, Port of Tinian, and Port of Saipan. However, Navy ships are mostly associated with transits into and out of Apra Harbor on Guam. U.S. Navy vessels do not berth at other locations in the MITT Study Area other than Apra Harbor. Within the CNMI, the Port of Rota (also called Rota West Harbor) is located on the southwestern tip of the island. It is a very small, poorly sheltered port with a pierside water depth of 6 to 10 ft, which limits the size of vessels that can access the pier. The Port of Rota is mainly used as a port for ferry boats transporting tourists and residents from its sister island, Tinian. The Port of Tinian is a well-sheltered small port. Mobile Oil operates a fuel plant at the port, and a ferry service transports tourists from Saipan to Tinian. The Port of Saipan is the largest of the three CNMI ports. The port of Saipan is on the southwest shore and houses commercial ships, small local boats or ferries, and military vessels (ships that are not managed by the Navy or part of these proposed activities). Guam's Jose D. Leon Guerrero Commercial Port is on Cabras Island along the southwest portion of Guam. The Port Authority of Guam, administers the Commercial Port, Agana Boat Basin, and the Agat Marina.

While the ships assigned to any particular homeport change periodically, Naval Base Guam is not home to any surface fleet commands. There are no Navy surface warships homeported in Guam. The types of vessels currently homeported in Apra Harbor include submarines, support vessels like a submarine tender and a military sealift (*i.e.,* logistics) unit, and small vessels like coastal riverine craft. Small vessels stay in nearshore, coastal waters. Navy large vessel movements for training and testing in the MITT Study Area often occur when U.S. West Coast and Hawaii based strike groups or independent deployers (*i.e.,* single vessels) transit to and from the Western Pacific, Indian Ocean, and Arabian Gulf. The Navy also maintains a contingent of vessels homeported in Japan that also visit the MITT Study Area to participate in various single unit or multi-unit training activities and MTEs. Unlike other Navy range complexes associated with fleet concentration areas, there may be long periods, from multiple weeks up to a month or more (*e.g.,* 1–3 months), without any significant Navy large surface vessel presence in the MITT Study Area. These gaps are the result of Navy ships training in other range complexes as part of pre-deployment preparations and Japan-based ships deployed to other portions of the Western Pacific for operational reasons.

The western approaches to Apra Harbor are the central corridor of vessel movements in the MITT Study Area, as visiting, transiting, and homeported vessels pull in and out for port calls and resupply. Depending on a given exercise, many of the participating ships could use Apra Harbor prior to or after the event depending on operational schedules. A significant amount of MIW events with vessel movements would be more likely west of Guam and adjacent to Apra Harbor, depending on the event.

The majority of the Air Warfare (launches from aircraft carriers and surface ships), ASW, Electronic Warfare, Strike Warfare, and SUW training and testing events involving vessel movement (Table 6 below) occurs in or adjacent to the specified training and testing areas shown in Figure 2–2 of the Navy's rulemaking/LOA application. Vessels involved in ASW training and testing typically use water depths greater than 200 m and areas greater than 3 NM from shore, conducting most events in designated areas or other locations well offshore. For safety reasons, the Navy also does not conduct explosive events such as vessel gunnery exercises less than 12 NM from shore, and more often in designated areas further offshore.

These generalities do not preclude individual ships or strike groups from conducting select training and testing between designated Navy training and testing areas, nor does it preclude select training or testing west of Guam in the eastern and central Philippine Sea or in the transit lane between Hawaii and the MITT Study Area. While the vast majority of activities are scheduled in designated areas, operational schedules could necessitate training or testing in other at-sea portions of the MITT Study Area and commanders are always able to conduct unit-level or small group training and testing as opportunities arise and schedules allow.

Destroyers and cruisers would be the only surface ships conducting Naval Surface Fire Support Exercise (FIREX)—Land-based target (Land) and would transit the waters adjacent to FDM, though the duration of these single events is relatively short (4–6 hours). The ships, because of both ship draft and training requirements, are typically a mile or more offshore in deeper waters during execution of FIREX events. Because of constricted scheduling needs at FDM for both surface and aviation activities, ships conducting FIREX move into the desired range, fire off an allotted amount of ordnance (inert or explosive five-inch projectiles), and depart back to other areas within the MITT Study Area.

Amphibious Warfare activities have slightly different vessel movements than activities in other warfare areas. Amphibious MTEs (Joint Expeditionary Exercise, Marine Air Ground Task Force Exercise (Amphibious)—Battalion) and other Amphibious Warfare activities involve amphibious assault ships maneuvering offshore then approaching designated beach landing areas to offload marines in landing craft, amphibious assault vehicles, or helicopters. Typical landing locations depending on activity type include Guam, FDM, Rota, Saipan, and Tinian (Tinian Military Lease Area). For large surface vessels during amphibious warfare activities, the objective is to not approach too close to shore, which would put a ship at risk from shore-based defenses. Typically, amphibious transport ships deploy landing craft, amphibious assault vehicles, or helicopters from several miles offshore. Given the steep nearshore bathymetry in the Mariana Islands greater than 3NM from shore, these ships are still in significantly deep water while deploying units (>200 m).

The only areas with consistently high concentrations of Navy vessel movement would be within Apra Harbor Guam and the coastal approaches to and from Apra Harbor. Some amphibious events use Tinian as a landing area so amphibious ships could occur in the offshore waters off that island. Most other activities are spread throughout the greater MITT Study Area with a high degree of spatial and temporal separation between activities.

The Navy tabulated annual at-sea vessel steaming days proposed for the MITT Study Area. Across all warfare areas and activities, 493 days of Navy at-sea time would occur annually in the MITT Study Area (Table 6). Amphibious Warfare activities account for 48 percent of total surface ship days, MTEs account for 38 percent, ASW activities account for 8 percent, and Air Warfare, ASW and Other activities (sonar maintenance, anchoring) account for 2 percent each (Table 6). In comparison to the Hawaii-Southern California Training and Testing (HSTT) Study Area, the estimated number of at-sea annual days in the MITT Study Area is approximately ten times less than in the HSTT Study Area over the same time period.

TABLE 6—ANNUAL NAVY SURFACE SHIP DAYS WITHIN THE MITT STUDY AREA

MITT events	Annual days	Percent by event	Annual days by warfare area	Percent by warfare area
AIR WARFARE			9	1.9
GUNNEX (Lg)	2	0.3		
GUNNEX (Sm)	3	0.6		
MISSILEX	5	0.9		
AMPHIBIOUS WARFARE			299	60.7
Fire Support (Land Target)	5	1.0		
Amphibious Rehearsal	144	29.2		
Amphibious Assault	14	2.8		

TABLE 6—ANNUAL NAVY SURFACE SHIP DAYS WITHIN THE MITT STUDY AREA—Continued

MITT events	Annual days	Percent by event	Annual days by warfare area	Percent by warfare area
Amphibious Raid	3	0.6		
Marine Air Ground Task Force Exercise	40	8.1		
Non-Combatant Evacuation Op	67	13.5		
Humanitarian Assist/Disaster Relief Op	7	1.4		
Special Purpose Marine Air Ground Task Force Exercise	20	4.1		
SURFACE WARFARE			41	8.4
MISSILEX	2	0.4		
GUNNEX (Lg)	14	2.8		
GUNNEX (Med)	10	2.0		
GUNNEX (Sm)	6	1.3		
SINKEX	7	1.4		
Maritime Security Op	3	0.5		
ANTI-SUBMARINE WARFARE			8	1.6
Tracking Exercise	8	1.5		
Torpedo Exercise	1	0.1		
MAJOR TRAINING EXERCISES			125	24.5
Joint Expeditionary Exercise	63	12.9		
Joint Multi-Strike Group Exercise	62	12.5		
OTHER			10	2.1
Surface Ship Sonar Maintenance	7	1.5%		
Precision Anchoring	3	0.6%		
Total	493			

Additional details on Navy at-sea vessel movement are provided in the 2019 MITT DSEIS/OEIS.

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 military missions and combat operations 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 on 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 proposed 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 2019 MITT DSEIS/OEIS.

▪ Vessel Safety

▪ Weapons Firing Safety

▪ Target Deployment and Retrieval Safety

▪ Towed In-Water Device Procedures

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 2.3.3 Standing Operating Procedures of the 2019 MITT DSEIS/OEIS for greater detail.

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

Marine mammal species that have the potential to occur in the MITT Study Area are presented in Table 7. The Navy requests authorization to take individuals of 26 marine mammal species by Level A and Level B harassment incidental to training and testing activities from the use of sonar and other transducers, and in-water detonations. The Navy does not request authorization for any serious injuries or mortalities of marine mammals, and NMFS agrees that serious injury and mortality is unlikely to occur from the Navy's activities. There are no areas of critical habitat designated under the Endangered Species Act (ESA), Biologically Important Areas, National Marine Sanctuaries, or unusual mortality events for marine mammals in the MITT Study Area. However, there are areas known to be important for humpback whale breeding and calving, which are described below.

Information on the status, distribution, abundance, population trends, habitat, and ecology of marine mammals in the MITT Study Area may be found in Chapter 4 of the Navy's rulemaking/LOA application. NMFS has reviewed this information and found it to be accurate and complete. Additional information on the general biology and ecology of marine mammals are included in the 2019 MITT DSEIS/OEIS. There are only a few species for which stock information exists for the MITT Study Area. Table 7 incorporates data from the U.S. Pacific and the Alaska Marine Mammal Stock Assessments (Carretta *et al.,* 2017c; Muto *et al.,* 2017b); as well as incorporates the best available science, including monitoring data from the Navy's marine mammal research efforts.

TABLE 7—MARINE MAMMAL OCCURRENCE WITHIN THE MITT STUDY AREA

Common name	Scientific name	Status		Occurrence *	
		MMPA	ESA	Mariana Islands	Transit corridor
Mysticetes					
Blue whale	*Balaenoptera musculus*	D	E	Seasonal	Seasonal.
Bryde's whale	*Balaenoptera edeni*		n/a	Regular	Regular.
Fin whale	*Balaenoptera physalus*	D	E	Rare	Rare.
Humpback whale	*Megaptera novaeangliae*	([1])	E	Seasonal	Seasonal.
Minke whale	*Balaenoptera acutorostrata*		n/a	Seasonal	Seasonal.
Omura's whale	*Balaenoptera omurai*		n/a	Rare	Rare.
Sei whale	*Balaenoptera borealis*	D	E	Seasonal	Seasonal.
Odontocetes					
Blainville's beaked whale	*Mesoplodon densirostris*		n/a	Regular	Regular
Common bottlenose dolphin	*Tursiops truncatus*		n/a	Regular	Regular.
Cuvier's beaked whale	*Ziphius cavirostris*		n/a	Regular	Regular.
Dwarf sperm whale	*Kogia sima*		n/a	Regular	Regular.
False killer whale	*Pseudorca crassidens*		n/a	Regular	Regular.
Fraser's dolphin	*Lagenodelphis hosei*		n/a	Regular	Regular.
Ginkgo-toothed beaked whale	*Mesoplodon ginkgodens*		n/a	Regular	Regular.
Killer whale	*Orcinus orca*		n/a	Regular	Regular.
Longman's beaked whale	*Indopacetus pacificus*		n/a	Regular	Regular.
Melon-headed whale	*Peponocephala electra*		n/a	Regular	Regular.
Pantropical spotted dolphin	*Stenella attenuata*		n/a	Regular	Regular.
Pygmy killer whale	*Feresa attenuata*		n/a	Regular	Regular.
Pygmy sperm whale	*Kogia breviceps*		n/a	Regular	Regular.
Risso's dolphin	*Grampus griseus*		n/a	Regular	Regular.
Rough-toothed dolphin	*Steno bredanensis*		n/a	Regular	Regular.
Short-finned pilot whale	*Globicephala macrorhynchus*		n/a	Regular	Regular.
Sperm whale	*Physeter macrocephalus*	D	E	Regular	Regular.
Spinner dolphin	*Stenella longirostris*		n/a	Regular	Regular.
Striped dolphin	*Stenella coeruleoalba*		n/a	Regular	Regular.

[1] Humpback whales in the Mariana Islands have not been assigned a stock by NMFS in the Alaska or Pacific Stock Assessment Reports given they are not recognized in those reports as being present in U.S. territorial waters (Carretta *et al.,* 2017c; Carretta *et al.,* 2018; Muto *et al.,* 2017b; Muto *et al.,* 2018), but because individuals from the Western North Pacific Distinct Population Segment have been photographically identified in the MITT Study Area, humpback whales in the Mariana Islands are assumed to be part of the Western North Pacific Stock.

Note: Status MMPA, D = depleted; ESA, E = endangered.

* Species occur in both the Mariana Islands and in the Transit Corridor, both of which are included in the overall MITT Study Area. The transit corridor is outside the geographic boundaries of the MIRC, but is a route across the high seas for Navy ships transiting between the MIRC and the HRC. Although not part of a defined range complex, vessels and aircraft would at times conduct basic and routine unit-level activities such as gunnery and sonar training while in transit in the corridor as long as the training would not interfere with the primary objective of reaching their intended destination. Ships also conduct sonar maintenance, which includes active sonar transmissions.

Humpback Whale Breeding and Calving Areas

Humpback whale breeding and calving have been documented in the MITT Study Area and particularly in the shallow waters (mostly within the 200 m isobath) offshore of Saipan at Marpi Reef and Chalan Kanoa Reef. Based on surveys conducted by NMFS' Pacific Islands Fisheries Science Center (PIFSC) during the winter months (January to March) 2015–2019, there were 22 encounters with mother/calf pairs with a total of 14 mother/calf pairs and all calves were considered born within the current season and one neotate (Hitt *et al., in press*). Additionally, competitive groups were observed in 2017 and 2018 (Hill *et al., in press*). Additional information from surveys and passive acoustic hydrophone recordings in the Mariana Islands has confirmed the presence of mother-calf pairs, non-calf whales, and singing males in the MITT Study Area (Fulling *et al.,* 2011; Hill *et al.,* 2016a; Hill *et al.,* 2018; Munger *et al.,* 2014; Munger *et al.,* 2015; Norris *et al.,* 2012; Oleson and Hill, 2010a; Oleson *et al.,* 2015; U.S. Department of the Navy, 2007; Uyeyama *et al.,* 2012). Future surveys are needed to determine the full extent of the humpback whale breeding habitat through the Mariana Archipelago; however, the available data confirms the shallow waters surrounding Marpi and Chalan Kanoa reefs are important to breeding and calving humpback whales.

Species Not Included in the Analysis

Consistent with the analysis provided in the 2015 MITT FEIS/OEIS and the previous Phase II rulemaking for the MITT Study Area, the species carried forward for analysis and in the Navy's rulemaking/LOA application are those likely to be found in the MITT Study Area based on the most recent sighting, survey, and habitat modeling data available. The analysis does not include species that may have once inhabited or transited the area, but have not been sighted in recent years (*e.g.,* species that no longer occur in the area due to factors such as 19th-century commercial exploitation). These species include the North Pacific right whale (*Eubalaena japonica*), the western subpopulation of gray whale (*Eschrichtius robustus*), short-beaked common dolphin (*Delphinus delphis*), Indo-Pacific bottlenose dolphin (*Tursiops aduncus*), northern elephant seal (*Mirounga angustirostris*), and Hawaiian monk seal *(Monachus schauinslandi*). The reasons for not including each of these species is explained below and NMFS agrees these species are unlikely to occur in the MITT Study Area. Further details can be found in the 2015 MITT FEIS/OEIS.

The North Pacific right whale population is very small, likely in the low hundred (NMFS 2019). Contemporary sightings of North Pacific right whales have mostly occurred in the central North Pacific and Bering Sea. Sightings have been reported as far south as central Baja California in the eastern North Pacific, as far south as Hawaii in the central North Pacific, and as far north as the sub-Arctic waters of the Bering Sea and the Sea of Okhotsk in the summer. Migration patterns of the North Pacific right whale are unknown, although it is thought the whales spend the summer in far northern feeding grounds and migrate south to warmer waters, such as southern California, during the winter. Due to their known homerange it is unlikely that a North Pacific right whale would occur in the MITT Study Area. North Pacific right whales have not been previously documented in the MITT Study Area. For the reasons discussed above, this species is not discussed further.

For the western subpopulation of gray whales there currently are no data available to suggest that gray whales would transit the MITT Study Area when migrating from the western to eastern Pacific. There have only been 13 records of gray whales in Japanese waters since 1990 (Nambu *et al.,* 2010). The Okhotsk Sea and Sakhalin Island are located far to the north off Russia, and the South China Sea begins approximately 1,458 NM east of the MITT Study Area. Given what is known of their present range, nearshore affinity, and extralimital occurrence in tropical waters, it is highly unlikely that this species would be present in the MITT Study Area (Reilly *et al.,* 2000; Weller *et al.,* 2002; Wiles, 2005; Nambu *et al.,* 2010). In addition, no gray whales have been previously documented in the MITT Study Area. For the reasons discussed above, this species is not discussed further.

The short-beaked common dolphin is found worldwide in temperate, tropical, and subtropical seas. The range of this species may extend entirely across the tropical and temperate north Pacific (Heyning and Perrin, 1994); however, this species prefers areas with large seasonal changes in surface temperature and thermocline depth (the point between warmer surface water and colder water) (Au and Perryman, 1985). They are one of the most abundant species found in temperate waters off the U.S. West Coast (Barlow and Forney, 2007). In tropical seas, they are typically sighted in upwelling-modified waters such as those in the eastern tropical Pacific (Au and Perryman, 1985; Ballance and Pitman, 1998; Reilly, 1990). The absence of known areas of major upwelling in the western tropical Pacific suggests that common dolphins are not found in the MITT Study Area (Hammond *et al.,* 2008). In addition, no short-beaked common dolphins have been previously documented in the MITT Study Area. For the reasons discussed above, this species is not discussed further.

The Indo-Pacific bottlenose dolphin generally occurs over shallow coastal waters on the continental shelf. Although typically associated with continental margins, they do occur around oceanic islands; however, the MITT Study Area is not included in their known geographic range, and there are no documented sightings there (Hammond *et al.,* 2008). In addition, no Indo-Pacific bottlenose dolphins have been previously documented in the MITT Study Area. For the reasons discussed above, this species is not discussed further.

The likelihood of a Hawaiian monk seal being present in the MITT Study Area is extremely low. There are no confirmed records of Hawaiian monk seals in the Micronesia region; although, Reeves *et al.* (1999) and Eldredge (1991, 2003) have noted occurrence records for unidentified seal species in the Marshall and Gilbert Islands. It is possible that Hawaiian monk seals wander from the Hawaiian Islands to appear at the Marshall or Gilbert Islands in the Micronesia region (Eldredge, 1991). However, the Marshall Islands are located approximately 1,180 mi. (1,900 km) from Guam and the Gilbert Islands are located even farther to the east. Given the extremely low likelihood of this species occurring in the MITT Study Area. No Hawaiian monk seals have been previously documented in the MITT Study Area. For the reasons discussed above, this species is not discussed further.

Northern elephant seals (*Mirounga angustirostris*) are common on island and mainland haul-out sites in Baja California, Mexico north through central California. Elephant seals spend several months at sea feeding and travel as far north as the Gulf of Alaska and forage in the mid-Pacific as far south as approximately 40 degrees north latitude. Vagrant individuals do sometimes range to the western north Pacific. The most far-ranging individual appeared on Nijima Island off the Pacific coast of Japan in 1989 (Kiyota *et al.,* 1992). Although northern elephant seals may wander great distances, it is very unlikely that they would travel to Japan and then continue traveling to the MITT Study Area. No Northern elephant seals have been previously documented in the MITT Study Area. For the reasons discussed above, this species is not discussed further.

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

Potential Effects of Specified Activities on Marine Mammals and Their Habitat

This section includes a 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 rule includes a quantitative analysis of the number of instances of take that could occur from these activities. The *Preliminary Analysis and Negligible Impact Determination* section considers the content of this section, the *Estimated Take of Marine Mammals* section, and the *Proposed Mitigation Measures* section to draw conclusions regarding the likely impacts of these activities on the reproductive success or survivorship of individuals and whether those impacts on individuals are likely to adversely affect the species through effects on annual rates of recruitment or survival.

The Navy has requested authorization for the take of marine mammals that may occur incidental to training and testing activities in the MITT Study Area. The Navy analyzed potential impacts to marine mammals from acoustic and explosive sources in its rulemaking/LOA application. NMFS carefully reviewed the information provided by the Navy along with independently reviewing applicable scientific research and literature and other information to evaluate the potential effects of the Navy's activities on marine mammals, which are presented in this section.

Other potential impacts to marine mammals from training and testing activities in the MITT Study Area were analyzed in the 2019 MITT DSEIS/OEIS, in consultation with NMFS as a cooperating agency, and determined to be unlikely to result in marine mammal take. These include incidental take from vessel strike and serious injury or mortality from explosives. Therefore, the Navy has not requested authorization for take of marine mammals incidental to other components of their proposed Specified Activities, and we agree that incidental 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 transducers) and impulsive (explosives) stressors.

For the purpose of MMPA incidental take authorizations, NMFS' 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) and non-auditory injury), serious injury, or mortality, including 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 the species or stocks and their habitat (*i.e.,* mitigation measures); (2) to determine whether the specified activities would have a negligible impact on the affected species or stocks of marine mammals (based on whether it is likely that the activities would adversely affect the species or stocks 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 stocks for subsistence uses (however, there are no subsistence communities that would be affected in the MITT Study Area, so this determination is inapplicable to this rulemaking); and (4) to prescribe requirements pertaining to monitoring and reporting.

In this section, NMFS provides a description of the ways marine mammals may be generally 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, 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. The *Preliminary Analysis and Negligible Impact Determination* section assesses whether the proposed authorized take would have a negligible impact on the affected species.

Potential Effects of Underwater Sound

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, Southall *et al.,* 2019a). 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. 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. We first describe general 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

Non-impulsive sources of sound can cause direct physiological effects including noise-induced loss of hearing sensitivity (or ''threshold shift''), nitrogen decompression, acoustically-induced bubble growth, and injury due to sound-induced acoustic resonance. Only noise-induced hearing loss is anticipated to occur due to the Navy's activities. Acoustically-induced (or 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* subsection.

Hearing Loss—Threshold Shift

Marine mammals exposed to high-intensity sound, or to lower-intensity sound for prolonged periods, can experience hearing threshold shift, which is the loss of hearing sensitivity at certain frequency ranges after cessation of sound (Finneran, 2015). Threshold shift can be permanent (PTS), in which case the loss of hearing sensitivity is not fully recoverable, or temporary (TTS), in which case the animal's hearing threshold would recover over time (Southall *et al.,* 2007). 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 (*e.g.,* an animal's hearing sensitivity might be reduced by only 6 dB or reduced by 30 dB). While there is no simple functional relationship between TTS and PTS or other auditory injury (*e.g.,* neural degeneration), as TTS increases, the likelihood that additional exposure sound pressure level (SPL) or duration will result in PTS or other injury also increases (see also the 2019 MITT DSEIS/OEIS for additional discussion). Exposure thresholds for the occurrence of PTS or other auditory injury can therefore be defined based on a specific amount of TTS; that is, although an exposure has been shown to produce only TTS, we assume that any additional exposure may result in some PTS or other injury. The specific upper limit of TTS is based on experimental data showing amounts of TTS that have not resulted in PTS or injury. In other words, we do not need to know the exact functional relationship between TTS and PTS or other injury, we only need to know the upper limit for TTS before some PTS or injury is possible. 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 threshold shift: 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 threshold shift and the frequency range in which it occurs. Generally, the amount of threshold shift, 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 sound exposure level (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 threshold shift 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).

The NMFS 2016 Acoustic Technical Guidance (revised in 2018) (NMFS 2016, 2018), which was used in the assessment of effects for this rule, 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. More recently, Southall *et al.* (2019a) evaluated Southall *et al.* (2007) and used updated scientific information to propose revised noise exposure criteria to predict onset of auditory effects in marine mammals (*i.e.,* PTS and TTS onset). Southall *et al.* (2019a) note that the quantitative processes described and the resulting exposure criteria (*i.e.,* thresholds and auditory weighting functions) are largely identical to those in Finneran (2016) and NMFS (2016 and 2018). They only differ in that the Southall *et al.* (2019a) exposure criteria are more broadly applicable as they include all marine mammal species (rather than only those under NMFS jurisdiction) for all noise exposures (both in air and underwater for amphibious species) and, while the hearing group compositions are identical, they renamed the hearing groups.

Many studies have examined noise-induced hearing loss in marine mammals (see Finneran (2015) and Southall *et al.* (2019a) for summaries), however for cetaceans, published data on the onset of TTS are limited to the captive bottlenose dolphin, beluga, harbor porpoise, and Yangtze finless porpoise, and for pinnipeds in water, measurements of TTS are limited to harbor seals, elephant seals, and California sea lions. These studies examine hearing thresholds measured in marine mammals before and after exposure to intense sounds. The difference between the pre-exposure and post-exposure thresholds can then be used to determine the amount of threshold shift at various post-exposure times. NMFS has reviewed the available studies, which are summarized below (see also the 2019 MITT DSEIS/OEIS which includes additional discussion on TTS studies related to sonar and other transducers):

- The method used to test hearing may affect the resulting amount of measured TTS, with neurophysiological measures producing larger amounts of TTS compared to psychophysical measures (Finneran *et al.,* 2007; Finneran, 2015).
- The amount of TTS varies with the hearing test frequency. As the exposure SPL increases, the frequency at which the maximum TTS occurs also increases (Kastelein *et al.,* 2014b). For high-level exposures, the maximum TTS typically occurs one-half to one octave above the exposure frequency (Finneran *et al.,* 2007; Mooney *et al.,* 2009a; Nachtigall *et al.,* 2004; Popov *et al.,* 2011; Popov *et al.,* 2013; Schlundt *et al.,* 2000). The overall spread of TTS from tonal exposures can therefore extend over a large frequency range (*i.e.,* narrowband exposures can produce broadband (greater than one octave) TTS).
- The amount of TTS increases with exposure SPL and duration and is correlated with SEL, especially if the range of exposure durations is relatively small (Kastak *et al.,* 2007; Kastelein *et al.,* 2014b; Popov *et al.,* 2014). As the exposure duration increases, however, the relationship between TTS and SEL begins to break down. Specifically, duration has a more significant effect on TTS than would be predicted on the basis of SEL alone (Finneran *et al.,* 2010a; Kastak *et al.,* 2005; Mooney *et al.,* 2009a). This means if two exposures have the same SEL but different durations, the exposure with the longer duration (thus lower SPL) will tend to produce more TTS than the exposure with the higher SPL and shorter duration. In most acoustic impact assessments, the scenarios of interest involve shorter duration exposures than the marine mammal experimental data from which impact thresholds are derived; therefore, use of SEL tends to over-estimate the amount of TTS. Despite this, SEL continues to be used in many situations because it is relatively simple, more accurate than SPL alone, and lends itself easily to scenarios involving multiple exposures with different SPL.
- The amount of TTS depends on the exposure frequency. Sounds at low frequencies, well below the region of best sensitivity, are less hazardous than those at higher frequencies, near the region of best sensitivity (Finneran and Schlundt, 2013). The onset of TTS—defined as the exposure level necessary to produce 6 dB of TTS (*i.e.,* clearly above the typical variation in threshold measurements)—also varies with exposure frequency. At low frequencies, onset-TTS exposure levels are higher compared to those in the region of best sensitivity.
- TTS can accumulate across multiple exposures, but the resulting TTS will be less than the TTS from a single, continuous exposure with the same SEL (Finneran *et al.,* 2010a; Kastelein *et al.,* 2014b; Kastelein *et al.,* 2015b; Mooney *et al.,* 2009b). This means that TTS predictions based on the total, cumulative SEL will overestimate the amount of TTS from intermittent exposures such as sonars and impulsive sources.
- The amount of observed TTS tends to decrease with increasing time following the exposure; however, the relationship is not monotonic (*i.e.,* increasing exposure does not always increase TTS). The time required for complete recovery of hearing depends on the magnitude of the initial shift; for relatively small shifts recovery may be complete in a few minutes, while large shifts (*e.g.,* approximately 40 dB) may require several days for recovery. Under many circumstances TTS recovers linearly with the logarithm of time (Finneran *et al.,* 2010a, 2010b; Finneran and Schlundt, 2013; Kastelein *et al.,* 2012a; Kastelein *et al.,* 2012b; Kastelein *et al.,* 2013a; Kastelein *et al.,* 2014b; Kastelein *et al.,* 2014c; Popov *et al.,* 2011; Popov *et al.,* 2013; Popov *et al.,* 2014). This means that for each doubling of recovery time, the amount of TTS will decrease by the same amount (*e.g.,* 6 dB recovery per doubling of time).

Nachtigall *et al.* (2018) and Finneran (2018) describe the measurements of hearing sensitivity of multiple odontocete species (bottlenose dolphin, harbor porpoise, beluga, and false killer whale) when a relatively loud sound was preceded by a warning sound. These captive animals were shown to reduce hearing sensitivity when warned of an impending intense sound. Based on these experimental observations of captive animals, the authors suggest that wild animals may dampen their hearing during prolonged exposures or if conditioned to anticipate intense sounds. Finneran recommends further investigation of the mechanisms of hearing sensitivity reduction in order to understand the implications for interpretation of existing TTS data obtained from captive animals, notably for considering TTS due to short duration, unpredictable exposures.

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 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-Induced Bubble Formation Due to Sonars and Other Pressure-Related Impacts

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).

As described in additional detail in the Nitrogen Decompression subsection of the 2019 MITT DSEIS/OEIS, marine mammals generally are thought to deal with nitrogen loads in their blood and other tissues, caused by gas exchange from the lungs under conditions of high ambient pressure during diving, through anatomical, behavioral, and physiological adaptations (Hooker *et al.,* 2012). Although not a direct injury, variations in marine mammal diving behavior or avoidance responses have been hypothesized to result in nitrogen off-gassing in super-saturated tissues, possibly to the point of deleterious vascular and tissue bubble formation (Hooker *et al.,* 2012; Jepson *et al.,* 2003; Saunders *et al.,* 2008) with resulting symptoms similar to decompression sickness, however the process is still not well understood.

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). They also 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-frequency (1–2 kHz), as defined by the authors, and mid-frequency (2–7 kHz) 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 directly connecting intense, anthropogenic underwater sounds with 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.

Injury Due to Sonar-Induced Acoustic Resonance

An object exposed to its resonant frequency will tend to amplify its vibration at that frequency, a phenomenon called acoustic resonance. Acoustic resonance has been proposed as a potential mechanism by which a sonar or sources with similar operating characteristics could damage tissues of marine mammals. In 2002, NMFS convened a panel of government and private scientists to investigate the potential for acoustic resonance to occur in marine mammals (National Oceanic and Atmospheric Administration, 2002). They modeled and evaluated the likelihood that Navy mid-frequency sonar (2–10 kHz) caused resonance effects in beaked whales that eventually led to their stranding. The workshop participants concluded that resonance in air-filled structures was not likely to have played a primary role in the Bahamas stranding in 2000. They listed several reasons supporting this finding including (among others): Tissue displacements at resonance are estimated to be too small to cause tissue damage; tissue-lined air spaces most susceptible to resonance are too large in marine mammals to have resonant frequencies in the ranges used by mid-frequency or low-frequency sonar; lung resonant frequencies increase with depth, and tissue displacements decrease with depth so if resonance is more likely to be caused at depth it is also less likely to have an affect there; and lung tissue damage has not been observed in any mass, multi-species stranding of beaked whales. The frequency at which resonance was predicted to occur in the animals' lungs was 50 Hz, well below the frequencies used by the mid-frequency sonar systems associated with the Bahamas event. The workshop participants focused on the March 2000 stranding of beaked whales in the Bahamas as high-quality data were available, but the workshop report notes that the results apply to other sonar-related stranding events. For the reasons given by the 2002 workshop participants, we do not anticipate injury due to sonar-induced acoustic resonance from the Navy's proposed activities.

Physiological Stress

There is growing interest in monitoring and assessing the impacts of stress responses to sound in marine animals. 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 serious fitness consequences. However, when an animal does not have sufficient energy reserves to satisfy the energetic costs of a stress response, energy resources must be diverted from other biotic functions, which 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 of distress will last until the animal replenishes its energetic reserves sufficiently 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 are well-studied through controlled experiments in both laboratory and free-ranging 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). However, it should be noted (and as is described in additional detail in the 2019 MITT DSEIS/OEIS) that our understanding of the functions of various stress hormones (for example, cortisol), is based largely upon observations of the stress response in terrestrial mammals. Atkinson *et al.,* 2015 note that the endocrine response of marine mammals to stress may not be the same as that of terrestrial mammals because of the selective pressures marine mammals faced during their evolution in an ocean environment. For example, due to the necessity of breath-holding while diving and foraging at depth, the physiological role of epinephrine and norepinephrine (the catecholamines) in marine mammals might be different than in other mammals.

As described in the 2019 MITT DSEIS/OEIS, marine mammals naturally experience stressors within their environment and as part of their life histories. Changing weather and ocean conditions, exposure to disease and naturally occurring toxins, lack of prey availability, and interactions with predators all contribute to the stress a marine mammal experiences (Atkinson *et al.,* 2015). Breeding cycles, periods of fasting, and social interactions with members of the same species are also stressors, although they are natural components of an animal's life history. Anthropogenic activities have the potential to provide additional stressors beyond those that occur naturally (Fair *et al.,* 2014; Meissner *et al.,* 2015; Rolland *et al.,* 2012). Anthropogenic stressors potentially include such things as fishery interactions, pollution, tourism, and ocean noise.

Acoustically induced stress in marine mammals is not well understood. There are ongoing efforts to improve our understanding of how stressors impact marine mammal populations (see Navy funded examples here: *e.g.,* King *et al.,* 2015; New *et al.,* 2013a; New *et al.,* 2013b; Pirotta *et al.,* 2015a), however little data exist on the consequences of sound-induced stress response (acute or chronic). Factors potentially affecting a marine mammal's response to a stressor include the individual's life history stage, sex, age, reproductive status, overall physiological and behavioral plasticity, and whether they are naïve or experienced with the sound (*e.g.,* prior experience with a stressor may result in a reduced response due to habituation (Finneran and Branstetter, 2013; St. Aubin and Dierauf, 2001a)). Stress responses due to exposure to anthropogenic sounds or other stressors and their effects on marine mammals have been reviewed (Fair and Becker, 2000; Romano *et al.,* 2002b) and, more rarely, studied in wild populations (*e.g.,* Romano *et al.,* 2002a). For example, 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. These and other studies lead to a reasonable expectation that some marine mammals will experience physiological stress responses upon exposure to acoustic stressors and that it is possible that some of these would be classified as ''distress.'' In addition, any animal experiencing TTS would likely also experience stress responses (NRC, 2003).

Other research has also investigated the impact from vessels (both whale-watching and general vessel traffic noise), and demonstrated impacts do occur (Bain, 2002; Erbe, 2002; Lusseau, 2006; Williams *et al.,* 2006; Williams *et al.,* 2009; Noren *et al.,* 2009; Read *et al.,* 2014; Rolland *et al.,* 2012; Skarke *et al.,* 2014; Williams *et al.,* 2013; Williams *et al.,* 2014a; Williams *et al.,* 2014b; Pirotta *et al.,* 2015). This body of research has generally investigated impacts associated with the presence of chronic stressors, which differ significantly from the proposed Navy training and testing vessel activities in the MITT 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) 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. 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 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.

Most sound-induced stress response studies in marine mammals have focused on acute responses to sound either by measuring catecholamines or by measuring heart rate as an assumed proxy for an acute stress response. As described in the 2019 MITT DSEIS/OEIS, belugas demonstrated no catecholamine response to the playback of oil drilling sounds (Thomas *et al.,* 1990) but showed a small but statistically significant increase in catecholamines following exposure to impulsive sounds produced from a seismic water gun (Romano *et al.,* 2004). A bottlenose dolphin exposed to the same seismic water gun signals did not demonstrate a catecholamine response, but did demonstrate a statistically significant elevation in aldosterone (Romano *et al.,* 2004), albeit the increase was within the normal daily variation observed in this species (St. Aubin *et al.,* 1996). Increases in heart rate were observed in bottlenose dolphins to which known calls of other dolphins were played, although no increase in heart rate was observed when background tank noise was played back (Miksis *et al.,* 2001). Unfortunately, in this study, it cannot be determined whether the increase in heart rate was due to stress or an anticipation of being reunited with the dolphin to which the vocalization belonged. Similarly, a young beluga's heart rate was observed to increase during exposure to noise, with increases dependent upon the frequency band of noise and duration of exposure, and with a sharp decrease to normal or below normal levels upon cessation of the exposure (Lyamin *et al.,* 2011). Spectral analysis of heart rate variability corroborated direct measures of heart rate (Bakhchina *et al.,* 2017). This response might have been in part due to the conditions during testing, the young age of the animal, and the novelty of the exposure; a year later the exposure was repeated at a slightly higher received level and there was no heart rate response, indicating the beluga whale may have acclimated to the noise exposure. Kvadsheim *et al.* (2010) measured the heart rate of captive hooded seals during exposure to sonar signals and found an increase in the heart rate of the seals during exposure periods versus control periods when the animals were at the surface. When the animals dove, the normal dive-related bradycardia (decrease in heart rate) was not impacted by the sonar exposure. Similarly, Thompson *et al.* (1998) observed a rapid but short-lived decrease in heart rates in harbor and grey seals exposed to seismic air guns (cited in Gordon *et al.,* 2003). Williams *et al.* (2017) recently monitored the heart rates of narwhals released from capture and found that a profound dive bradycardia persisted, even though exercise effort increased dramatically as part of their escape response following release. Thus, although some limited evidence suggests that tachycardia might occur as part of the acute stress response of animals that are at the surface, the dive bradycardia persists during diving and might be enhanced in response to an acute stressor.

Despite the limited amount of data available on sound-induced stress responses for marine mammals exposed to anthropogenic sounds, studies of other marine animals and terrestrial animals would also lead us to expect that some marine mammals 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. However, take due to aircraft noise is not anticipated as a result of the Navy's activities. 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.

Auditory 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, or 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. As described in detail in the 2019 MITT DSEIS/OEIS, 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. Masking can lead to behavioral changes including vocal changes (*e.g.,* Lombard effect, increasing amplitude, or changing frequency), cessation of foraging, and leaving an area, to both signalers and receivers, in an attempt to compensate for noise levels (Erbe *et al.,* 2016). 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 only occurs during the sound exposure. Because masking (without resulting in threshold shift) is not associated with abnormal physiological function, it is not considered a physiological effect, but rather a potential behavioral effect.

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 (including critical ratios, or the lowest signal-to-noise ratio in which animals can detect a signal, Finneran and Branstetter, 2013; Johnson *et al.,* 1989; Southall *et al.,* 2000) 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 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).

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.

Impacts on signal detection, measured by masked detection thresholds, are not the only important factors to address when considering the potential effects of masking. As marine mammals use sound to recognize conspecifics, prey, predators, or other biologically significant sources (Branstetter *et al.,* 2016), it is also important to understand the impacts of masked recognition thresholds (often called ''informational masking''). Branstetter *et al.,* 2016 measured masked recognition thresholds for whistle-like sounds of bottlenose dolphins and observed that they are approximately 4 dB above detection thresholds (energetic masking) for the same signals. Reduced ability to recognize a conspecific call or the acoustic signature of a predator could have severe negative impacts. Branstetter *et al.,* 2016 observed that if ''quality communication'' is set at 90 percent recognition the output of communication space models (which are based on 50 percent detection) would likely result in a significant decrease in communication range.

As marine mammals use sound to recognize predators (Allen *et al.,* 2014; Cummings and Thompson, 1971; Curé *et al.,* 2015; Fish and Vania, 1971), the presence of masking noise may also prevent marine mammals from responding to acoustic cues produced by their predators, particularly if it occurs in the same frequency band. For example, harbor seals that reside in the coastal waters off British Columbia are frequently targeted by mammal-eating killer whales. The seals acoustically discriminate between the calls of mammal-eating and fish-eating killer whales (Deecke *et al.,* 2002), a capability that should increase survivorship while reducing the energy required to attend to all killer whale calls. Similarly, sperm whales (Curé *et al.,* 2016; Isojunno *et al.,* 2016), long-finned pilot whales (Visser *et al.,* 2016), and humpback whales (Curé *et al.,* 2015) changed their behavior in response to killer whale vocalization playbacks; these findings indicate that some recognition of predator cues could be missed if the killer whale vocalizations were masked. The potential effects of masked predator acoustic cues depends on the duration of the masking noise and the likelihood of a marine mammal encountering a predator during the time that detection and recognition of predator cues are impeded.

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.

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.

Impaired Communication

In addition to making it more difficult for animals to perceive and recognize 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'' (or communication 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 (repetition rate), or ceasing to vocalize.

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).

Marine mammals are also known to make vocal changes in response to anthropogenic noise. In cetaceans, vocalization changes have been reported from exposure to anthropogenic noise sources such as sonar, vessel noise, and seismic surveying (see the following for examples: Gordon *et al.,* 2003; Di Iorio and Clark, 2010; Hatch *et al.,* 2012; Holt *et al.,* 2008; Holt *et al.,* 2011; Lesage *et al.,* 1999; McDonald *et al.,* 2009; Parks *et al.,* 2007, Risch *et al.,* 2012, Rolland *et al.,* 2012), as well as changes in the natural acoustic environment (Dunlop *et al.,* 2014). Vocal changes can be temporary, or can be persistent. For example, model simulation suggests that the increase in starting frequency for the North Atlantic right whale upcall over the last 50 years resulted in increased detection ranges between right whales. The frequency shift, coupled with an increase in call intensity by 20 dB, led to a call detectability range of less than 3 km to over 9 km (Tennessen and Parks, 2016). Holt *et al.* (2008) 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). 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 surveys 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.

In some cases, these vocal changes may have fitness consequences, such as an increase in metabolic rates and oxygen consumption, as observed in bottlenose dolphins when increasing their call amplitude (Holt *et al.,* 2015). A switch from vocal communication to physical, surface-generated sounds such as pectoral fin slapping or breaching was observed for humpback whales in the presence of increasing natural background noise levels, indicating that adaptations to masking may also move beyond vocal modifications (Dunlop *et al.,* 2010).

While these changes all represent possible tactics by the sound-producing animal to reduce the impact of masking, the receiving animal can also reduce masking by using active listening strategies such as orienting to the sound source, moving to a quieter location, or reducing self-noise from hydrodynamic flow by remaining still. The temporal structure of noise (*e.g.,* amplitude modulation) may also provide a considerable release from masking through comodulation masking release (a reduction of masking that occurs when broadband noise, with a frequency spectrum wider than an animal's auditory filter bandwidth at the frequency of interest, is amplitude modulated) (Branstetter and Finneran, 2008; Branstetter *et al.,* 2013). Signal type (*e.g.,* whistles, burst-pulse, sonar clicks) and spectral characteristics (*e.g.,* frequency modulated with harmonics) may further influence masked detection thresholds (Branstetter *et al.,* 2016; Cunningham *et al.,* 2014).

Masking Due to Sonar and Other Transducers

The functional hearing ranges of mysticetes, odontocetes, and pinnipeds underwater 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. Masking by low-frequency or mid-frequency active sonar (LFAS and MFAS) with relatively low-duty cycles is not anticipated (or would be of very short duration) for most cetaceans as sonar signals occur over a relatively short duration and narrow bandwidth (overlapping with only a small portion of the hearing range). LFAS could overlap in frequency with mysticete vocalizations, however LFAS and MFAS does not overlap with vocalizations for most marine mammal species. For example, in the presence of LFAS, humpback whales were observed to increase the length of their songs (Fristrup *et al.,* 2003; Miller *et al.,* 2000), potentially due to the overlap in frequencies between the whale song and the LFAS. While dolphin whistles and MFAS are similar in frequency, masking is not anticipated (or would be of very short duration) due to the low-duty cycle of most sonars.

As described in the 2019 MITT DSEIS/OEIS, newer high-duty cycle or continuous active sonars have more potential to mask vocalizations. These sonars transmit more frequently (greater than 80 percent duty cycle) than traditional sonars, but at a substantially lower source level. HFAS, such as pingers that operate at higher repetition rates (*e.g.,* 2–10 kHz with harmonics up to 19 kHz, 76 to 77 pings per minute) (Culik *et al.,* 2001), also operate at lower source levels and have a faster attenuation rates due to the higher frequencies used. These lower source levels limit the range of impacts, however compared to traditional sonar systems, individuals close to the source are likely to experience masking at longer time scales. The frequency range at which high-duty cycle systems operate overlaps the vocalization frequency of many mid-frequency cetaceans. Continuous noise at the same frequency of communicative vocalizations may cause disruptions to communication, social interactions, acoustically mediated cooperative behaviors, and important environmental cues. There is also the potential for the mid-frequency sonar signals to mask important environmental cues (*e.g.,* predator or conspecific acoustic cues), possibly affecting survivorship for targeted animals. While there are currently no available studies of the impacts of high-duty cycle sonars on marine mammals, masking due to these systems is likely analogous to masking produced by other continuous sources (*e.g.,* vessel noise and low-frequency cetaceans), and would likely have similar short-term consequences, though longer in duration due to the duration of the masking noise. These may include changes to vocalization amplitude and frequency (Brumm and Slabbekoorn, 2005; Hotchkin and Parks, 2013) and behavioral impacts such as avoidance of the area and interruptions to foraging or other essential behaviors (Gordon *et al.,* 2003). Long-term consequences could include changes to vocal behavior and vocalization structure (Foote *et al.,* 2004; Parks *et al.,* 2007), abandonment of habitat if masking occurs frequently enough to significantly impair communication (Brumm and Slabbekoorn, 2005), a potential decrease in survivorship if predator vocalizations are masked (Brumm and Slabbekoorn, 2005), and a potential decrease in recruitment if masking interferes with reproductive activities or mother-calf communication (Gordon *et al.,* 2003).

Masking Due to Vessel Noise

Masking is more likely to occur in the presence of broadband, relatively continuous noise sources such as vessels. Several studies have shown decreases in marine mammal communication space and changes in behavior as a result of the presence of vessel noise. For example, right whales were 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) as well as increasing the amplitude (intensity) of their calls (Parks, 2009; Parks *et al.,* 2011). Clark *et al.* (2009) also observed that right whales communication space decreased by up to 84 percent in the presence of vessels (Clark *et al.,* 2009). Cholewiak *et al.* (2018) also observed loss in communication space in Stellwagen National Marine Sanctuary for North Atlantic right whales, fin whales, and humpback whales with increased ambient noise and shipping noise. Although humpback whales off Australia did not change the frequency or duration of their vocalizations in the presence of ship noise, their source levels were lower than expected based on source level changes to wind noise, potentially indicating some signal masking (Dunlop, 2016). Multiple delphinid species have also been shown to increase the minimum or maximum frequencies of their whistles in the presence of anthropogenic noise and reduced communication space (for examples see: Holt *et al.,* 2008; Holt *et al.,* 2011; Gervaise *et al.,* 2012; Williams *et al.,* 2013; Hermannsen *et al.,* 2014; Papale *et al.,* 2015; Liu *et al.,* 2017).

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 predisposed to respond to certain sounds in certain ways) (Southall *et al.,* 2007). Related to the sound itself, the perceived nearness of the sound, bearing of the sound (approaching vs. retreating), the 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 received levels (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 received levels 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 received levels (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. Forney *et al.* (2017) also point out that an apparent lack of response (*e.g.,* no displacement or avoidance of a sound source) may not necessarily mean there is no cost to the individual or population, as some resources or habitats may be of such high value that animals may choose to stay, even when experiencing stress or hearing loss. Forney *et al.* (2017) recommend considering both the costs of remaining in an area of noise exposure such as TTS, PTS, or masking, which could lead to an increased risk of predation or other threats or a decreased capability to forage, and the costs of displacement, including potential increased risk of vessel strike, increased risks of predation or competition for resources, or decreased habitat suitable for foraging, resting, or socializing. 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 method for predicting Level B harassment in this rule 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 responses: Increased alertness; orientation or attraction to a sound source; vocal modifications; cessation of feeding; cessation of social interaction; alteration of movement or diving behavior; 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; Gomez *et al.,* 2016) 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. Gomez *et al.* (2016) conducted a review of the literature considering the contextual information of exposure in addition to received level and found that higher received levels were not always associated with more severe behavioral responses and vice versa. Southall *et al.* (2016) states that results demonstrate that some individuals of different species display clear yet varied responses, some of which have negative implications, while others appear to tolerate high levels, and that responses may not be fully predictable with simple acoustic exposure metrics (*e.g.,* received sound level). Rather, the authors state that differences among species and individuals along with contextual aspects of exposure (*e.g.,* behavioral state) appear to affect response probability. The following subsections provide examples of behavioral responses that provide an idea of the variability in behavioral responses that would be expected given the differential sensitivities of marine mammal species to sound and the wide range of potential acoustic sources to which a marine mammal may be exposed. 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. The flight response differs from other avoidance responses in the intensity of the response (*e.g.,* directed movement, rate of travel). 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). The result of a flight response could range from brief, temporary exertion and displacement from the area where the signal provokes flight to, in extreme cases, 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 species on land. 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 (*e.g.,* Frankel and Clark, 2000; Ng and Leung, 2003; Nowacek *et al.;* 2004; Goldbogen *et al.,* 2013a, 2013b). 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, which showed 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 received levels 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. As for other types of behavioral response, the frequency, duration, and temporal pattern of signal presentation, as well as differences in species sensitivity, are likely contributing factors to differences in response in any given circumstance (*e.g.,* Croll *et al.,* 2001; Nowacek *et al.;* 2004; Madsen *et al.,* 2006a; Yazvenko *et al.,* 2007). A determination of whether foraging disruptions incur fitness consequences would require information on or estimates of the energetic requirements of the affected individuals and the relationship between prey availability, foraging effort and success, and the life history stage of the animal.

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, Melco´n *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 (Melco´n *et al.,* 2012). Results from the 2010–2011 field season of a 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, Southall *et al.,* 2019b). 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. Surface feeding blue whales did not show a change in behavior in response to mid-frequency simulated and real sonar sources with received levels between 90 and 179 dB re 1 μPa, but deep feeding and non-feeding whales showed temporary reactions including cessation of feeding, reduced initiation of deep foraging dives, generalized avoidance responses, and changes to dive behavior (DeRuiter *et al.,* 2017; Goldbogen *et al.,* 2013b; Sivle *et al.,* 2015). Goldbogen *et al.* (2013b) 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.

Similarly, while the rates of foraging lunges decrease in humpback whales due to sonar exposure, there was variability in the response across individuals, with one animal ceasing to forage completely and another animal starting to forage during the exposure (Sivle *et al.,* 2016). In addition, almost half of the animals that avoided were foraging before the exposure but the others were not; the animals that avoided while not feeding responded at a slightly lower received level and greater distance than those that were feeding (Wensveen *et al.,* 2017). These findings indicate that the behavioral state of the animal plays a role in the type and severity of a behavioral response. In fact, when the prey field was mapped and used as a covariate in similar models looking for a response in the same blue whales, the response in deep-feeding behavior by blue whales was even more apparent, reinforcing the need for contextual variables to be included when assessing behavioral responses (Friedlaender *et al.,* 2016).

Breathing

Respiration naturally varies 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.,* 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—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 Auditory 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 in vocalization behavior may result in response to anthropogenic noise can occur for any of these modes and may result from a need to compete with an increase in background noise or may reflect an increased vigilance or a startle response. For example, in the presence of potentially masking signals (low-frequency active sonar), humpback whales have been observed to increase the length of their songs (Miller *et al.,* 2000; Fristrup *et al.,* 2003). 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 hours 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 that 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 cumulative sound exposure level (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 changes in vocalization and/or behavioral responses.

Avoidance

Avoidance is the displacement of an individual from an area or migration path as a result of the presence of a sound or other stressors. 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. 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). Longer-term displacement is possible, however, which may lead to changes in abundance or distribution patterns of the affected species in the affected region if habituation to the presence of the sound does not occur (*e.g.,* Blackwell *et al.,* 2004; Bejder *et al.,* 2006; Teilmann *et al.,* 2006). 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).

Forney *et al.* (2017) detailed the potential effects of noise on marine mammal populations with high site fidelity, including displacement and auditory masking, noting that a lack of observed response does not imply absence of fitness costs and that apparent tolerance of disturbance may have population-level impacts that are less obvious and difficult to document. Avoidance of overlap between disturbing noise and areas and/or times of particular importance for sensitive species may be critical to avoiding population-level impacts because (particularly for animals with high site fidelity) there may be a strong motivation to remain in the area despite negative impacts. Forney *et al.* (2017) stated that, for these animals, remaining in a disturbed area may reflect a lack of alternatives rather than a lack of effects. The authors discuss several case studies, including western Pacific gray whales, which are a small population of mysticetes believed to be adversely affected by oil and gas development off Sakhalin Island, Russia (Weller *et al.,* 2002; Reeves *et al.,* 2005). Western gray whales display a high degree of interannual site fidelity to the area for foraging purposes, and observations in the area during air gun surveys has shown the potential for harm caused by displacement from such an important area (Weller *et al.,* 2006; Johnson *et al.,* 2007). Forney *et al.* (2017) also discuss beaked whales, noting that anthropogenic effects in areas where they are resident could cause severe biological consequences, in part because displacement may adversely affect foraging rates, reproduction, or health, while an overriding instinct to remain could lead to more severe acute effects.

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 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 received levels 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 (referenced and summarized in the following paragraphs).

The studies that address responses of low-frequency cetaceans to non-pulse sounds include data gathered in the field and related to several types of sound sources (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 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 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 controlled exposure experiments on blue whales (n = 19) and of these, 11 controlled exposure experiments involved exposure to the MF active sonar sound type. For the majority of controlled exposure experiment 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 controlled exposure experiment 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 NM) from the first controlled exposure experiment 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 controlled exposure experiments involving blue whales engaged in surface feeding or social behaviors, but was observed in three of the ten controlled exposure experiments 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 demonstrate clear, strong, and pronounced but varied behavioral changes including avoidance with associated energetic swimming and cessation of individual foraging dives 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. Similar responses by beaked whales to sonar have been documented by Stimpert *et al.,* 2014, Falcone *et al.,* 2017, DiMarzio *et al.,* 2018, and Joyce *et al.,* 2019. However, there are a number of variables influencing response or non-response include source distance (close vs. far), received sound levels, and other contextual variables such as other sound sources *(e.g.,* vessels, etc.) (Manzano-Roth *et al.,* 2016, Falcone *et al.,* 2017, Harris *et al.,* 2018). Wensveen *et al.* (2019) found northern bottlenose whales to avoid sonar out to distances of 28 km, but these distances are well in line with those observed on Navy ranges (Manzano-Roth *et al.,* 2016; Joyce *et al.,* 2019) where the animals return once the sonar has ceased. Furthermore, beaked whales have also shown response to other non-sonar anthropogenic sounds such as commercial shipping and echosounders (Soto *et al.,* 2006, Pirotta *et al.,* 2012, Cholewiak *et al.,* 2017). Pirotta *et al.* (2012) documented broadband ship noise causing a significant change in beaked whale behavior up to at least 5.2 kilometers away from the vessel. Even though beaked whales appear to be sensitive to anthropogenic sounds, the level of response at the population level does not appear to be significant based on over a decade of research at two heavily used Navy training areas in the Pacific (Falcone *et al.,* 2012, Schorr *et al.,* 2014, DiMarzio *et al.,* 2018, Schorr *et al.,* 2019). With the exception of seasonal patterns, DiMarzio *et al.* (2018) did not detect any changes in annual Cuvier's beaked whale abundance estimates in Southern California derived from passive acoustic echolocation detections over nine years (2010–2018). Similar results for Blainville's beaked whales abundance estimates over several years was documented in Hawaii (Henderson *et al.,* 2016;, DiMarzio *et al.,* 2018). Visually, there have been documented repeated sightings in southern California of the same individual Cuvier's beaked whales over 10 years, sightings of mother-calf pairs, and recently sightings of the same mothers with their second calf (Falcone *et al.,* 2012; Schorr *et al.,* 2014; Schorr *et al.,* 2019; Schorr, unpublished data).

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 *et al.* (1996) 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.

The strongest baleen whale response in any behavioral response study was observed in a minke whale in the 3S2 study, which responded at 146 dB re 1 μPa by strongly avoiding the sound source (Kvadsheim *et al.,* 2017; Sivle *et al.,* 2015). Although the minke whale increased its swim speed, directional movement, and respiration rate, none of these were greater than rates observed in baseline behavior, and its dive behavior remained similar to baseline dives. A minke whale tagged in the Southern California behavioral response study also responded by increasing its directional movement, but maintained its speed and dive patterns, and so did not demonstrate as strong of a response (Kvadsheim *et al.,* 2017). In addition, the 3S2 minke whale demonstrated some of the same avoidance behavior during the controlled ship approach with no sonar, indicating at least some of the response was to the vessel (Kvadsheim *et al.,* 2017). Martin *et al.* (2015) found that the density of calling minke whales was reduced during periods of Navy training involving sonar relative to the periods before training, and increased again in the days after training was completed. The responses of individual whales could not be assessed, so in this case it is unknown whether the decrease in calling animals indicated that the animals left the range, or simply ceased calling. Similarly, minke whale detections made using Marine Acoustic Recording Instruments off Jacksonville, FL, were reduced or ceased altogether during periods of sonar use (Simeone *et al.,* 2015; U.S. Department of the Navy, 2013b), especially with an increased ping rate (Charif *et al.,* 2015).

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 had 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 or resting. These effects have generally not been demonstrated for marine mammals, but studies involving fish and terrestrial animals have shown that increased vigilance may substantially reduce feeding rates (Saino, 1994; Beauchamp and Livoreil, 1997; Fritz *et al.,* 2002; Purser and Radford, 2011). 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).

Chronic disturbance can cause population declines through reduction of fitness (*e.g.,* decline in body condition) and subsequent reduction in reproductive success, survival, or both (*e.g.,* Harrington and Veitch, 1992; Daan *et al.,* 1996; Bradshaw *et al.,* 1998). 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). However, 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.

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). 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 a 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 at-sea exercises last for multiple days does not necessarily mean that individual animals will be either exposed to those activity-related stressors (*i.e.,* sonar) for multiple days or further, exposed in a manner that would result in sustained multi-day substantive behavioral responses. Stone (2015a) reported data from at-sea observations during 1,196 airgun surveys from 1994 to 2010. When large arrays of airguns (considered to be 500 in^3 or more) were firing, lateral displacement, more localized avoidance, or other changes in behavior were evident for most odontocetes. However, significant responses to large arrays were found only for the minke whale and fin whale. Behavioral responses observed included changes in swimming or surfacing behavior, with indications that cetaceans remained near the water surface at these times. Cetaceans were recorded as feeding less often when large arrays were active. Behavioral observations of gray whales during an air gun survey monitored whale movements and respirations pre-, during-, and post-seismic survey (Gailey *et al.,* 2016). Behavioral state and water depth were the best 'natural' predictors of whale movements and respiration and, after considering natural variation, none of the response variables were significantly associated with survey or vessel sounds.

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 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, the authors chose 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 (see MMPA section 410(3)). This definition is useful for considering stranding events even when they occur beyond lands and waters under the jurisdiction of the United States.

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 2017).

Numerous studies suggest that the physiology, behavior, habitat, social relationships, age, or condition of cetaceans may cause them to strand or might predispose them to strand when exposed to another phenomenon. These suggestions are consistent with the conclusions of numerous other studies that have demonstrated that combinations of dissimilar stressors commonly combine to kill an animal or dramatically reduce its fitness, even though one exposure without the other does not produce the same result (Chroussos, 2000; Creel, 2005; 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.

In the United States between 2001 and 2009, there were approximately 9,895 cetacean strandings and 24,225 pinniped strandings (34,120 total). From 2006–2017 there were 19,430 cetacean strandings and 55,833 pinniped stranding (75,263 total) (P. Onens, NMFS, pers comm. 2019). 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 Measures* 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 the 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 U.S. Navy 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 stranded marine mammals 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-hour 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 NM (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 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 Mojácar (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 Mojácar 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 NM (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 2001 NMFS/Navy joint 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 Cuvier's beaked whale), 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-Induced Bubble Formation Due to Sonars and Other Pressure-related Injury* section and an indirect cause of stranding). 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 in the MITT Study Area

Although records of marine mammal strandings exist as far back as 1878 in Guam, reporting of marine mammal strandings across the Mariana Islands has likely only become consistent in recent years. A variety of marine mammals have historically stranded in the MITT Study Area and have been documented by sources such as the Department of Lands and Natural Resources Division of Fish and Wildlife and by the Department of Agriculture, Division of Aquatic and Wildlife Resources. Species that have stranded include pygmy and dwarf sperm whales, false killer whales, melon-headed whales, striped dolphins, sperm whales, and beaked whales.

The stranding of a pygmy sperm whale in 1997 (Trianni and Tenorio, 2012) is the only other confirmed occurrence of this species in the MITT Study Area. There have been four known dwarf sperm whale strandings in the Mariana Islands (Trianni and Tenorio, 2012; Uyeyama, 2014). Three false killer whale strandings occurred in 2000, 2003, and 2007 (Trianni and Tenorio, 2012; Uyeyama, 2014). There was a live stranding of a melon-headed whale on the beach at Inarajan Bay, Guam in 1980 (Donaldson, 1983; Kami, 1982), and four individuals at Orote in 2009 (Uyeyama, 2014). Two striped dolphins stranding have occurred, one recorded in July1985 (Eldredge, 1991, 2003) and a second in 1993 off Saipan (Trianni and Tenorio, 2012). Six sperm whale stranding have occurred between 1962 to 2018. Through January 2019, nine beaked whales stranding events were reported in the Mariana Islands (Guam and Saipan), with the first recorded stranding in 2007. All identified beaked whales were Cuvier's beaked whales. Stranding events consisted of 1–3 animals. A tenth event, and most recent stranding (live) event of a Cuvier's beaked whale, occurred in November 2019 on Rota (Commonwealth of the Northern Mariana Islands). A review of Navy records indicates that sonar use occurred within 72 hours or 80 NM of three of these stranding events (2011, 2015, and 2016) (C. Johnson, Navy, *pers. comm.* 2019).

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 occurs and, if so, whether it results in injury, serious injury, or mortality (Knowlton and Kraus, 2001; Laist *et al.,* 2001; Jensen and Silber, 2003; Pace and Silber, 2005; Vanderlaan and Taggart, 2007; Conn and Silber 2013). 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 Large Whale Ship Strike Database represents a minimum number of collisions, because the vast majority probably goes undetected or unreported. In contrast, Navy personnel 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.

In the MITT Study Area, NMFS has no documented vessel strikes of marine mammals by the Navy. This, however, precludes the use of the quantitative approach to assess the likelihood of vessel strikes used in the 2018 and 2019 incidental take rulemakings for Navy activities in the AFTT and HSTT Study Areas, which starts with the number of Navy strikes that have occurred in the study area in question. Based on this lack of strikes and other factors described below, which the Navy presented and NMFS agrees are appropriate factors to consider in assessing the likelihood of ship strike, the Navy does not anticipate vessel strikes and has not requested authorization to take marine mammals by serious injury or mortality within the MITT Study Area during training and testing activities. NMFS agrees with the Navy's decision based on the analysis and other factors described below. Table 8 summarizes the factors considered in determining the risk of vessel strikes on large whales in the MITT Study Area, along with the associated qualitative scores for each, which are described below. For species with definite seasonal occurrence (*e.g.,* winter), the approach assigns a value of +1 for a ''yes'' and +0.5 for a ''no'' answer to account for the possibility that a species could be there. In the other columns, the approach assigns a value of +1 for a ''yes'' and −1 for a ''no'' answer. Justification for inclusion of a vessel strike request was based on whether a final evaluation score was greater than zero (similar to the analysis in the HSTT rule). None of the final evaluation scores for large whales were greater than zero. Regardless of the scoring system the Navy presented, NMFS concurs that the factors considered are appropriate and that they support a determination that vessel strike is not likely to occur.

TABLE 8—WEIGHT OF EVIDENCE APPROACH FOR DETERMINING THE RISK OF VESSEL STRIKE ON LARGE WHALES IN THE MITT STUDY AREA

Species	Year-round presence? (yes =1/ no = 0.5)	High Density (>0.001/km^2)? (yes =1/no = −1)	Stranding record? (yes = 1/no = −1)	Ship strike record? (yes =1/no = −1)	Final evaluation	Justification for including vessel strike request (final evaluation >0)
Blue whale	no (0.5)	no (−1)	no (−1)	no (−1)	−2.5	Did not request vessel strike.
Fin whale	no (0.5)	no (−1)	no (−1)	no (−1)	−2.5	Did not request vessel strike.
Humpback whale	no (0.5)	no (−1)	no (−1)	no (−1)	−2.5	Did not request vessel strike.
Sei whale	no (0.5)	no (−1)	no (−1)	no (−1)	−2.5	Did not request vessel strike.

TABLE 8—WEIGHT OF EVIDENCE APPROACH FOR DETERMINING THE RISK OF VESSEL STRIKE ON LARGE WHALES IN THE MITT STUDY AREA—Continued

Species	Year-round presence? (yes =1/ no = 0.5)	High Density (>0.001/km^2)? (yes =1/no = −1)	Stranding record? (yes = 1/no = −1)	Ship strike record? (yes =1/no = −1)	Final evaluation	Justification for including vessel strike request (final evaluation >0)
Sperm whale	yes (1)	no (−1)	yes (1) *	no (−1)	0	Did not request vessel strike.

* Six sperm whale strandings 1962 to 2018.

Additionally, the Navy has fewer vessel transits than commercial entities and other Federal agencies in the MITT Study Area. For example, over the five-year period between 2014 and 2018, there were a total of 8,984 civilian commercial and Federal agency vessel transits (excluding Navy) through Apra Harbor (Table 9). This represents 86 percent of all vessel transits. The remaining 14 percent were Navy vessel transits (total of 1,497 transits). Other Federal agency vessels include NOAA research vessels, U.S. Coast Guard vessels, and Department of Defense (other than Navy) vessels account for approximately 5 percent of these total transits. The most frequent ship types arriving at the Jose D. Leon Guerrero Commercial Port were container ships (27 percent), long-line fishing vessels (22 percent), tankers (12 percent), and break bulk ships (10 percent) (Port of Guam, unpublished data). These statistics do not account for civilian recreational boats, tour boats, or personal watercraft (*i.e., jet skis*). The Navy transits are about five times less than commercial shipping transits alone. Overall, the percentage of Navy vessel traffic relative to the commercial and other Federal agency shipping traffic is much smaller (14 percent), and therefore represents a correspondingly smaller threat of potential ship strikes when compared to other vessel use.

TABLE 9—COMMERCIAL AND NAVY SHIP TRANSITS THROUGH APRA HARBOR GUAM 2014–2018

Year	Commercial and other federal agency vessel transits	U.S. Navy vessel transits	Total annual transits
2014	1,735	339	2,074
2015	1,654	328	1,982
2016	1,534	293	1,827
2017	2,068	264	2,332
2018	1,993	273	2,266
5-yr Total	8,984 (86 percent)	1,497 (14 percent)	10,481
5-yr Average	1,797 (86 percent)	299 (14 percent)	2,096

Outside of the vessel traffic as described above, major commercial shipping vessels use shipping lanes for transporting goods between Hawaii, the continental United States, and Asia. Typically, these are great circle routes based on the most direct path between major commercial ports. There are no standard commercial routes between Guam and the United States. There are also commercial shipping routes from Asia and Japan to the equatorial Pacific and Australia that pass through larger portions of the Guam and CNMI Economic Exclusive Zones (EEZ) as well as the MITT Study Area. Across all warfare areas and activities, 493 days of Navy at-sea time would occur annually in MITT, three times less than in the HSTT Study Area.

In addition, 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.

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 LOA requirements. In 2009, the Navy implemented Marine Species Awareness Training designed to improve effectiveness of visual observation for marine resources, including marine mammals. 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.

Based on all of these considerations, NMFS has preliminarily determined that the Navy's decision not to request take authorization for vessel strike of large whales is supported by multiple factors, including the lack of ship strike reports in regional NMFS stranding records (1962–2018) for the Mariana Islands (including no strikes by Navy vessels in the MITT Study Area), the relatively low density of large marine mammals in the Mariana Islands, and the seasonal nature of several species (blue whales, humpback whales, fin whales, and sei whales). In addition, there are relatively small numbers of

Navy vessels across a large expanse of offshore waters in the MITT Study Area, and the procedural mitigation measures that would be in place further minimize potential vessel strike.

In addition to the reasons listed above that make it unlikely that the Navy will hit a large whale (more maneuverable ships, larger crew, etc.), the following are additional reasons that vessel strike of dolphins and small whales is very unlikely. Dating back more than 20 years and for as long as it has kept records, the Navy has no records of individuals of these groups being struck by a vessel as a result of Navy activities and, further, their smaller size and maneuverability make a strike unlikely. Also, NMFS has never received any reports from other authorized activities indicating that these species have been struck by vessels. Worldwide ship strike records show little evidence of strikes of these groups from the shipping sector and larger vessels, and the majority of the Navy's activities involving faster-moving vessels (that could be considered more likely to hit a marine mammal) are located in offshore areas where smaller delphinid densities are lower. Based on this information, NMFS concurs with the Navy's assessment that vessel strike is not likely to occur for either large whales or smaller marine mammals.

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 potential effects was considered in the 2019 MITT DSEIS/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 2019 MITT DSEIS/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 a 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. 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 (Halvorsen *et al.,* 2012; Jørgensen *et al.,* 2005; Juanes *et al.,* 2017; Kane *et al.,* 2010; Kvadsheim & Sevaldsen, 2005; Popper *et al.,* 2007; Popper and Hawkins, 2016; Watwood *et al.,* 2016).

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) were 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.

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 e*t 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).

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).

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 or 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. Mortality 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 MITT 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 were much lower than typical Navy sources within the MITT 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.

Explosions could kill or injure nearby marine invertebrates. 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 populations. Long-term consequences to marine invertebrate populations would not be expected as a result of exposure to sounds or vessels in the MITT Study Area.

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 MITT 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 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 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 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 MITT 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 or 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 MITT 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 MITT 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 2019 MITT DSEIS/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 2019 MITT DSEIS/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 MITT 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 and 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 are based on the maximum amount of take that NMFS anticipates is reasonably expected to occur. NMFS coordinated closely with the Navy in the development of their incidental take application, and preliminarily agrees that the methods the Navy has put forth described herein to estimate take (including the model, thresholds, and density estimates), and the resulting numbers are based on the best available science and appropriate for authorization.

Takes would be in the form of harassment only. For military readiness activities, the MMPA defines ''harassment'' as (i) Any act that injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment); or (ii) Any act that disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural 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).

Proposed authorized takes would primarily be in the form of Level B harassment, as use of the acoustic and explosive sources (*i.e.,* sonar and explosives) is more likely to result in behavioral disruption (rising to the level of a take as described above) or temporary threshold shift (TTS) for marine mammals than other forms of take. There is also the potential for Level A harassment, however, in the form of auditory injury and/or tissue damage (the latter from explosives only) to result from exposure to the sound sources utilized in training and testing activities.

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

Acoustic Thresholds

Using the best available science, NMFS, in coordination with the Navy, has established acoustic thresholds that identify the most appropriate received level of underwater sound above which marine mammals exposed to these sound sources could be reasonably expected to experience a disruption in behavior 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 non-auditory injury from exposure to pressure waves from explosive detonation.

Despite the quickly evolving science, there are still challenges in quantifying expected behavioral responses that qualify as take by Level B harassment, especially where the goal is to use one or two predictable indicators (*e.g.,* received level and distance) to predict responses that are also driven by additional factors that cannot be easily incorporated into the thresholds (*e.g.,* context). So, while the behavioral Level B harassment thresholds have been refined here to better consider the best available science (*e.g.,* incorporating both received level and distance), they also still have some built-in conservative factors to address the challenge noted. For example, while duration of observed responses in the data are now considered in the thresholds, some of the responses that are informing take thresholds are of a very short duration, such that it is possible some of these responses might not always rise to the level of disrupting behavior patterns to a point where they are abandoned or significantly altered. We describe the application of this Level B harassment threshold as identifying the maximum number of instances in which marine mammals could be reasonably expected to experience a disruption in behavior patterns to a point where they are abandoned or significantly altered. In summary, we believe these behavioral Level B harassment thresholds are the most appropriate method for predicting behavioral Level B harassment given the best available science and the associated uncertainty.

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

Non-Impulsive and Impulsive

NMFS' Acoustic Technical Guidance (NMFS, 2018) 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 Acoustic Technical Guidance also identifies criteria to predict TTS, which is not considered injury and falls into the Level B harassment category. The Navy's planned activity includes the use of non-impulsive (sonar) and impulsive (explosives) sources.

These thresholds (Tables 10 and 11) were developed by compiling and synthesizing the best available science and soliciting input multiple times from both the public and peer reviewers. The references, analysis, and methodology used in the development of the thresholds are described in Acoustic Technical Guidance, which may be accessed at: *https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-acoustic-technical-guidance.*

TABLE 10—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
Otarid 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 11 to predict the onset of TTS, PTS, tissue damage, and mortality for explosives (impulsive) and other impulsive sound sources.

TABLE 11—ONSET OF TTS, PTS, TISSUE DAMAGE, AND MORTALITY THRESHOLDS FOR MARINE MAMMALS FOR EXPLOSIVES AND OTHER IMPULSIVE SOURCES

Functional hearing group	Species	Onset TTS	Onset PTS	Mean onset slight GI tract injury	Mean onset slight lung injury	Mean onset mortality
Low-frequency cetaceans	All mysticetes	168 dB SEL (weighted) or 213 dB Peak SPL.	183 dB SEL (weighted) 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 (weighted) or 224 dB Peak SPL.	185 dB SEL (weighted) or 230 dB Peak SPL.	237 dB Peak SPL.		
High-frequency cetaceans	Porpoises and Kogia spp.	140 dB SEL (weighted) or 196 dB Peak SPL.	155 dB SEL (weighted) or 202 dB Peak SPL.	237 dB Peak SPL.		
Phocidae	Harbor seal, Hawaiian monk seal, Northern elephant seal.	170 dB SEL (weighted) or 212 dB Peak SPL.	185 dB SEL (weighted) or 218 dB Peak SPL.	237 dB Peak SPL.		
Otariidae	California sea lion, Guadalupe fur seal, Northern fur seal.	188 dB SEL (weighted) or 226 dB Peak SPL.	203 dB SEL (weighted) 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: $103M^{1/3} (1+[D_{\leq Rm}/10.1])^{1/6}$ Pa-sec. M = mass of the animals in kg; D_{Rm} = depth of the receiver (animal) in meters; SPL = sound pressure level.

The criteria used to assess the onset of TTS and PTS due to exposure to sonars (non-impulsive, see Table 10 above) are discussed further in the Navy's rulemaking/LOA application (see Hearing Loss from Sonar and Other Transducers in Chapter 6, Section 6.4.2.1, Methods for Analyzing Impacts from Sonars and Other Transducers). 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 under the *Potential Effects of Specified Activities on Marine Mammals and Their Habitat* section—*Acoustically Mediated Bubble Growth and other Pressure-related Injury* and is therefore not considered further in this analysis.

Behavioral Harassment

Though significantly driven by received level, the onset of Level B harassment by 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 (Ellison *et al.,* 2011; Southall *et al.,* 2007). Based on what the available science indicates and the practical need to use thresholds based on a factor, or factors, that are both predictable and measurable for most activities, NMFS uses generalized acoustic thresholds based primarily on received level (and distance in some cases) to estimate the onset of Level B behavioral harassment.

Sonar

As noted above, the Navy coordinated with NMFS to develop, and propose for use in this rule, Level B behavioral harassment thresholds specific to their military readiness activities utilizing active sonar. These behavioral response thresholds are used to estimate the number of animals that may exhibit a behavioral response that rises to the level of a take when exposed 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 Level B harassment 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 has carefully reviewed the Navy's Level B behavioral thresholds and establishment of cutoff distances for the species, and agrees that it is the best available science and is the appropriate method to use at this time for determining impacts to marine mammals from sonar and other transducers and for calculating take and to support the determinations made in this proposed rule.

As discussed above, marine mammal responses to sound (some of which are considered disturbances that rise to the level of a take) are highly variable and context specific, *i.e.,* they are 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. This means that there is support for considering alternative approaches for estimating Level B behavioral harassment. Although the statutory definition of Level B harassment for military readiness activities means that a natural behavior pattern of a marine mammal is significantly altered or abandoned, the current state of science for determining those thresholds is somewhat unsettled.

In its analysis of impacts associated with sonar acoustic sources (which was coordinated with NMFS), the Navy used an updated conservative approach that likely overestimates the number of takes by Level B harassment due to behavioral disturbance and response. Many of the behavioral responses identified using the Navy's quantitative analysis are most likely to be of moderate severity as described in the Southall *et al.* (2007) behavioral response severity scale. These ''moderate'' severity responses were considered significant if they were sustained for the duration of the exposure or longer. Within the Navy's quantitative analysis, many reactions are predicted from exposure to sound that may exceed an animal's Level B behavioral harassment threshold for only a single exposure (a few seconds) to several minutes, and it is likely that some of the resulting estimated behavioral responses that are counted as Level B harassment would not constitute ''significantly altering or abandoning natural behavioral patterns.'' The Navy and NMFS have used the best available science to address the challenging differentiation between significant and non-significant behavioral reactions (*i.e.,* whether the behavior has been abandoned or significantly altered such that it qualifies as harassment), but have erred on the cautious side where uncertainty exists (*e.g.,* counting these lower duration reactions as take), which likely results in some degree of overestimation of Level B behavioral harassment. We consider application of this Level B behavioral harassment threshold, therefore, as identifying the maximum number of instances in which marine mammals could be reasonably expected to experience a disruption in behavior patterns to a point where they are abandoned or significantly altered (*i.e.,* Level B harassment). Because this is the most appropriate method for estimating Level B harassment given the best available science and uncertainty on the topic, it is these numbers of Level B harassment by behavioral disturbance that are analyzed in the *Preliminary Analysis and Negligible Impact Determination* section and would be authorized.

In the Navy's acoustic impact analyses during Phase II (previous phase of Navy testing and training, 2013–2018, see also Navy's *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis Technical Report,* 2012), the likelihood of Level B behavioral harassment in response 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 (at the level of a Level B harassment) to the received SPL. The BRF was used to estimate the percentage of an exposed population that is likely to exhibit Level B harassment due to 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, a step function at an SPL of 140 dB re 1 μPa was used for beaked whales as the threshold to predict Level B harassment by behavioral disturbance.

Developing the Level B behavioral harassment criteria for Phase III (the current phase of Navy training and testing activities) involved multiple steps: All available behavioral response studies conducted both in the field and on captive animals were examined to understand the breadth of behavioral responses of marine mammals to sonar and other transducers (See also Navy's *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III) Technical Report,* 2017). Six behavioral response field studies with observations of 14 different marine mammal species reactions to sonar or sonar-like signals and 6 captive animal behavioral studies with observations of 8 different species reactions to sonar or sonar-like signals were used to provide a robust data set for the derivation of the Navy's Phase III marine mammal behavioral response criteria. All behavioral response research that has been published since the derivation of the Navy's Phase III criteria (c.a. December 2016) has been examined and is consistent with the current behavioral response functions. 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 12 below). This was determined by examining all available published field observations of behavioral reactions to sonar or sonar-like signals that included the distance between the sound source and the marine mammal. The longest distance, rounded up to the nearest 5-km increment, was chosen as the cutoff distance for each behavioral criteria group (*i.e.* odontocetes, mysticetes, and beaked whales). For animals within the cutoff distance, a behavioral response function based on a received SPL as presented in Chapter 3, 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 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 (however, we note that helicopter dipping sonars were considered in the intense sound source group, despite lower source levels, because of data indicating that marine mammals are sometimes more responsive to the less predictable employment of this source). There are currently few behavioral observations under these circumstances; therefore, the Navy conservatively predicted significant behavioral responses that would rise to Level B harassment at farther ranges as shown in Table 12, versus less intense events.

TABLE 12—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	High SL/multi-platform cutoff distance
Odontocetes	10 km	20 km.
Mysticetes	10 km	20 km.
Beaked Whales	25 km	50 km.

Note: dB re 1 μPa @1 m: Decibels referenced to 1 micropascal at 1 meter; km: Kilometer; SL: Source level.

The range to received sound levels in 6-dB steps from five representative sonar bins and the percentage of animals that may be taken by Level B harassment under each behavioral response function are shown in Table 13 through Table 17. 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 Chapter 6, Section 6.4.2.1.1 (Methods for Analyzing Impacts from Sonars and Other Transducers) of the Navy's rulemaking/LOA application for further details on the derivation and use of the behavioral response functions, thresholds, and the cutoff distances to identify takes by Level B harassment, which were coordinated with NMFS. Table 13 illustrates the maximum likely percentage of exposed individuals taken at the indicated received level and associated range (in which marine mammals would be reasonably expected to experience a disruption in behavior patterns to a point where they are abandoned or significantly altered) for LFAS. As noted previously, NMFS carefully reviewed, and contributed to, the Navy's proposed Level B behavioral harassment thresholds and cutoff distances for the species, and agrees that these methods represent the best available science at this time for determining impacts to marine mammals from sonar and other transducers.

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Table 13. Ranges to estimated Level B behavioral harassment takes for sonar bin LF4 over a representative range of environments within the MITT Study Area.

Received Level (dB re 1 µPa)	Average Range (m) with Minimum and Maximum Values in Parenthesis	Probability of Level B Behavioral Harassment for Sonar Bin LF4		
		Odontocetes	Mysticetes	Beaked Whales
196	1 (1–1)	100%	100%	100%
190	3 (3–3)	100%	98%	100%
184	6 (6–6)	99%	88%	100%
178	12 (12–12)	97%	59%	100%
172	25 (25–25)	91%	30%	99%
166	51 (50–55)	78%	20%	97%
160	130 (130–160)	58%	18%	93%
154	272 (270–300)	40%	17%	83%
148	560 (550–675)	29%	16%	66%
142	1,048 (1,025–1,525)	25%	13%	45%
136	2,213 (1,525–4,525)	23%	9%	28%
130	4,550 (2,275–24,025)	20%	5%	18%
124	16,903 (4,025–66,275)	17%	2%	14%
118	43,256 (7,025–87,775)	12%	1%	12%
112	60,155 (7,775–100,000*)	6%	0%	11%
106	80,689 (8,775–100,000*)	3%	0%	11%
100	92,352 (9,025–100,000*)	1%	0%	8%

Notes: dB re 1 µPa = decibels referenced to 1 micropascal, m = meters
* Indicates maximum range to which acoustic model was run, a distance of approximately 100 kilometers from the sound source. 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. Cut-off ranges in this table are for activities with high source levels and/or multiple platforms (see Table 6.4-1 from the Navy's rule making/LOA application for behavioral cut-off distances).

Table 14. Ranges to estimated Level B behavioral harassment takes for sonar bin MF1 over a representative range of environments within the MITT Study Area.

Table 14. Ranges to estimated Level B behavioral harassment takes for sonar bin MF1 over a representative range of environments within the MITT Study Area.

Received Level (dB re 1 µPs)	Average Range (m) with Minimum and Maximum Values in Parenthesis	Probability of Level B Behavioral Harassment for Sonar Bin MF1		
		Odontocetes	Mysticetes	Beaked Whales
196	106 (100–110)	100%	100%	100%
190	240 (240–250)	100%	98%	100%
184	501 (490–525)	99%	88%	100%
178	1,019 (975–1,025)	97%	59%	100%
172	3,275 (2,025–5,275)	91%	30%	99%
166	7,506 (2,525–11,025)	78%	20%	97%
160	15,261 (4,775–20,775)	58%	18%	93%
154	27,759 (5,525–36,525)	40%	17%	83%
148	43,166 (7,525–65,275)	29%	16%	66%
142	58,781 (8,525–73,525)	25%	13%	45%
136	71,561 (11,275–90,775)	23%	9%	28%
130	83,711 (13,025–100,000*)	20%	5%	18%
124	88,500 (23,525–100,000*)	17%	2%	14%
118	90,601 (27,025–100,000*)	12%	1%	12%
112	92,750 (27,025–100,000*)	6%	0%	11%
106	94,469 (27,025–100,000*)	3%	0%	11%
100	95,838 (27,025–100,000*)	1%	0%	8%

Notes: dB re 1 µPa = decibels referenced to 1 micropascal, m = meters
* Indicates maximum range to which acoustic model was run, a distance of approximately 100 kilometers from the sound source. 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. Cut-off ranges in this table are for activities with high source levels and/or multiple platforms (see Table 6.4-1 of the Navy's rulemaking/LOA application for behavioral cut-off distances).

Table 15. Ranges to estimated Level B behavioral harassment takes for sonar bin MF4 over a representative range of environments within the MITT Study Area.

Received Level (dB re 1 µPa)	Average Range (m) with Minimum and Maximum Values in Parenthesis	Probability of Level B Behavioral Harassment for Sonar Bin MF4		
		Odontocetes	Mysticetes	Beaked Whales
196	8 (8–8)	100%	100%	100%
190	17 (17–17)	100%	98%	100%
184	35 (35–35)	99%	88%	100%
178	70 (65–70)	97%	59%	100%
172	141 (140–150)	91%	30%	99%
166	354 (330–420)	78%	20%	97%
160	773 (725–1,275)	58%	18%	93%
154	1,489 (1,025–3,275)	40%	17%	83%
148	3,106 (1,775–6,775)	29%	16%	66%
142	8,982 (3,025–18,775)	25%	13%	45%
136	15,659 (3,775–31,025)	23%	9%	28%
130	25,228 (4,775–65,775)	20%	5%	18%
124	41,778 (5,525–73,275)	17%	2%	14%
118	51,832 (6,025–89,775)	12%	1%	12%
112	62,390 (6,025–100,000*)	6%	0%	11%
106	69,235 (6,775–100,000*)	3%	0%	11%
100	73,656 (7,025–100,000*)	1%	0%	8%

Notes: dB re 1 µPa = decibels referenced to 1 micropascal, m = meters

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

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. Cut-off ranges in this table are for activities with high source levels and/or multiple platforms (see Table 6.4-1 of the Navy's rulemaking/LOA application for behavioral cut-off distances).

Table 16. Ranges to estimated Level B behavioral harassment takes for sonar bin MF5 over a representative range of environments within the MITT Study Area.

Received Level (dB re 1 µPa)	Average Range (m) with Minimum and Maximum Values in Parenthesis	Probability of Level B Behavioral Harassment for Sonar Bin MF5		
		Odontocetes	Mysticetes	Beaked Whales
196	0 (0–0)	100%	100%	100%
190	1 (0–3)	100%	98%	100%
184	4 (0–7)	99%	88%	100%
178	14 (0–15)	97%	59%	100%
172	29 (0–30)	91%	30%	99%
166	58 (0–60)	78%	20%	97%
160	125 (0–150)	58%	18%	93%
154	284 (160–525)	40%	17%	83%
148	607 (450–1,025)	29%	16%	66%
142	1,213 (875–4,025)	25%	13%	45%
136	2,695 (1,275–7,025)	23%	9%	28%
130	6,301 (2,025–12,525)	20%	5%	18%
124	10,145 (3,025–19,525)	17%	2%	14%
118	14,359 (3,525–27,025)	12%	1%	12%
112	19,194 (3,525–37,275)	6%	0%	11%
106	24,153 (4,025–48,025)	3%	0%	11%
100	29,325 (5,025–57,775)	1%	0%	8%

Notes: dB re 1 µPa = decibels referenced to 1 micropascal, m= meters
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. Cut-off ranges in this table are for activities with high source levels and/or multiple platforms (see Table 6.4-1 of the Navy's rulemaking/LOA application for behavioral cut-off distances).

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Table 17 identifies the maximum likely percentage of exposed individuals taken at the indicated received level and associated range for HFAS.

TABLE 17—RANGES TO ESTIMATED LEVEL B BEHAVIORAL HARASSMENT TAKES FOR SONAR BIN HF4 OVER A REPRESENTATIVE RANGE OF ENVIRONMENTS WITHIN THE MITT STUDY AREA

Received level (dB re 1 µPa)	Average range (m) with minimum and maximum values in parenthesis	Probability of level B behavioral harassment for sonar Bin HF4		
		Odontocetes (%)	Mysticetes (%)	Beaked whales (%)
196	3 (2–4)	100	100	100
190	8 (6–10)	100	98	100
184	16 (12–20)	99	88	100
178	32 (24–40)	97	59	100
172	63 (45–80)	91	30	99
166	120 (75–160)	78	20	97
160	225 (120–310)	58	18	93
154	392 (180–550)	40	17	83
148	642 (280–1,275)	29	16	66
142	916 (420–1,775)	25	13	45
136	1,359 (625–2,525)	23	9	28
130	1,821 (950–3,275)	20	5	18
124	2,567 (1,275–5,025)	17	2	14
118	3,457 (1,775–6,025)	12	1	12
112	4,269 (2,275–7,025)	6	0	11
106	5,300 (3,025–8,025)	3	0	11
100	6,254 (3,775–9,275)	1	0	8

Notes: dB re 1 µPa = decibels referenced to 1 micropascal, m = meters.

Explosives

Phase III explosive criteria for Level B behavioral harassment thresholds for marine mammals is the hearing groups' TTS threshold minus 5 dB (see Table 18 below and Table 11 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. NMFS continues to concur that this approach represents the best available science for determining impacts to marine mammals from explosives.

TABLE 18—LEVEL B BEHAVIORAL HARASSMENT THRESHOLDS FOR EXPLOSIVES FOR MARINE MAMMALS

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

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

Navy's Acoustic Effects Model

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 and each dosimeter records its individual sound ''dose.'' The model bases the distribution of animats over the MITT 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, 2018).

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 in not only 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 five 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 13 through Table 17 above, respectively. See Chapter 6, Section 6.4.2.1 (Methods for Analyzing Impacts from Sonars 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 that are used to identify Level B behavioral harassment.

The ranges to PTS for five representative sonar systems for an exposure of 30 seconds is shown in Table 19 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 19—RANGE TO PERMANENT THRESHOLD SHIFT (METERS) FOR FIVE REPRESENTATIVE SONAR SYSTEMS

Hearing group	Approximate range in meters for PTS from 30 second exposure [1]				
	Sonar bin HF4	Sonar bin LF4	Sonar bin MF1	Sonar bin MF4	Sonar bin MF5
High-frequency cetaceans	29 (22–35)	0 (0–0)	181 (180–190)	30 (30–30)	9 (8–10)
Low-frequency cetaceans	0 (0–0)	0 (0–0)	65 (65–65)	15 (15–15)	0 (0–0)
Mid-frequency cetaceans	1 (0–1)	0 (0–0)	16 (16–16)	3 (3–3)	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 five representative sonar systems (see Table 20 through Table 24).

TABLE 20—RANGES TO TEMPORARY THRESHOLD SHIFT (METERS) FOR SONAR BIN LF4 OVER A REPRESENTATIVE RANGE OF ENVIRONMENTS WITHIN THE MITT STUDY AREA

Hearing group	Approximate TTS ranges (meters) [1]			
	Sonar Bin LF4			
	1 second	30 seconds	60 seconds	120 seconds
High-frequency cetaceans	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)
Low-frequency cetaceans	3 (3–3)	4 (4–4)	6 (6–6)	9 (9–9)
Mid-frequency cetaceans	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 MITT 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 21—RANGES TO TEMPORARY THRESHOLD SHIFT (METERS) FOR SONAR BIN MF1 OVER A REPRESENTATIVE RANGE OF ENVIRONMENTS WITHIN THE MITT STUDY AREA

Hearing group	Approximate TTS ranges (meters) [1]			
	Sonar Bin MF1			
	1 second	30 seconds	60 seconds	120 seconds
High-frequency cetaceans	3,181 (2,025–5,025)	3,181 (2,025–5,025)	5,298 (2,275–7,775)	6,436 (2,525–9,775)
Low-frequency cetaceans	898 (850–1,025)	898 (850–1,025)	1,271 (1,025–1,525)	1,867 (1,275–3,025)
Mid-frequency cetaceans	210 (200–210)	210 (200–210)	302 (300–310)	377 (370–390)

[1] Ranges to TTS represent the model predictions in different areas and seasons within the MITT 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.

Note: Ranges for 1-second and 30-second periods are identical for Bin MF1 because this system nominally pings every 50 seconds; therefore, these periods encompass only a single ping.

TABLE 22—RANGES TO TEMPORARY THRESHOLD SHIFT (METERS) FOR SONAR BIN MF4 OVER A REPRESENTATIVE RANGE OF ENVIRONMENTS WITHIN THE MITT STUDY AREA

Hearing group	Approximate TTS ranges (meters) [1]			
	Sonar Bin MF4			
	1 second	30 seconds	60 seconds	120 seconds
High-frequency cetaceans	232 (220–260)	454 (420–600)	601 (575–875)	878 (800–1,525)
Low-frequency cetaceans	85 (85–90)	161 (160–170)	229 (220–250)	352 (330–410)
Mid-frequency cetaceans	22 (22–22)	35 (35–35)	50 (45–50)	70 (70–70)

[1] Ranges to TTS represent the model predictions in different areas and seasons within the MITT 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 23— RANGES TO TEMPORARY THRESHOLD SHIFT (METERS) FOR SONAR BIN MF5 OVER A REPRESENTATIVE RANGE OF ENVIRONMENTS WITHIN THE MITT STUDY AREA.

Hearing group	Approximate TTS ranges (meters) [1]			
	Sonar Bin MF5			
	1 second	30 seconds	60 seconds	120 seconds
High-frequency cetaceans	114 (110–130)	114 (110–130)	168 (150–200)	249 (210–290)
Low-frequency cetaceans	11 (10–12)	11 (10–12)	16 (16–17)	23 (23–24)
Mid-frequency cetaceans	5 (0–9)	5 (0–9)	12 (11–13)	18 (17–18)

[1] Ranges to TTS represent the model predictions in different areas and seasons within the MITT 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 24—RANGES TO TEMPORARY THRESHOLD SHIFT (METERS) FOR SONAR BIN HF4 OVER A REPRESENTATIVE RANGE OF ENVIRONMENTS WITHIN THE MITT STUDY AREA

Hearing group	Approximate TTS ranges (meters) [1]			
	Sonar Bin HF4			
	1 second	30 seconds	60 seconds	120 seconds
High-frequency cetaceans	155 (110–210)	259 (180–350)	344 (240–480)	445 (300–600)
Low-frequency cetaceans	1 (0–2)	2 (1–3)	4 (3–5)	7 (5–8)
Mid-frequency cetaceans	10 (7–12)	17 (12–21)	24 (17–30)	33 (25–40)

[1] Ranges to TTS represent the model predictions in different areas and seasons within the MITT 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, Section 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, Section 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 25 through 29). Ranges are determined by modeling the distance that noise from an explosion would need to propagate to reach exposure level thresholds specific to a hearing group that would cause behavioral response (to the degree of Level B behavioral harassment), 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. Ranges to non-auditory injury and mortality are shown in Tables 28 and 29, respectively. NMFS has reviewed the range distance to effect data provided by the Navy and concurs with the analysis. 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, 2018).

Table 25 shows the minimum, average, and maximum ranges to onset of auditory and likely behavioral effects that rise to the level of Level B harassment for high-frequency cetaceans based on the developed thresholds.

TABLE 25—SEL-BASED RANGES (METERS) TO ONSET PTS, ONSET TTS, AND LEVEL B BEHAVIORAL HARASSMENT FOR HIGH-FREQUENCY CETACEANS

Range to effects for explosives bin: High-frequency cetaceans [1]					
Bin	Source depth (m)	Cluster size	PTS	TTS	Behavioral
E1	0.1	1	353 (340–370)	1,303 (1,275–1,775)	2,139 (2,025–4,275)
		18	1,031 (1,025–1,275)	3,409 (2,525–8,025)	4,208 (3,025–11,525)
E2	0.1	1	431 (410–700)	1,691 (1,525–2,775)	2,550 (2,025–4,525)
		5	819 (775–1,275)	2,896 (2,275–6,775)	3,627 (2,525–10,275)
E3	0.1	1	649 (625–700)	2,439 (2,025–4,525)	3,329 (2,525–7,525)
		12	1,682 (1,525–2,275)	4,196 (3,025–11,525)	5,388 (4,525–16,275)
	18.25	1	720 (675–775)	4,214 (2,275–6,275)	7,126 (3,525–8,775)
		12	1,798 (1,525–2,775)	10,872 (4,525–13,775)	14,553 (5,525–17,775)
E4	10	2	1,365 (1,025–2,775)	7,097 (4,275–10,025)	9,939 (5,025–15,275)
	60	2	1,056 (875–2,275)	3,746 (2,775–5,775)	5,262 (3,025–7,775)
E5	0.1	20	2,926 (1,525–6,275)	6,741 (4,525–16,025)	9,161 (4,775–20,025)
	30	20	4,199 (3,025–6,275)	13,783 (8,775–17,775)	17,360 (10,525–22,775)
E6	0.1	1	1,031 (1,025–1,275)	3,693 (2,025–8,025)	4,659 (3,025–12,775)
	30	1	1,268 (1,025–1,275)	7,277 (3,775–8,775)	10,688 (5,275–12,525)
E7	28	1	1,711 (1,525–2,025)	8,732 (4,275–11,775)	12,575 (4,275–16,025)
E8	0.1	1	1,790 (1,775–3,025)	4,581 (4,025–10,775)	6,028 (4,525–15,775)
	45.75	1	1,842 (1,525–2,025)	9,040 (4,525–12,775)	12,729 (5,025–18,525)
E9	0.1	1	2,343 (2,275–4,525)	5,212 (4,025–13,275)	7,573 (5,025–17,025)
E10	0.1	1	2,758 (2,275–5,025)	6,209 (4,275–16,525)	8,578 (5,275–19,775)
E11	45.75	1	3,005 (2,525–3,775)	11,648 (5,025–18,775)	14,912 (6,525–24,775)
	91.4	1	3,234 (2,525–4,525)	5,772 (4,775–11,775)	7,197 (5,775–14,025)
E12	0.1	1	3,172 (3,025–6,525)	7,058 (5,025–17,025)	9,262 (6,025–21,775)
		4	4,209 (3,775–10,025)	9,817 (6,275–22,025)	12,432 (7,525–27,775)

[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.

Table 26 shows the minimum, average, and maximum ranges to onset of auditory and likely behavioral effects that rise to the level of Level B harassment for mid-frequency cetaceans based on the developed thresholds.

TABLE 26—SEL-BASED RANGES (METERS) TO ONSET PTS, ONSET TTS, AND LEVEL B BEHAVIORAL HARASSMENT FOR MID-FREQUENCY CETACEANS

Range to effects for explosives bin: Mid-frequency cetaceans [1]					
Bin	Source depth (m)	Cluster size	PTS	TTS	Behavioral
E1	0.1	1	25 (25–25)	116 (110–120)	199 (190–210)
		18	94 (90–100)	415 (390–440)	646 (525–700)
E2	0.1	1	30 (30–35)	146 (140–170)	248 (230–370)
		5	63 (60–70)	301 (280–410)	481 (430–675)
E3	0.1	1	50 (50–50)	233 (220–250)	381 (360–400)
		12	155 (150–160)	642 (525–700)	977 (700–1,025)
	18.25	1	40 (40–40)	202 (190–220)	332 (320–350)
		12	126 (120–130)	729 (675–775)	1,025 (1,025–1,025)
E4	10	2	76 (70–90)	464 (410–550)	783 (650–975)
	60	2	60 (60–60)	347 (310–675)	575 (525–900)
E5	0.1	20	290 (280–300)	1,001 (750–1,275)	1,613 (925–3,275)
	30	20	297 (240–420)	1,608 (1,275–2,775)	2,307 (2,025–2,775)
E6	0.1	1	98 (95–100)	430 (400–450)	669 (550–725)
	30	1	78 (75–80)	389 (370–410)	619 (600–650)
E7	28	1	110 (110–110)	527 (500–575)	1,025 (1,025–1,025)
E8	0.1	1	162 (150–170)	665 (550–700)	982 (725–1,025)
	45.75	1	127 (120–130)	611 (600–625)	985 (950–1,025)
E9	0.1	1	215 (210–220)	866 (625–1,000)	1,218 (800–1,525)
E10	0.1	1	270 (250–280)	985 (700–1,275)	1,506 (875–2,525)
E11	45.75	1	241 (230–250)	1,059 (1,000–1,275)	1,874 (1,525–2,025)
	91.4	1	237 (230–270)	1,123 (900–2,025)	1,731 (1,275–2,775)
E12	0.1	1	332 (320–370)	1,196 (825–1,525)	1,766 (1,025–3,525)
		4	572 (500–600)	1,932 (1,025–4,025)	2,708 (1,275–6,775)

[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.

Table 27 shows the minimum, average, and maximum ranges to onset of auditory and likely behavioral effects that rise to the level of Level B harassment for low-frequency cetaceans based on the developed thresholds.

TABLE 27—SEL-BASED RANGES (METERS) TO ONSET PTS, ONSET TTS, AND LEVEL B BEHAVIORAL HARASSMENT FOR LOW-FREQUENCY CETACEANS

Range to effects for explosives bin: Low-frequency cetaceans [1]					
Bin	Source depth (m)	Cluster size	PTS	TTS	Behavioral
E1	0.1	1	51 (50–55)	231 (200–250)	378 (280–410)
		18	183 (170–190)	691 (450–775)	934 (575–1,275)
E2	0.1	1	66 (65–70)	291 (220–320)	463 (330–500)
		5	134 (110–140)	543 (370–600)	769 (490–950)
E3	0.1	1	113 (110–120)	477 (330–525)	689 (440–825)
		12	327 (250–370)	952 (600–1,525)	1,240 (775–4,025)
	18.25	1	200 (200–200)	955 (925–1,000)	1,534 (1,275–1,775)
		12	625 (600–625)	5,517 (2,275–7,775)	10,299 (3,775–13,025)
E4	10	2	429 (370–600)	2,108 (1,775–2,775)	4,663 (3,025–6,025)
	60	2	367 (340–470)	1,595 (1,025–2,025)	2,468 (1,525–4,275)
E5	0.1	20	702 (380–1,275)	1,667 (850–11,025)	2,998 (1,025–19,775)
	30	20	1,794 (1,275–2,775)	8,341 (3,775–11,525)	13,946 (4,025–22,275)
E6	0.1	1	250 (190–410)	882 (480–1,775)	1,089 (625–6,525)
	30	1	495 (490–500)	2,315 (2,025–2,525)	5,446 (3,275–6,025)
E7	28	1	794 (775–900)	4,892 (2,775–6,275)	9,008 (3,775–12,525)
E8	0.1	1	415 (270–725)	1,193 (625–4,275)	1,818 (825–8,525)
	45.75	1	952 (900–975)	6,294 (3,025–9,525)	12,263 (4,275–20,025)
E9	0.1	1	573 (320–1,025)	1,516 (725–7,275)	2,411 (950–14,275)
E10	0.1	1	715 (370–1,525)	2,088 (825–28,275)	4,378 (1,025–32,275)
E11	45.75	1	1,881 (1,525–2,275)	12,425 (4,275–27,275)	23,054 (7,025–65,275)
	91.4	1	1,634 (1,275–2,525)	5,686 (3,775–11,275)	11,618 (5,525–64,275)
E12	0.1	1	790 (420–2,775)	2,698 (925–25,275)	6,032 (1,025–31,275)
		4	1,196 (575–6,025)	6,876 (1,525–31,275)	13,073 (3,775–64,275)

[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.

Table 28 shows 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). Ranges to gastrointestinal tract injury typically exceed ranges to slight lung injury; therefore, the maximum range to effect is not mass-dependent. 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 28—RANGES [1] TO 50 PERCENT NON-AUDITORY INJURY RISK FOR ALL MARINE MAMMAL HEARING GROUPS

Bin	Range (m) (min-max)
E1	12 (11–13)
E2	16 (15–16)
E3	25 (25–25)
E4	30 (30–35)
E5	40 (40–65)
E6	52 (50–60)
E7	120 (120–120)
E8	98 (90–150)
E9	123 (120–270)
E10	155 (150–430)
E11	418 (410–420)
E12	195 (180–675)

[1] Distances in meters (m). Average distance is shown with the minimum and maximum distances due to varying propagation environments in parentheses.

Note: All ranges to non-auditory injury within this table are driven by gastrointestinal tract injury thresholds regardless of animal mass.

Ranges to mortality, based on animal mass, are shown in Table 29 below.

TABLE 29—RANGES [1] TO 50 PERCENT MORTALITY RISK FOR ALL MARINE MAMMAL HEARING GROUPS AS A FUNCTION OF ANIMAL MASS

Bin	Range to mortality (meters) for various animal mass intervals (kg) [1]					
	10	250	1,000	5,000	25,000	72,000
E1	3 (3–3)	1 (0–2)	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)
E2	4 (3–4)	2 (1–3)	1 (0–1)	0 (0–0)	0 (0–0)	0 (0–0)
E3	9 (7–10)	4 (2–8)	2 (1–2)	1 (0–1)	0 (0–0)	0 (0–0)
E4	13 (12–15)	7 (4–12)	3 (3–4)	2 (1–3)	1 (1–1)	1 (0–1)
E5	13 (12–30)	7 (4–25)	3 (2–7)	2 (1–5)	1 (1–2)	1 (0–2)
E6	16 (15–25)	9 (5–23)	4 (3–8)	3 (2–6)	1 (1–2)	1 (1–2)
E7	55 (55–55)	26 (18–40)	13 (11–15)	9 (7–10)	4 (4–4)	3 (2–3)
E8	42 (25–65)	22 (9–50)	11 (6–19)	8 (4–13)	4 (2–6)	3 (1–5)
E9	33 (30–35)	20 (13–30)	10 (9–12)	7 (5–9)	4 (3–4)	3 (2–3)

TABLE 29—RANGES [1] TO 50 PERCENT MORTALITY RISK FOR ALL MARINE MAMMAL HEARING GROUPS AS A FUNCTION OF ANIMAL MASS—Continued

Bin	Range to mortality (meters) for various animal mass intervals (kg) [1]					
	10	250	1,000	5,000	25,000	72,000
E10	55 (40–170)	24 (16–35)	13 (11–15)	9 (7–11)	5 (4–5)	4 (3–4)
E11	206 (200–210)	98 (55–170)	44 (35–50)	30 (25–35)	16 (14–18)	12 (10–15)
E12	86 (50–270)	35 (20–210)	16 (13–19)	11 (9–13)	6 (5–6)	5 (4–5)

[1] Average distance (m) to mortality is depicted above the minimum and maximum distances, which are in parentheses.

Marine Mammal Density

A quantitative analysis of impacts on a species or stock 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 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 broad geographic areas. This is the general approach applied in estimating cetacean abundance in NMFS' Stock Assessment Reports (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 or seasons that were not surveyed. More recently, spatial habitat modeling developed by NMFS' Southwest Fisheries Science Center has been used to estimate cetacean densities (Barlow *et al.,* 2009; Becker *et al.,* 2010, 2012a, b, c, 2014, 2016; Ferguson *et al.,* 2006a; 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.

Ideally, density data would be available for all species throughout the study area year-round, in order to best estimate the impacts of Navy activities on marine species. However, in many places, ship availability, lack of funding, inclement weather conditions, and high sea states prevent the completion of comprehensive year-round surveys. Even with surveys that are completed, poor conditions may result in lower sighting rates for species that would typically be sighted with greater frequency under favorable conditions. Lower sighting rates preclude having an acceptably low uncertainty in the density estimates. A high level of uncertainty, indicating a low level of confidence in the density estimate, is typical for species that are rare or difficult to sight. In areas where survey data are limited or non-existent, known or inferred associations between marine habitat features and the likely presence of specific species are sometimes used to predict densities in the absence of actual animal sightings. Consequently, there is no single source of density data for every area, species, and season because of the fiscal costs, resources, and effort involved in providing enough survey coverage to sufficiently estimate density.

To characterize marine species density for large oceanic regions, the Navy reviews, critically assesses, and prioritizes existing density estimates from multiple sources, requiring the development of a systematic method for selecting the most appropriate density estimate for each combination of species, area, and season. The selection and compilation of the best available marine species density data resulted in the Navy Marine Species Density Database (NMSDD). NMFS vetted all cetacean densities by the Navy prior to use in the Navy's acoustic analysis for the current MITT rulemaking process.

In the MITT Study Area there is a paucity of line-transect survey data, and little is known about the stock structure of the majority of marine mammal species in the region. The Navy conducted the first comprehensive marine mammal survey of waters off Guam and the Commonwealth of the Northern Mariana Islands in 2007, and data from this survey were used to derive line-transect abundance estimates for 12 cetacean species (Fulling *et al.,* 2011). There has not been a subsequent systematic survey of the MITT Study Area at this scale, so these data still provide the best available density estimates for this region.

In the absence of study-area-specific density data, line-transect estimates derived for Hawaiian waters were used to provide conservative density estimates for the MITT Study Area. For Phase II, these estimates were based on systematic surveys conducted by NMFS' Southwest Fisheries Science Center (SWFSC) within the Exclusive Economic Zone of the Hawaiian Islands in 2002 (Barlow, 2006). New survey data collected within the Exclusive Economic Zone of the Hawaiian Islands (2010) and Palmyra Atoll/Kingman Reef (2011–2012) allowed NMFS' Pacific Islands Fisheries Science Center (PIFSC) to update the line-transect density estimates that included new sea-state-specific estimates of trackline detection probability (Bradford *et al.,* 2017) and represent improvements to the estimates used for Phase II. In addition, an updated density estimate for minke whale was available for Phase III based on line-transect analyses of acoustic data collected from a towed hydrophone during the 2007 systematic survey (Norris *et al.,* 2017). Finally, a habitat model was developed for sperm whale based on acoustic data collected during the 2007 survey, and provided spatially explicit density predictions at a10 km × 10 km (100 square km) spatial resolution (Yack *et al.,* 2016).

To characterize the marine species density for large areas, including the MITT 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, used in the NMSDD, includes seasonal density values for every marine mammal species present within the MITT Study Area. This database is described in the technical report titled *U.S. Navy Marine Species Density Database Phase III for the Mariana Islands Training and Testing Study Area* (U.S. Department of the Navy, 2018), 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 MITT Study Area. Because this data is collected using different methods with varying amounts of accuracy and uncertainty, the Navy has developed a 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 list below 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 e*t 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; therefore, this model cannot be used for species with low numbers of sightings.

2. Stratified design-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.

The Navy describes some of the challenges of interpreting the results of the quantitative analysis summarized above and 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).''

NMFS coordinated with the Navy in the development of its take estimates and concurs that the Navy's approach for density appropriately utilizes the best available science. Later, in the *Preliminary Analysis and Negligible Impact Determination* section, we assess how the estimated take numbers compare to 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 2019 MITT DSEIS/OEIS considered all training and testing activities proposed to occur in the MITT Study Area that have the potential to result in the MMPA defined take of marine mammals. The Navy determined that the two stressors below 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 by harassment of marine mammals from the Navy's planned activities.

- Acoustics (sonar and other transducers);
- Explosives (explosive shock wave and sound, assumed to encompass the risk due to fragmentation).

The quantitative analysis process used for the 2019 MITT DSEIS/OEIS and the Navy's take 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* (U.S. Department of the Navy, 2018). 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 procedural mitigation is expected to reduce the risk for model-estimated PTS for exposures to sonars and for model-estimated mortality for exposures to explosives, based on species sightability, observation area, visibility, and the ability to exercise positive control over the sound source. Where the analysis indicates mitigation would effectively reduce risk, the model-estimated PTS are considered reduced to TTS and the model-estimated mortalities are considered reduced to injury. For a complete explanation of the process for assessing the effects of mitigation, see the Navy's rulemaking/LOA application and the technical report titled *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing* (U.S. Department of the Navy, 2018). The extent to which the mitigation areas reduce impacts on the affected species is addressed separately in the *Preliminary Analysis and Negligible Impact Determination* section.

The Navy assessed the effectiveness of its procedural 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 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 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 procedural mitigation.

Equation 1:

$$\text{Mitigation Effectiveness} = \text{Species Sightability} \times \text{Visibility} \times \text{Observation Area} \times \text{Positive Control}$$

Species Sightability is the ability to detect marine mammals and 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 the standard ''detection probability'' referred to as g(0) is most appropriate. 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* (U.S. Department of the Navy, 2018).

To quantify the number of marine mammals predicted to be sighted by Lookouts in the injury zone during implementation of procedural mitigation 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:

$$\text{Number of Animals Sighted by Lookouts} = \text{Mitigation Effectiveness} \times \text{Model-Estimated Impacts}$$

The marine mammals sighted by Lookouts in the injury zone during implementation of mitigation, as calculated by the equation above, would avoid being exposed to these higher level impacts. To quantify the number of marine mammals predicted to be sighted by Lookouts in the mortality zone during implementation of procedural mitigation 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 predicted to be sighted in the mortality zone by Lookouts during implementation of procedural mitigation, 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.

The NAEMO (animal movement) model overestimates the number of marine mammals that would be exposed to sound sources that could cause PTS because the model does not consider horizontal movement of animats, including avoidance of high intensity sound exposures. Therefore, the potential for animal avoidance is considered separately. At close ranges and high sound levels, avoidance of the area immediately around the sound source is one of the assumed behavioral responses for marine mammals. Animal avoidance refers to the movement out of the immediate injury zone for subsequent exposures, not wide-scale area avoidance. Various researchers have demonstrated that cetaceans can perceive the location and movement of a sound source (*e.g.,* vessel, seismic source, etc.) relative to their own location and react with responsive movement away from the source, often at distances of 1 km or more (Au & Perryman,1982; Jansen *et al.,* 2010; Richardson *et al.,* 1995; Tyack *et al.,* 2011; Watkins, 1986; Würsig *et al.,* 1998) A marine mammal's ability to avoid a sound source and reduce its cumulative sound energy exposure would reduce risk of both PTS and TTS. However, the quantitative analysis conservatively only considers the potential to reduce some instances of PTS by accounting for marine mammals swimming away to avoid repeated high-level sound exposures. All reductions in PTS impacts from likely avoidance behaviors are instead considered TTS impacts.

NMFS coordinated with the Navy in the development of this quantitative method to address the effects of procedural mitigation on acoustic and explosive exposures and takes, and NMFS independently reviewed and concurs with the Navy that it is appropriate to incorporate the quantitative assessment of mitigation 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* (U.S. Department of the Navy, 2018) and Chapter 6 (Take Estimates for Marine Mammals) and Chapter 11 (Mitigation Measures) of the Navy's rulemaking/LOA application.

As a general matter, NMFS does not prescribe the methods for estimating take for any applicant, but we review and ensure that applicants use the best available science, and methodologies that are logical and technically sound. Applicants may use different methods of calculating take (especially when using models) and still get to a result that is representative of the best available science and that allows for a rigorous and accurate evaluation of the effects on the affected populations. There are multiple pieces of the Navy take estimation methods—propagation models, animat movement models, and behavioral thresholds, for example. NMFS evaluates the acceptability of these pieces as they evolve and are used in different rules and impact analyses. Some of the pieces of the Navy's take estimation process have been used in Navy incidental take rules since 2009 and undergone multiple public comment processes, all of them have undergone extensive internal Navy review, and all of them have undergone comprehensive review by NMFS, which has sometimes resulted in modifications to methods or models.

The Navy uses rigorous review processes (verification, validation, and accreditation processes, peer and public review) to ensure the data and methodology it uses represent the best available science. For instance, the NAEMO model is the result of a NMFS-led Center for Independent Experts (CIE) review of the components used in earlier models. The acoustic propagation component of the NAEMO model (CASS/GRAB) is accredited by the Oceanographic and Atmospheric Master Library (OAML), and many of the environmental variables used in the NAEMO model come from approved OAML databases and are based on in-situ data collection. The animal density components of the NAEMO model are base products of the NMSDD, which includes animal density components that have been validated and reviewed by a variety of scientists from NMFS Science Centers and academic institutions. Several components of the model, for example the Duke University habitat-based density models, have been published in peer reviewed literature. Others like the Atlantic Marine Assessment Program for Protected Species, which was conducted by NMFS Science Centers, have undergone quality assurance and quality control (QA/QC) processes. Finally the NAEMO model simulation components underwent QA/QC review and validation for model parts such as the scenario builder, acoustic builder, scenario simulator, etc., conducted by qualified statisticians and modelers to ensure accuracy. Other models and methodologies have gone through similar review processes.

In summary, we believe the Navy's methods, including the method for incorporating mitigation and avoidance, are the most appropriate methods for predicting PTS, TTS, and behavioral disruption. But even with the consideration of mitigation and avoidance, given some of the more conservative components of the methodology (*e.g.,* the thresholds do not consider ear recovery between pulses), we would describe the application of these methods as identifying the maximum number of instances in which marine mammals would be reasonably expected to be taken through PTS, TTS, or behavioral disruption.

Summary of Requested Take From Training and Testing Activities

Based on the methods discussed in the previous sections and the Navy's model and quantitative assessment of mitigation, the Navy provided its take estimate and request for authorization of takes incidental to the use of acoustic and explosive sources for training and testing activities both annually (based on the maximum number of activities that could occur per 12-month period) and over the seven-year period covered by the Navy's rulemaking/LOA application. NMFS has reviewed the Navy's data, methodology, and analysis and determined that it is complete and accurate. NMFS agrees that the estimates for incidental takes by harassment from all sources requested for authorization are the maximum number of instances in which marine mammals are reasonably expected to be taken.

For training and testing activities, Table 30 summarizes the Navy's take estimate and request and the annual and maximum amount and type of Level A harassment and Level B harassment for the seven-year period that NMFS concurs is reasonably expected to occur by species. Note that take by Level B harassment includes both behavioral disruption and TTS. Tables 6.4–13 through 6.4–38 in Section 6 of the Navy's rulemaking/LOA application provide the comparative amounts of TTS and behavioral disruption for each species annually, noting that if a modeled marine mammal was ''taken'' through exposure to both TTS and behavioral disruption in the model, it was recorded as a TTS.

TABLE 30—ANNUAL AND SEVEN-YEAR TOTAL SPECIES-SPECIFIC TAKE ESTIMATES PROPOSED FOR AUTHORIZATION FROM ACOUSTIC AND EXPLOSIVE SOUND SOURCE EFFECTS FOR ALL TRAINING AND TESTING ACTIVITIES IN THE MITT STUDY AREA

Species	Annual		7-Year Total [1]	
	Level B	Level A	Level B	Level A
Mysticetes				
Blue whale *	24	0	169	0
Bryde's whale	298	0	2,078	0
Fin whale *	25	0	173	0
Humpback whale *	479	0	3,348	0
Minke whale	95	0	665	0
Omura's whale	29	0	199	0

TABLE 30—ANNUAL AND SEVEN-YEAR TOTAL SPECIES-SPECIFIC TAKE ESTIMATES PROPOSED FOR AUTHORIZATION FROM ACOUSTIC AND EXPLOSIVE SOUND SOURCE EFFECTS FOR ALL TRAINING AND TESTING ACTIVITIES IN THE MITT STUDY AREA—Continued

Species	Annual		7-Year Total [1]	
	Level B	Level A	Level B	Level A
Sei whale *	155	0	1,083	0
Odontocetes				
Blainville's beaked whale	1,718	0	12,033	0
Bottlenose dolphin	137	0	961	0
Cuvier's beaked whale	646	0	4,529	0
Dwarf sperm whale	8,499	50	59,459	341
False killer whale	762	0	5,331	0
Fraser's dolphin	13,278	1	92,931	8
Ginkgo-toothed beaked whale	3,726	0	26,088	0
Killer whale	44	0	309	0
Longman's beaked whale	6,066	0	42,487	0
Melon-headed whale	2,815	0	19,691	0
Pantropical spotted dolphin	14,896	1	104,242	7
Pygmy killer whale	104	0	726	0
Pygmy sperm whale	3,410	19	23,853	136
Risso's dolphin	3,170	0	22,179	0
Rough-toothed dolphin	197	0	1,379	0
Short-finned pilot whale	1,163	0	8,140	0
Sperm whale *	203	0	1,420	0
Spinner dolphin	1,414	1	9,896	4
Striped dolphin	4,007	0	28,038	0

*ESA-listed species within the MITT Study Area

[1] The 7-year totals may be less than the annual totals times seven, given that not all activities occur every year, some activities occur multiple times within a year, and some activities only occur a few times over the course of a 7-year period.

Proposed Mitigation Measures

Under section 101(a)(5)(A) of the MMPA, NMFS must set forth the permissible methods of taking pursuant to the activity, and other means of effecting the least practicable adverse impact on the species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of the species or stocks for subsistence uses (''least practicable adverse impact''). NMFS does not have a regulatory definition for least practicable adverse impact. The 2004 NDAA 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] satisfies] 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 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' 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 previous rules we have issued, such as the Navy's HSTT rule (83 FR 66846; December 27, 2018) and Atlantic Fleet Training and Testing rule (83 FR 57076; November 14, 2018).

Before NMFS can issue incidental take regulations under section 101(a)(5)(A) of the MMPA, it must make a finding that the total taking will have a ''negligible impact'' on the affected ''species or stocks'' of marine mammals. NMFS' and 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 [1] and, therefore are considered in evaluating population level impacts.

As stated in the preamble to the proposed rule for the MMPA 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).

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

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

The negligible impact and least practicable adverse impact standards in the MMPA both call for evaluation at the level of the ''species or stock.'' The MMPA does not define the term ''species.'' However, Merriam-Webster Dictionary defines ''species'' to include ''related organisms or *populations* potentially capable of interbreeding.'' See *www.merriam-webster.com/dictionary/species* (emphasis added). Section 3(11) of 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. 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 definitions involving groups of individuals that belong to the same species and that are located in a manner that allows for interbreeding. In fact under MMPA section 3(11), the term ''stock'' in the MMPA is interchangeable with the statutory term ''population stock.'' Both the negligible impact standard and the least practicable adverse impact standard call for evaluation at the level of the species or stock, and the terms ''species'' and ''stock'' both relate to populations; therefore, it is appropriate to view both the negligible impact standard and the least practicable adverse impact standard as having a population-level focus.

This interpretation is consistent with Congress' statutory findings for enacting the MMPA, nearly all of which are most applicable at the species or stock (*i.e.,* population) level. *See* MMPA section 2 (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, 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.[3] In *NRDC* v. *Pritzker,* the Court stated, ''[t]he statute is properly read to mean that even if population levels are not threatened *significantly,* still the agency must adopt mitigation measures aimed at protecting *marine mammals* to the greatest extent practicable in light of military readiness needs.'' *Pritzker* 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.

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

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

Implementation of Least Practicable Adverse Impact Standard

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

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

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

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

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' analysis focuses on measures that are designed to avoid or minimize impacts on individual marine mammals that are likely to increase the probability or severity of population-level effects.

While direct evidence of impacts to species or stocks from a specified activity is rarely available, and additional study is still needed to understand how specific disturbance events affect the fitness of individuals of certain species, there have been improvements in understanding the process by which disturbance effects are translated to the population. With recent scientific advancements (both marine mammal energetic research and the development of energetic frameworks), the relative likelihood or degree of impacts on species or stocks may often be inferred given a detailed understanding of the activity, the environment, and the affected species or stocks—and the best available science has been used here. This same information is used in the development of mitigation measures and helps us understand how mitigation measures contribute to lessening effects (or the risk thereof) to species or stocks. We also acknowledge that there is always the potential that new information, or a new recommendation could become available in the future and necessitate 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 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 its habitat, the greater the weight that measure is given when considered in combination with practicability to determine the appropriateness of the mitigation measure, and vice versa. We discuss consideration of these factors in greater detail below.

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

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

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

every individual taken, if that mitigation is unlikely to meaningfully contribute to the reduction of adverse impacts on the species or stock and its habitat, even when practicable for implementation by the applicant.

The status of the species or stock is also relevant in evaluating the appropriateness of potential mitigation measures in the context of least practicable adverse impact. The following are examples of factors that may (either alone, or in combination) result in greater emphasis on the importance of a mitigation measure in reducing impacts on a species or stock: the stock is known to be decreasing or status is unknown, but believed to be declining; the known annual mortality (from any source) is approaching or exceeding the potential biological removal (PBR) level (as defined in MMPA section 3(20)); the affected species or stock is a small, resident population; or the stock is involved in a UME or has other known vulnerabilities, such as recovering from an oil spill.

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

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

2. *Practicability.* Factors considered may include cost, impact on activities, and, in the case of a military readiness activity, will include personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity (see MMPA section 101(a)(5)(A)(ii)).

Assessment of Mitigation Measures for the MITT Study Area

NMFS has fully reviewed the specified activities and the mitigation measures included in the Navy's rulemaking/LOA application and the 2019 MITT DSEIS/OEIS to determine if the mitigation measures would result in the least practicable adverse impact on marine mammals and their habitat. 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 Navy's 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 I (*Geographic Mitigation Assessment*) of the 2019 MITT DSEIS/OEIS. The process described in Chapter 5 (*Mitigation*) and Appendix I (*Geographic Mitigation Assessment*) of the 2019 MITT DSEIS/OEIS robustly supported NMFS' independent evaluation of whether the mitigation measures would meet the least practicable adverse impact standard. The Navy would be required to implement the mitigation measures identified in this rule for the full seven years to avoid or reduce potential impacts from acoustic and explosive stressors.

As a general matter, where an applicant proposes measures that are likely to reduce impacts to marine mammals, the fact that they are included in the application indicates that the measures are practicable, and it is not necessary for NMFS to conduct a detailed analysis of the measures the applicant proposed (rather, they are simply included). We note that in their application, the Navy added three geographic mitigation measures that are new since the 2015–2020 MITT incidental take regulations: (1) Marpi Reef Geographic Mitigation Area—to avoid potential impacts from explosives on marine mammals and report hours of MFAS–MF1 within the mitigation area, which contains a seasonal presence of humpback whales (2) Chalan Kanoa Reef Geographic Mitigation Area—to avoid potential impacts from explosives on marine mammals and report hours of MFAS–MF1 within the mitigation area, which contains a seasonal presence of humpback whales and (3) Agat Bay Nearshore Geographic Mitigation Area—to avoid potential impacts from explosives and MFAS–MF1 on spinner dolphins. However, it is still necessary for NMFS to consider whether there are additional practicable measures that would meaningfully reduce the probability or severity of impacts that could affect reproductive success or survivorship. In the case of this rule, we worked with the Navy after it submitted its 2019 rulemaking/LOA application but prior to the development of this proposed rule and the Navy also agreed to expand the geographic mitigation areas for Marpi Reef and Chalan Kanoa Reef Geographic Mitigation Areas to more fully encompass the 400 m isobaths based on the available data indicating the presence of humpback whale mother/calf pairs (seasonal breeding area), which is expected to further avoid impacts from explosives that would be more likely to affect reproduction or survival of individuals and could adversely impact the species. The Navy also agreed to the addition of the Marpi Reef and Chalan Kanoa Reef Awareness Notification Message Areas, which allow Navy personnel to inform other personnel of the presence of humpback whales, enabling them to avoid potential impacts from vessel strikes and training and testing activities as these areas contain important seasonal breeding habitat for this species.

Overall the Navy has agreed to procedural mitigation measures that would 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 avoid mortality or serious injury, 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 would also implement multiple time/area restrictions that would reduce take of marine mammals in areas or at times where they are known to engage in important behaviors, such as 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. Summaries of the Navy's procedural mitigation measures and mitigation areas for the MITT Study Area are provided in Tables 31 and 32.

TABLE 31—SUMMARY OF PROCEDURAL MITIGATION

Stressor or activity	Mitigation zone sizes and other requirements
Environmental Awareness and Education	Afloat Environmental Compliance Training program for applicable personnel.
Active Sonar	Depending on sonar source: 1,000 yd power down, 500 yd power down, and 200 yd shut down.
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	2,000 yd (>21–500 lb net explosive weight), or 900 yd (0.6–20 lb net explosive weight).
Explosive Bombs	2,500 yd.
Sinking Exercises	2.5 NM.
Explosive Mine Countermeasure and Neutralization Activities.	600 yd.
Explosive Mine Neutralization Activities involving Navy Divers.	1,000 yd (charges using time delay fuses), or 500 yd (positive control charges).
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.

Notes: lb: Pounds; NM: Nautical miles; yd: Yards

TABLE 32—SUMMARY OF MITIGATION AREAS FOR MARINE MAMMALS

Geographic mitigation area name	Approximate area (km^2)	Summary of actions
Marpi Reef	*33*	*Humpback whales (seasonally) reporting MFAS–MF1; no explosives year-round.*
Chalan Kanoa Reef	*102*	*Humpback whales (seasonally) reporting MFAS–MF1; no explosives year-round.*
Agat Bay Nearshore	*5*	*No MFAS- MF1 sonar or explosive year-round.*
Marpi Reef and Chalan Kanoa Reef Notification Awareness Message Areas.	*33 and 102*	*Inform personnel to the presence of humpback whales enabling them to avoid potential impacts from vessel strikes and training and testing activities.*

The Navy assessed the practicability of the proposed measures 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 are supportable. As described in more detail below, NMFS has independently evaluated the measures the Navy proposed in the manner described earlier in this section (*i.e.,* in consideration of their ability to reduce adverse impacts on marine mammal species and their habitat and their practicability for implementation). We have determined that the measures will significantly and adequately reduce impacts on the affected marine mammal species and their habitat and, further, 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 their habitat.

The Navy also evaluated numerous measures in the 2019 MITT DSEIS/OEIS that were not included in the Navy's rulemaking/LOA application, and NMFS independently reviewed and 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 considered these additional potential mitigation measures in two groups. First, Chapter 5 (*Mitigation)* of the 2019 MITT DSEIS/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 non-governmental organizations or the public, through scoping or public comment on environmental compliance documents. Appendix I (*Geographic Mitigation Assessment*) of the 2019 MITT DSEIS/OEIS includes an in-depth analysis of time/area restrictions that have been recommended over time or previously implemented as a result of litigation (outside of the MITT Study Area). As described in Chapter 5 (*Mitigation*) of the 2019 MITT DSEIS/OEIS, commenters sometimes recommend that the Navy reduce its overall amount of training, reduce explosive use, modify its sound sources, completely replace live training with computer simulation, or include time of day restrictions. Many of these mitigation 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 described in Chapter 5 (*Mitigation*) of the 2019 MITT DSEIS/OEIS, the Navy needs to train and test in the conditions in which it fights—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. After independent review, NMFS finds Navy's judgment on the impacts of potential mitigation measures to personnel safety, practicality of implementation, and the effectiveness of training and testing within the MITT Study Area persuasive, and 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 (*Mitigation*) of the 2019 MITT DSEIS/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 measures would have significant direct negative effects on mission effectiveness and are considered impracticable (see Chapter 5 *Mitigation* of 2019 MITT DSEIS/OEIS). NMFS independently reviewed the Navy's evaluation and concurs with this assessment, which supports NMFS' preliminary findings that the impracticability of this additional mitigation would greatly outweigh any potential minor reduction in marine mammal impacts that might result; therefore, these additional mitigation measures are not warranted.

Last, Appendix I (*Geographic Mitigation Assessment*) of the 2019 MITT DSEIS/OEIS 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 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).

In its application, the Navy proposed several time/area mitigations that were not included in the 2015–2020 MITT regulations. For most of the areas that were considered in the 2019 MITT DSEIS/OEIS but not included in this rule, the Navy found that the mitigation was not warranted because the anticipated reduction of adverse impacts on marine mammal species and their habitat was not sufficient to offset the impracticability of implementation. In some cases potential benefits to marine mammals were non-existent, while in others the consequences on mission effectiveness were too great. NMFS has reviewed the Navy's analysis in Chapter 5 *Mitigation* and Appendix I *Geographic Mitigation Assessment* of the 2019 MITT DSEIS/OEIS, which considers the same factors that NMFS considers to satisfy the least practicable adverse impact standard, and concurs with the analysis and conclusions. Therefore, NMFS is not proposing to include any of the measures that the Navy ruled out in the 2019 MITT DSEIS/OEIS. Below are the mitigation measures that NMFS determined will ensure the least practicable adverse impact on all affected species and their habitat, including the specific considerations for military readiness activities. The following sections summarize the mitigation measures that would 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 would implement whenever and wherever an applicable training or testing activity takes place within the MITT 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 33) is designed to aid Lookouts and other applicable Navy personnel with their observation, environmental compliance, and reporting responsibilities. The remainder of the procedural mitigation measures (Tables 34 through 50) are organized by stressor type and activity category and includes acoustic stressors (*i.e.,* active sonar, 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 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 33—PROCEDURAL MITIGATION FOR ENVIRONMENTAL AWARENESS AND EDUCATION

Procedural Mitigation Description
Stressor or Activity:
All training and testing activities, as applicable
Mitigation Requirements:
Appropriate Navy personnel (including civilian 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.,* Endangered Species Act, Marine Mammal Protection Act) and the corresponding responsibilities that are relevant to Navy training and testing activities. 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 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.

TABLE 33—PROCEDURAL MITIGATION FOR ENVIRONMENTAL AWARENESS AND EDUCATION—Continued

Procedural Mitigation Description
—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.

Procedural Mitigation for Acoustic Stressors

Mitigation measures for acoustic stressors are provided in Tables 34 and 35.

Procedural Mitigation for Active Sonar

Procedural mitigation for active sonar is described in Table 34 below.

TABLE 34—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:
  - —1 Lookout: Platforms with space or manning restrictions while underway (at the forward part of a small boat or ship) and platforms using active sonar while moored or at anchor (including pierside).
  - —2 Lookouts: Platforms without space or manning restrictions while underway (at the forward part of the ship).
- Sources that are not hull-mounted:
  - —1 Lookout on the ship or aircraft conducting the activity.

Mitigation Requirements:
- Mitigation zones:
  - —During the activity at 1,000 yd, Navy personnel must power down 6dB, at 500 yd, Navy personnel must power down an additional 4 dB (for a total of 10 dB), and at 200 yd Navy personnel must shut down for low-frequency active sonar ≥200 dB and hull-mounted mid-frequency active sonar.
  - —200 yd shut down for low-frequency active sonar <200 dB, mid-frequency active sonar sources that are not hull-mounted, and high-frequency active sonar.
- Prior to the initial start of the activity (*e.g.,* when maneuvering on station):
  - —Observe the mitigation zone for marine mammals; if marine mammals are observed, relocate or delay the start of active sonar transmission.
- During the activity:
  - —Low-frequency active sonar at ≥200 dB or more, and hull-mounted mid-frequency active sonar: Navy personnel must observe the mitigation zone for marine mammals; power down active sonar transmission by 6 dB if marine mammals are observed within 1,000 yd of the sonar source; power down an additional 4 dB (for a total of 10 dB total) within 500 yd; cease transmission within 200 yd.
  - —Low-frequency active sonar <200 dB, mid-frequency active sonar sources that are not hull-mounted, and high-frequency active sonar: Navy personnel must observe the mitigation zone for marine mammals; cease active sonar transmission if observed within 200 yd of the sonar source.
- Commencement/recommencement conditions after a marine mammal sighting before or during the activity:
  - —Navy personnel will allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing or powering up active sonar transmission) until one of the following 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 ship 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 Weapons Firing Noise

Procedural mitigation for weapons firing noise is described in Table 35 below.

TABLE 35—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 Procedural Mitigation for Explosive Medium- and Large-Caliber Projectiles (Table 38) or Procedural Mitigation for Small-, Medium-, and Large-Caliber Non-Explosive Practice Munitions (Table 47). Mitigation Requirements: • Mitigation Zone: —30° on either side of the firing line out to 70 yd from the muzzle of the weapon being fired. • Prior to the initial start of the activity: —Observe the mitigation zone for marine mammals; if observed, relocate or delay the start of weapons firing. • During the activity: —Observe the mitigation zone for marine mammals; if marine mammals are observed, cease weapons firing. • Commencement/recommencement conditions after a marine mammal sighting before or during the activity: —Navy personnel will allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing weapons firing) until one of the following 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 36 through 44.

Procedural Mitigation for Explosive Sonobuoys

Procedural mitigation for explosive sonobuoys is described in Table 36 below.

TABLE 36—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 a small boat. • If additional platforms are participating in the activity, Navy personnel positioned in those assets (*e.g.,* safety observers, evaluators) will support observing the mitigation zone for applicable biological resources while performing their regular duties. Mitigation Requirements: • Mitigation Zone: —600 yd around an explosive sonobuoy. • Prior to the initial start of the activity (*e.g.,* during deployment of a sonobuoy pattern, which typically lasts 20–30 minutes): —Conduct passive acoustic monitoring for marine mammals; use information from detections to assist visual observations. —Visually observe the mitigation zone for marine mammals; if marine mammals are observed, relocate or delay the start of sonobuoy or source/receiver pair detonations. • During the activity: —Observe the mitigation zone for marine mammals; if marine mammals are observed, cease sonobuoy or source/receiver pair detonations. • Commencement/recommencement conditions after a marine mammal sighting before or during the activity: —Navy personnel will allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing detonations) until one of the following 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. • After completion of the activity (*e.g.,* prior to maneuvering off station): —When practical (*e.g.,* when platforms are not constrained by fuel restrictions or mission-essential follow-on commitments), observe the vicinity of where detonations occurred; if any injured or dead marine mammals are observed, follow established incident reporting procedures. —If additional platforms are supporting this activity (*e.g.,* providing range clearance), these assets will assist in the visual observation of the area where detonations occurred.

Procedural Mitigation for Explosive Torpedoes

Procedural mitigation for explosive torpedoes is described in Table 37 below.

TABLE 37—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. • If additional platforms are participating in the activity, Navy personnel positioned in those assets (*e.g.,* safety observers, evaluators) will support observing the mitigation zone for applicable biological resources while performing their regular duties. Mitigation Requirements: • Mitigation Zone: —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; use information from detections to assist visual observations. —Visually observe the mitigation zone for marine mammals; if marine mammals are observed, relocate or delay the start of firing. • During the activity: —Observe the mitigation zone for marine mammals; if marine mammals are observed, cease firing. • Commencement/recommencement conditions after a marine mammal sighting before or during the activity: —Navy personnel will allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing firing) until one of the following 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 (*e.g.,* prior to maneuvering off station): —When practical (*e.g.,* when platforms are not constrained by fuel restrictions or mission-essential follow-on commitments), observe the vicinity of where detonations occurred; if any injured or dead marine mammals are observed, follow established incident reporting procedures. —If additional platforms are supporting this activity (*e.g.,* providing range clearance), these assets will assist in the visual observation of the area where detonations occurred.

Procedural Mitigation for Medium- and Large-Caliber Projectiles

Procedural mitigation for medium- and large-caliber projectiles is described in Table 38 below.

TABLE 38—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. —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 (Table 35). • If additional platforms are participating in the activity, Navy personnel positioned in those assets (*e.g.,* safety observers, evaluators) will support observing the mitigation zone for applicable biological resources while performing their regular duties. Mitigation Requirements: • Mitigation zones: —200 yd around the intended impact location for air-to-surface activities using explosive medium-caliber projectiles. —600 yd around the intended impact location for surface-to-surface activities using explosive medium-caliber projectiles. —1,000 yd around the intended impact location for surface-to-surface activities using explosive large-caliber projectiles. • Prior to the initial start of the activity (*e.g.,* when maneuvering on station): —Observe the mitigation zone for marine mammals; if marine mammals are observed, relocate or delay the start of firing. • During the activity: —Observe the mitigation zone for marine mammals; if marine mammals are observed, cease firing. • Commencement/recommencement conditions after a marine mammal sighting before or during the activity:

TABLE 38—PROCEDURAL MITIGATION FOR EXPLOSIVE MEDIUM-CALIBER AND LARGE-CALIBER PROJECTILES—Continued

Procedural Mitigation Description
—Navy personnel will allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing firing) until one of the following 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. • After completion of the activity (*e.g.,* prior to maneuvering off station): —When practical (*e.g.,* when platforms are not constrained by fuel restrictions or mission-essential follow-on commitments), observe the vicinity of where detonations occurred; if any injured or dead marine mammals are observed, follow established incident reporting procedures. —If additional platforms are supporting this activity (*e.g.,* providing range clearance), these assets will assist in the visual observation of the area where detonations occurred.

Procedural Mitigation for Explosive Missiles and Rockets

Procedural mitigation for explosive missiles and rockets is described in Table 39 below.

TABLE 39—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. • If additional platforms are participating in the activity, Navy personnel positioned in those assets (*e.g.,* safety observers, evaluators) will support observing the mitigation zone for applicable biological resources while performing their regular duties. Mitigation Requirements: • Mitigation zones: —900 yd around the intended impact location for missiles or rockets with 0.6–20 lb net explosive weight. —2,000 yd around the intended impact location for missiles with 21–500 lb net explosive weight. • Prior to the initial start of the activity (*e.g.,* during a fly-over of the mitigation zone): —Observe the mitigation zone for marine mammals; if marine mammals are observed, relocate or delay the start of firing. • During the activity: —Observe the mitigation zone for marine mammals; if marine mammals are observed, cease firing. • Commencement/recommencement conditions after a marine mammal sighting before or during the activity: —Navy personnel will allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing firing) until one of the following 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 (*e.g.,* prior to maneuvering off station): —When practical (*e.g.,* when platforms are not constrained by fuel restrictions or mission-essential follow-on commitments), observe the vicinity of where detonations occurred; if any injured or dead marine mammals are observed, follow established incident reporting procedures. —If additional platforms are supporting this activity (*e.g.,* providing range clearance), these assets will assist in the visual observation of the area where detonations occurred.

Procedural Mitigation for Explosive Bombs

Procedural mitigation for explosive bombs is described in Table 40 below.

TABLE 40—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.

TABLE 40—PROCEDURAL MITIGATION FOR EXPLOSIVE BOMBS—Continued

Procedural Mitigation Description
• If additional platforms are participating in the activity, Navy personnel positioned in those assets (*e.g.,* safety observers, evaluators) will support observing the mitigation zone for applicable biological resources while performing their regular duties. Mitigation Requirements: • Mitigation zone: —2,500 yd around the intended target. • Prior to the initial start of the activity (*e.g.,* when arriving on station): —Observe the mitigation zone for marine mammals; if marine mammals are observed, relocate or delay the start of bomb deployment. • During the activity (*e.g.,* during target approach): —Observe the mitigation zone for marine mammals; if marine mammals are observed, cease bomb deployment. • Commencement/recommencement conditions after a marine mammal sighting before or during the activity: —Navy personnel will allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing bomb deployment) until one of the following 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. • After completion of the activity (*e.g.,* prior to maneuvering off station): —When practical (*e.g.,* when platforms are not constrained by fuel restrictions or mission-essential follow-on commitments), observe the vicinity of where detonations occurred; if any injured or dead marine mammals are observed, follow established incident reporting procedures. —If additional platforms are supporting this activity (*e.g.,* providing range clearance), these assets will assist in the visual observation of the area where detonations occurred.

Procedural Mitigation for Sinking Exercises

Procedural mitigation for sinking exercises is described in Table 41 below.

TABLE 41—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). • If additional platforms are participating in the activity, Navy personnel positioned in those assets (*e.g.,* safety observers, evaluators) will support observing the mitigation zone for applicable biological resources while performing their regular duties. Mitigation Requirements: • Mitigation Zone: —2.5 NM around the target ship hulk. • Prior to the initial start of the activity (90 min. prior to the first firing): —Conduct aerial observations of the mitigation zone for marine mammals; if marine mammals are observed, delay the start of firing. • During the activity: —Conduct passive acoustic monitoring for marine mammals; use information from detections to assist visual observations. —Visually observe the mitigation zone for marine mammals from the vessel; if marine mammals are observed, Navy personnel must cease firing. —Immediately after any planned or unplanned breaks in weapons firing of longer than 2 hours, observe the mitigation zone for marine mammals from the aircraft and vessel; if marine mammals are observed, Navy personnel must delay recommencement of firing. • Commencement/recommencement conditions after a marine mammal sighting before or during the activity: —Navy personnel will allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing firing) until one of the following 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. • After completion of the activity (for 2 hours after sinking the vessel or until sunset, whichever comes first): —Observe the vicinity of where detonations occurred; if any injured or dead marine mammals are observed, Navy personnel must follow established incident reporting procedures. —If additional platforms are supporting this activity (*e.g.,* providing range clearance), these assets will assist in the visual observation of the area where detonations occurred.

Procedural Mitigation for Explosive Mine Countermeasure and Neutralization Activities

Procedural mitigation for explosive mine countermeasure and neutralization activities is described in Table 42 below.

TABLE 42—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. • If additional platforms are participating in the activity, Navy personnel positioned in those assets (*e.g.,* safety observers, evaluators) will support observing the mitigation zone for applicable biological resources while performing their regular duties. Mitigation Requirements: • Mitigation Zone: —600 yd around the detonation site. • Prior to the initial 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 the mitigation zone for marine mammals; if marine mammals are observed, relocate or delay the start of detonations. • During the activity: —Observe the mitigation zone for marine mammals; if marine mammals are observed, cease detonations. • Commencement/recommencement conditions after a marine mammal sighting before or during the activity: —Navy personnel will allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing detonations) until one of the following 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 that have fuel constraints, or 30 min. when the activity involves aircraft that are not typically fuel constrained. • After completion of the activity (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 the vicinity of where detonations occurred; if any injured or dead marine mammals are observed, follow established incident reporting procedures. —If additional platforms are supporting this activity (*e.g.,* providing range clearance), these assets will assist in the visual observation of the area where detonations occurred.

Procedural Mitigation for Explosive Mine Neutralization Activities Involving Navy Divers

Procedural mitigation for explosive mine neutralization activities involving Navy divers is described in Table 43 below.

TABLE 43—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 Platforms: • 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. • All divers placing the charges on mines will support the Lookouts while performing their regular duties and will report applicable sightings to their supporting small boat or Range Safety Officer. • If additional platforms are participating in the activity, Navy personnel positioned in those assets (*e.g.,* safety observers, evaluators) will support observing the mitigation zone for applicable biological resources while performing their regular duties. Mitigation Requirements: • Mitigation Zones: —500 yd around the detonation site during activities under positive control. —1,000 yd around the detonation site during activities using time-delay fuses. • Prior to the initial 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 the mitigation zone for marine mammals; if marine mammals are observed, relocate or delay the start of detonations or fuse initiation. • During the activity: —Observe the mitigation zone for marine mammals; if marine mammals are observed, cease detonations or fuse initiation.

TABLE 43—PROCEDURAL MITIGATION FOR EXPLOSIVE MINE NEUTRALIZATION ACTIVITIES INVOLVING NAVY DIVERS—Continued

Procedural Mitigation Description
—To the maximum extent practical 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. —The Navy will not set time-delay firing devices to exceed 10 min. • Commencement/recommencement conditions after a marine mammal before or during the activity: —Navy personnel will allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing detonations) until one of the following 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 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 (for 30 min): —Observe the vicinity of where detonations occurred; if any injured or dead marine mammals are observed, follow established incident reporting procedures. —If additional platforms are supporting this activity (*e.g.,* providing range clearance), these assets will assist in the visual observation of the area where detonations occurred.

Procedural Mitigation for Maritime Security Operations—Anti-Swimmer Grenades

Procedural mitigation for maritime security operations—anti-swimmer grenades is described in Table 44 below.

TABLE 44—PROCEDURAL MITIGATION FOR MARITIME SECURITY OPERATIONS—ANTI-SWIMMER GRENADES

Procedural Mitigation Description
Stressor or Activity: • Maritime Security Operations—Anti-Swimmer Grenades. Number of Lookouts and Observation Platform: • 1 Lookout positioned on the small boat conducting the activity. • If additional platforms are participating in the activity, Navy personnel positioned in those assets (*e.g.,* safety observers, evaluators) will support observing the mitigation zone for applicable biological resources while performing their regular duties. Mitigation Requirements: • Mitigation zone: —200 yd around the intended detonation location. • Prior to the initial start of the activity (*e.g.,* when maneuvering on station): —Observe the mitigation zone for marine mammals; if marine mammals are observed, relocate or delay the start of detonations. • During the activity: —Observe the mitigation zone for marine mammals; if marine mammals are observed, cease detonations. • Commencement/recommencement conditions after a marine mammal sighting before or during the activity: —Navy personnel will allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing detonations) until one of the following 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. • After completion of the activity (*e.g.,* prior to maneuvering off station): —When practical (*e.g.,* when platforms are not constrained by fuel restrictions or mission-essential follow-on commitments), observe vicinity of where detonations occurred; if any injured or dead marine mammals are observed, follow established incident reporting procedures. —If additional platforms are supporting this activity (*e.g.,* providing range clearance), these assets will assist in the visual observation of the area where detonations occurred.

Procedural Mitigation for Physical Disturbance and Strike Stressors

Mitigation measures for physical disturbance and strike stressors are provided in Table 45 through Table 49.

Procedural Mitigation for Vessel Movement

Procedural mitigation for vessel movement is described in Table 45 below.

TABLE 45—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 impractical based on mission requirements (*e.g.,* during Amphibious Assault and Amphibious Raid exercises). Number of Lookouts and Observation Platform: • 1 Lookout on the vessel that is underway. Mitigation Requirements: • Mitigation Zones: —500 yd around whales. —200 yd around other marine mammals (except bow-riding dolphins). • During the activity: —When underway, observe the mitigation zone for marine mammals; if marine mammals are observed, maneuver to maintain distance. • Additional requirements: —If a marine mammal vessel strike occurs, the Navy will follow the established incident reporting procedures.

Procedural Mitigation for Towed In-Water Devices

Procedural mitigation for towed in-water devices is described in Table 46 below.

TABLE 46—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 a manned towing platform. Mitigation Requirements: • Mitigation Zones: —250 yd. around marine mammals. • During the activity (*i.e.,* when towing an in-water device): —Observe the mitigation zone for marine mammals; if marine mammals are 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 47 below.

TABLE 47—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 Procedural Mitigation for Weapons Firing Noise (Table 35). *Mitigation Requirements:* • Mitigation Zone: —200 yd around the intended impact location. • Prior to the initial start of the activity (*e.g.*, when maneuvering on station): —Observe the mitigation zone for marine mammals; if marine mammals are observed, relocate or delay the start of firing. • During the activity: —Observe the mitigation zone for marine mammals; if marine mammals are observed, cease firing. • Commencement/recommencement conditions after a marine mammal sighting before or during the activity:

TABLE 47—PROCEDURAL MITIGATION FOR SMALL-, MEDIUM-, AND LARGE-CALIBER NON-EXPLOSIVE PRACTICE MUNITIONS—Continued

Procedural Mitigation Description
—Navy personnel will allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing firing) until one of the following 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 48 below.

TABLE 48—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 Requirements:* • Mitigation Zone: —900 yd. around the intended impact location. • Prior to the initial start of the activity (*e.g.*, during a fly-over of the mitigation zone): —Observe the mitigation zone for marine mammals; if marine mammals are observed, relocate or delay the start of firing. • During the activity: —Observe the mitigation zone for marine mammals; if marine mammals are observed, cease firing. • Commencement/recommencement conditions after a marine mammal sighting prior to or during the activity: —Navy personnel will allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing firing) until one of the following 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 49 below.

TABLE 49—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 Requirements:* • Mitigation Zone: —1,000 yd around the intended target. • Prior to the start of the activity (*e.g.*, when arriving on station): —Observe the mitigation zone for marine mammals; if marine mammals are observed, relocate or delay start of bomb deployment or mine laying. • During the activity (*e.g.*, during approach of the target or intended minefield location): —Observe the mitigation zone for marine mammals; if marine mammals are observed, cease bomb deployment or mine laying. • Commencement/recommencement conditions after a marine mammal sighting prior to or during the activity:

TABLE 49—PROCEDURAL MITIGATION FOR NON-EXPLOSIVE BOMBS AND MINE SHAPES—Continued

Procedural Mitigation Description
—Navy personnel will allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing bomb deployment or mine laying) until one of the following 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 would implement mitigation measures within mitigation areas to avoid or minimize potential impacts on marine mammals. 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 I (*Geographic Mitigation Assessment*) of the 2019 MITT DSEIS/OEIS. The Navy took into account public comments received on the 2019 MITT DSEIS/OEIS, best available science, and the practicability of implementing additional mitigation measures and has enhanced its mitigation areas and mitigation measures, beyond the 2015–2020 regulations, to further reduce impacts to marine mammals.

NMFS also worked with the Navy after it submitted its 2019 rulemaking/LOA application but prior to the development of this proposed rule and the Navy also agreed to expand the geographic mitigation areas for Marpi Reef and Chalan Kanoa Reef Geographic Mitigation Areas to more fully encompass the 400 m isobaths based on the available data indicating the presence of humpback whale mother/calf pairs (seasonal breeding area), which is expected to further avoid impacts from explosives that would be more likely to affect reproduction or survival of individuals and could adversely impact the species. The Navy also agreed to the addition of the Marpi Reef and Chalan Kanoa Reef Awareness Notification Message Areas, which allow Navy personnel to inform other personnel of the presence of humpback whales, enabling them to avoid potential impacts from vessel strikes and training and testing activities as these areas contain important seasonal breeding habitat for this species.

Information on the mitigation measures that the Navy will implement within geographic mitigation areas is provided in Table 50 (see below). The mitigation applies year-round unless specified otherwise in the table.

NMFS conducted an independent analysis of the mitigation areas that the Navy proposed, which are described below. NMFS preliminarily concurs with the Navy's analysis, which indicates that the measures in these mitigation areas are both practicable and will reduce the likelihood or severity of adverse impacts to marine mammal species or their habitat in the manner described in the Navy's analysis and this rule. NMFS is heavily reliant on the Navy's description of operational practicability, since the Navy is best equipped to describe the degree to which a given mitigation measure affects personnel safety or mission effectiveness, and is practical to implement. The Navy considers the measures in this proposed rule to be practicable, and NMFS concurs. We further discuss the manner in which the Geographic Mitigation Areas in the proposed rule will reduce the likelihood or severity of adverse impacts to marine mammal species or their habitat in the *Preliminary Analysis and Negligible Impact Determination* section. Marpi Reef and Chalan Kanoa Reef Geographic Mitigation Areas (Both seasonal and year round):

The Navy would not use in-water explosives year-round. The Navy would also report the total hours of MF1 surface ship hull-mounted mid-frequency active sonar from December through April used in this area in its annual training and testing activity reports submitted to NMFS (Table 50).

Marpi Reef and Chalan Kanoa Reef Awareness Notification Message Areas (December–April):

The Navy would issue an annual seasonal awareness notification message to alert ships and aircraft operating in the area to the possible presence of large whales or increased concentrations of humpback whales between December and April. To maintain safety of navigation and to avoid interactions with large whales during transits, the Navy would instruct vessels to remain vigilant to the presence of large whales, that when concentrated seasonally, may become vulnerable to vessel strikes. Platforms would 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 (Table 50).

Agat Bay Nearshore Geographic Mitigation Area:

The Navy would not use in-water explosives year-round. The Navy also would not use MF1 ship hull-mounted mid-frequency active sonar year round (Table 50).

TABLE 50—GEOGRAPHIC MITIGATION AREAS FOR MARINE MAMMALS IN THE MITT STUDY AREA

Geographic Mitigation Area Description
Stressor or Activity: • MF1 Sonar. • Explosives.
Mitigation Area Requirements: • Marpi Reef: —Seasonal (December–April): The Navy will report the total hours of MF1 surface ship hull-mounted mid-frequency active sonar used in this area in its annual training and testing activity reports submitted to NMFS.

TABLE 50—GEOGRAPHIC MITIGATION AREAS FOR MARINE MAMMALS IN THE MITT STUDY AREA—Continued

Geographic Mitigation Area Description
—Year-round: Year-round prohibition on in-water explosives. Should national security present a requirement to use explosives that could potentially result in the take of marine mammals 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 (*e.g.*, explosives usage) in its annual activity reports submitted to NMFS.
• Chalan Kanoa Reef:
—Seasonal (December–April): The Navy will report the total hours of MF1 surface ship hull-mounted mid-frequency active sonar used in this area in its annual training and testing activity reports submitted to NMFS.
—Year-round: Year-round prohibition on in-water explosives. Should national security present a requirement to use explosives that could potentially result in the take of marine mammals 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 (*e.g.*, explosives usage) in its annual activity reports submitted to NMFS.
• Marpi Reef and Chalan Kanoa Reef Awareness Notification Message Areas:
—Seasonal (December–April): The Navy will issue an annual seasonal awareness notification message to alert ships and aircraft operating in the area to the possible presence of large whales or increased concentrations of humpback whales between December and April. 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 whales, that when concentrated seasonally, may become vulnerable to vessel strikes. Platforms 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.
• Agat Bay Nearshore:
—Year-round prohibition on use of MF1 ship hull-mounted mid-frequency active sonar and in-water explosives. Should national security present a requirement to use surface ship hull-mounted active sonar or explosives that could potentially result in the take of marine mammals 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 (*e.g.*, sonar hours or explosives usage) in its annual activity reports submitted to NMFS.

Humpback whales have been sighted in the MITT Study Area from January through March (U.S. Department of the Navy, 2005b; Uyeyama, 2014), and male humpback songs have been recorded from December through April (Hill et al., 2017a; Klinck et al., 2016; Munger et al., 2014; Norris et al., 2014; Oleson et al., 2015). Recent scientific research by NOAA Fisheries Pacific Island Fisheries Science Center (PIFSC) indicates the shallower water around Marpi Reef and Chalan Kanoa Reef are important habitat for humpback whale breeding and calving. With the presence of humpback whale newborn calves and competitive groups, researchers were able to confirm this new breeding location (NOAA, 2018). The Navy obtained all humpback whale sighting data in the Marianas from the PIFSC (2015–2019) to determine the extent of this geographic mitigation area. Humpback whales, including mother-calf pairs, have been seasonally present in the Marpi Reef Area in shallow waters (out to the 400 m isobaths) and the area may be of biological importance to humpback whales for biologically important life processes associated with reproduction (*e.g.,* breeding, birthing, and nursing) for part of the year.

Calves are considered more sensitive and susceptible to adverse impacts from Navy stressors than adults (especially given their lesser weight and the association between weight and explosive impacts), as well as being especially reliant upon mother-calf communication for protection and guidance. Both gestation and lactation increase energy demands for mothers. Breeding activities typically involve vocalizations and complex social interactions that can include violent interactions between males. Reducing exposure of humpback whales to explosive detonations in this area and time is expected to reduce the likelihood of impacts that could affect reproduction or survival, by minimizing impacts on calves during this sensitive life stage, avoiding the additional energetic costs to mothers of avoiding the area during explosive exercises, and minimizing the chances that important breeding behaviors are interrupted to the point that reproduction is inhibited or abandoned for the year, or otherwise interfered with. Since the Navy submitted its application, it has extended both the Marpi Reef and Chalan Kanoa Reef Mitigation Areas out to the 400 m isobath to account for animals transiting to and from the more critical < 200 m areas used by humpback whales for breeding behaviors (Figures 2 and 3 below). Additional data would be needed to determine which DPS the humpbacks are assigned to.

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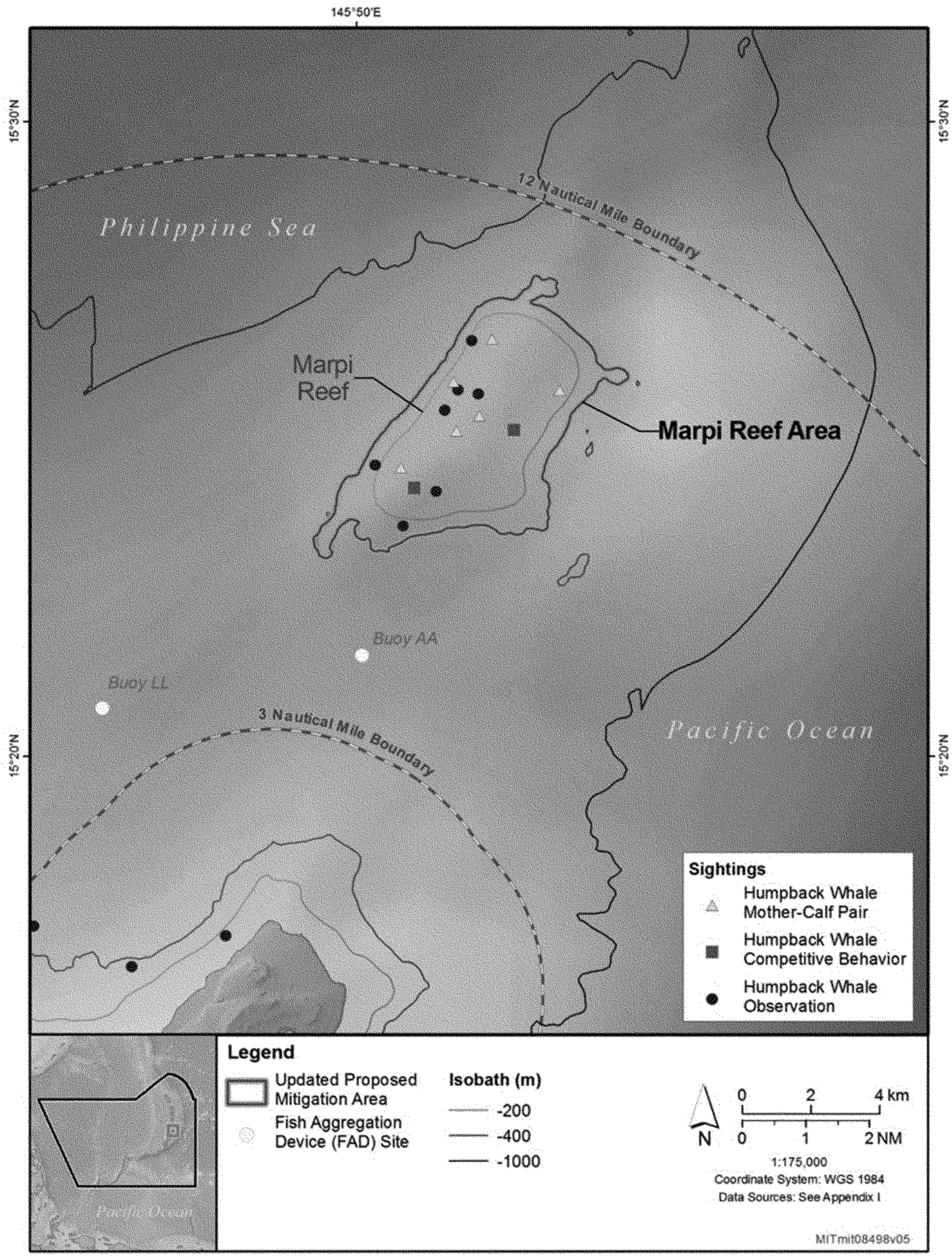

Figure 2. Proposed Marpi Reef Geographic Mitigation Area.

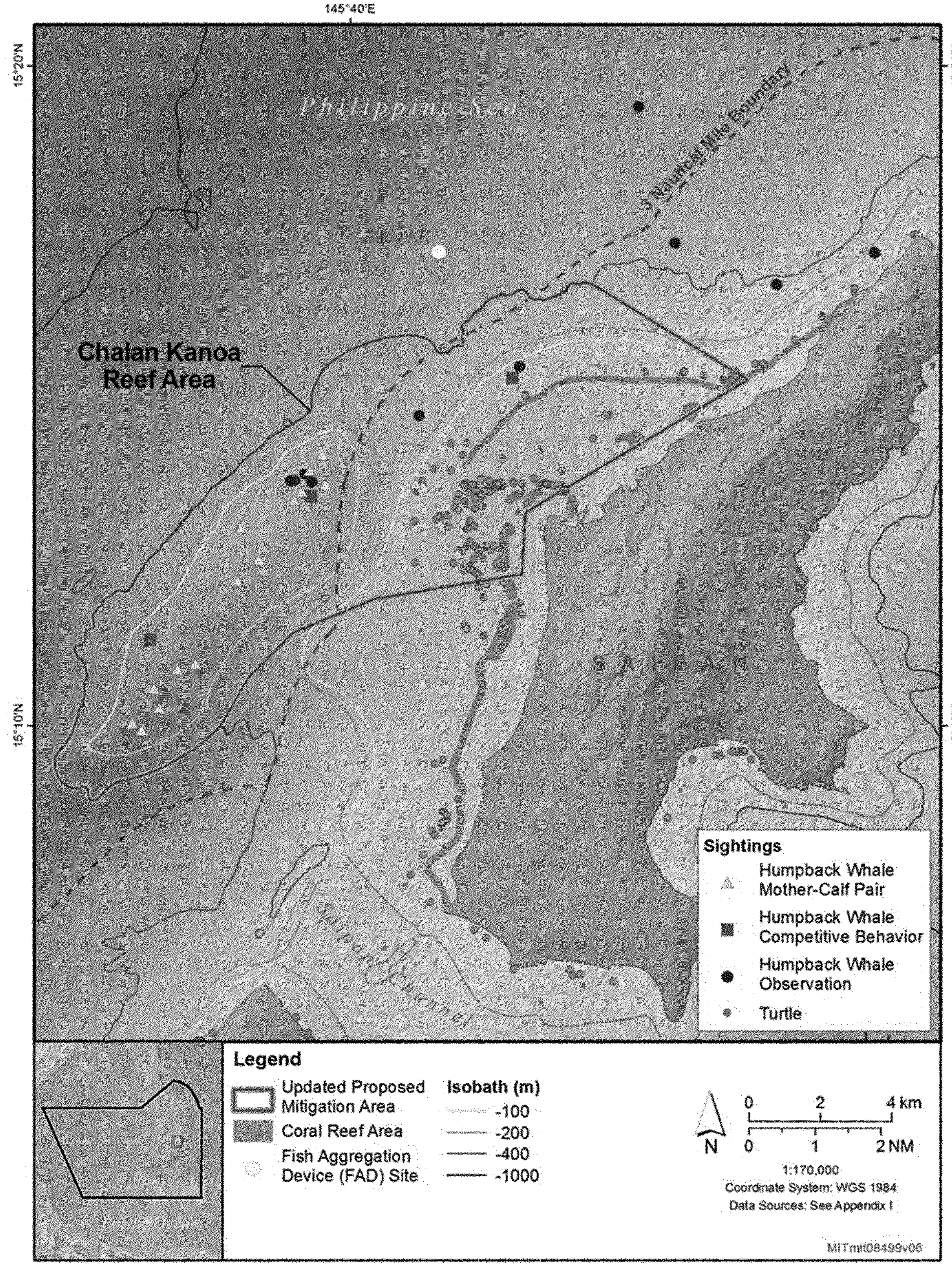

Figure 3. Proposed Chalan Kanoa Reef Geographic Mitigation Area.

Agat Bay Nearshore Geographic Mitigation Area (year-round):

The Navy would not use MF1 ship hull-mounted mid-frequency active sonar and in-water explosives year-round in the Agat Bay Nearshore Geographic Mitigation Area (Table 50 above). Spinner dolphins are known to congregate and rest in Agat Bay. Behavioral disruptions during resting periods can adversely impact health and energetic budgets by not allowing animals to get the needed rest and/or by creating the need to travel and expend additional energy to find other suitable resting areas. Avoiding sonar and explosives in this area reduces the likelihood of impacts that would affect reproduction and survival.

The boundaries of the proposed Agat Bay Nearshore Geographic Mitigation Area were defined by Navy scientists based on spinner dolphin sightings documented during small boat surveys from 2010 through 2014. Spinner dolphins have been the most frequently encountered species during small boat reconnaissance surveys conducted in the Mariana Islands since 2010. Consistent with more intensive studies completed for the species in the Hawaiian Islands, island-associated spinner dolphins are expected to occur in shallow water resting areas (about 50 meters (m) deep or less) in the morning and throughout the middle of the day, moving into deep waters offshore during the night to feed (Heenehan et al., 2016b; Heenehan et al., 2017a; Hill et al., 2010; Norris & Dohl, 1980).

The Agat Bay Nearshore Geographic Mitigation Area encompasses the shoreline between Tipalao, Dadi Beach, and Agat on the west coast of Guam, with a boundary across the bay enclosing an area of approximately 5 km^2 in relatively shallow waters (less than 100 m) (Figure 4).

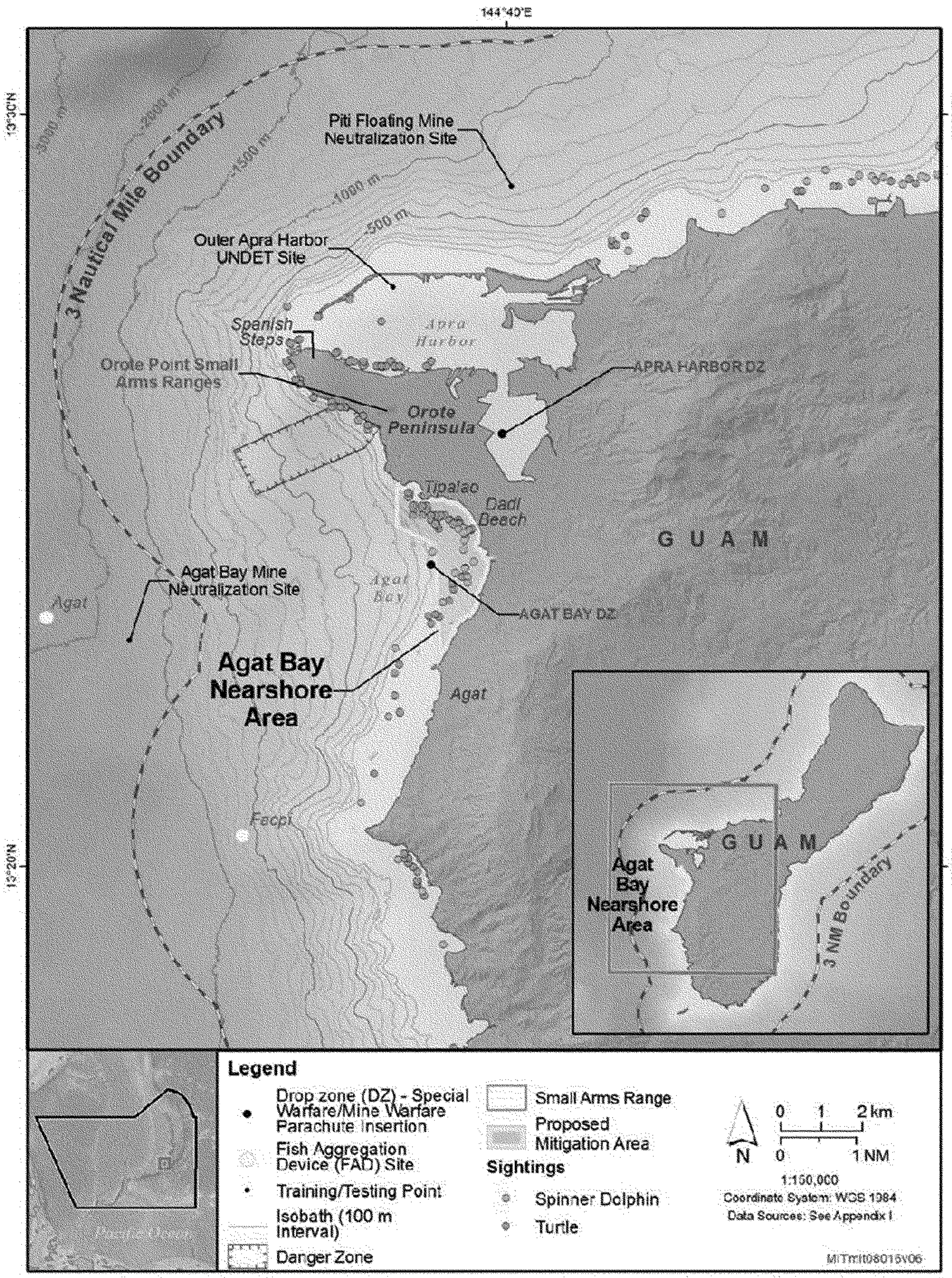

Figure 4: Proposed Agat Bay Nearshore Geographic Mitigation Area.

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Marpi Reef and Chalan Kanoa Reef Awareness Notification Message Areas (Seasonal):

The Navy would issue an annual seasonal awareness notification message to alert ships and aircraft operating in the area to the possible presence of large whales including increased concentrations of humpback whales between December and April. To maintain safety of navigation and to avoid interactions with large whales during transits, the Navy would instruct vessels to remain vigilant to the presence of large whales, that when concentrated seasonally, may become more vulnerable to vessel strikes. Platforms would 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. This restriction would further reduce any potential for vessel strike of humpback whales when they may be seasonally concentrated.

Mitigation Conclusions

NMFS has carefully evaluated the Navy's proposed mitigation measures—many of which were developed with NMFS' 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 2019 MITT DSEIS/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 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 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 these proposed mitigation measures are appropriate means of effecting the least practicable adverse impact on marine mammal species and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and considering specifically personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity. Additionally, an adaptive management component helps further ensure that mitigation is regularly assessed and provides a mechanism 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 Navy's activities and 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 and their habitat, NMFS will consider all public comments to help inform our final determination. Consequently, the proposed mitigation measures may be refined, modified, removed, or added to prior to the issuance of the final rule based on public comments received and, as appropriate, analysis of additional potential mitigation measures.

Proposed Monitoring

Section 101(a)(5)(A) of the MMPA states that in order to authorize incidental take 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 incidental take authorizations 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 MITT Study Area for over 20 years, it developed a formal marine species monitoring program in support of the MMPA and ESA authorizations in 2009. This robust program has resulted in hundreds of technical reports and publications on marine mammals that have informed Navy and NMFS analyses 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.navymarinespeciesmonitoring.us*) and the data on the Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations (OBIS–SEAMAP) (*http://seamap.env.duke.edu/*).

The Navy will continue collecting monitoring data to inform our understanding of the occurrence of marine mammals in the MITT Study Area; the likely exposure of marine mammals to stressors of concern in the MITT Study 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 seeks to leverage and build on existing research efforts whenever possible.

As agreed upon between the Navy and NMFS, the 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 activities.

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 our 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 our 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 our 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 our 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 our understanding of the effectiveness of mitigation and monitoring measures;

▪ A better understanding and record of the manner in which the Navy complies with the incidental take regulations and LOAs and the ESA 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

▪ Ensuring that adverse impact of activities remains at the least practicable level.

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 intermediate scientific objectives and a conceptual framework incorporating a progression of knowledge spanning occurrence, exposure, response, and consequence. 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 would leverage 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/*).

Past and Current Monitoring in the MITT Study Area

The monitoring program has undergone significant changes since the first rule was issued for the MITT Study Area in 2009, which highlights the monitoring program's 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.

Progress has also been made on the conceptual framework categories from the Scientific Advisory Group for Navy Marine Species Monitoring (U.S. Department of the Navy, 2011c), ranging from occurrence of animals, to their exposure, response, and population consequences. The Navy continues to manage the Atlantic and Pacific program as a whole, with monitoring in each range complex taking a slightly different but complementary approach. The Navy has continued to use the approach of layering multiple simultaneous components in many of the range complexes to leverage an increase in return of the progress toward answering scientific monitoring questions. This includes, in the Marianas for example, (a) glider deployment in offshore areas, (b) analysis of existing passive acoustic monitoring datasets, (c) small boat surveys using visual, biopsy and satellite tagging and (d) seasonal, humpback whale specific surveys.

Specific monitoring under the current regulations includes:

▪ Review of the available data and analyses in the MITT Study Area 2010 through February 2018 (2019a).

▪ The continuation of annual small vessel nearshore surveys, sightings, satellite tagging, biopsy and genetic analysis, photo-identification, and opportunistic acoustic recording off Guam, Saipan, Tinian, Rota, and Aguigan in partnership with NMFS (Hill *et al.,* 2015; Hill *et al.,* 2016b; Hill *et al.,* 2017a; Hill *et al.,* 2018, Hill *et al.,* 2019b). The satellite tagging and genetic analyses have resulted in the first information discovered on the movement patterns, habitat preference, and population structure of multiple odontocete species in the MITT Study Area.

▪ Since 2015, the addition of a series of small vessel surveys in the winter season dedicated to humpback whales has provided new information relating to the occurrence, calving behavior, and population identity of this species (Hill *et al.,* 2016a; Hill *et al.,* 2017b), which had not previously been sighted during the previous small vessel surveys in the summer or winter. This work has included sighting data, photo ID matches of individuals to other areas demonstrating migration as well as re-sights within the Marianas across different years, and the collection of biopsy samples for genetic analyses of populations.

▪ The continued deployment of passive acoustic monitoring devices and analysis of acoustic data obtained using bottom-moored acoustic recording devices deployed by NMFS has provided information on the presence and seasonal occurrence of mysticetes, as well as the occurrence of cryptic odontocetes typically found offshore, including beaked whales and Kogia *spp.* (Hill *et al.,* 2015; Hill *et al.,* 2016a; Hill *et al.,* 2016b; Hill *et al.,* 2017a; Munger *et al.,* 2015; Norris *et al.,* 2017; Oleson *et al.,* 2015; Yack *et al.,* 2016).

▪ Acoustic surveys using autonomous gliders were used to characterize the occurrence of odontocetes and mysticetes in abyssal offshore waters near Guam and CNMI, including species not seen in the small vessel visual survey series such as killer whales and Risso's dolphins. Analysis of collected data also provided new information on the seasonality of baleen whales, patterns of beaked whale occurrence and potential call variability, and identification of a new unknown marine mammal call (Klinck *et al.,* 2016b; Nieukirk *et al.,* 2016).

- Visual surveys were conducted from a shore-station at high elevation on the north shore of Guam to document the nearshore occurrence of marine mammals in waters where small vessel visual surveys are challenging due to regularly high sea states (Deakos and Richlen, 2015; Deakos *et al.,* 2016).
- Analysis of archive data that included marine mammal sightings during Guam Department of Agriculture Division of Aquatic and Wildlife Resources aerial surveys undertaken between 1963 and 2012 (Martin *et al.,* 2016).
- Analysis of archived acoustic towed-array data for an assessment of the abundance and density of minke whales (Norris *et al.,* 2017), abundance and density of sperm whales (Yack *et al.,* 2016), and the characterization of sei and humpback whale vocalizations (Norris *et al.,* 2014).

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 the Office of Naval Research programs have also resulted in significant contributions to information on hearing ranges and 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 the 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, and marine mammals observed within the mitigation zones when mitigations are implemented. These data are provided to NMFS in both classified and unclassified annual exercise reports, which would continue under this proposed rule.

NMFS has received multiple years' worth of annual exercise and monitoring reports addressing active sonar use and explosive detonations within the MITT 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 training and testing activities within the MITT Study Area. The Navy's annual exercise and monitoring reports may be viewed at: *https://www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-military-readiness-activities* and *http://www.navymarinespeciesmonitoring.us.*

Prior to Phase I monitoring, the information on marine mammal presence and occurrence in the MIRC was largely absent and limited to anecdotal information from incidental sightings and stranding events (U.S. Department of the Navy, 2005). In 2007, the Navy funded the Mariana Islands Sea Turtle and Cetacean Survey (MISTCS) (U.S. Department of the Navy, 2007) to proactively support the baseline data feeding the MIRC EIS (U.S. Department of the Navy, 2010b). The MISTCS research effort was the first systematic marine survey in these waters. This survey provided the first empirically-based density estimates for marine mammals (Fulling *et al.,* 2011). In cooperation with NMFS, the Phase I monitoring program beginning in 2010 was designed to address basic occurrence-level questions in the MIRC, whereas monitoring the impacts of Navy training such as exposure to mid-frequency active sonar was planned for other Navy range complexes where marine mammal occurrence was already better characterized.

This emphasis on studying occurrence continued through Phase I and II monitoring in the MIRC, and combined various complementary methodologies. Small vessel visual surveys collected occurrence information, and began building the first individual identification catalog for multiple species (Hill *et al.,* 2014). During these visual surveys, biopsies were collected for genetic analysis and satellite tags were also applied, resulting in a progressively improving picture of the habitat use and population structure of various species. Deep water passive acoustic deployments, including autonomous gliders with passive acoustic recorders, added complementary information on species groups such as baleen whales and beaked whales that were rarely sighted on the vessel surveys (Klinck *et al.,* 2015; Munger *et al.,* 2014; Munger *et al.,* 2015; Nieukirk *et al.,* 2016; Norris *et al.,* 2015). Other methodologies were also explored to fill other gaps in waters generally inaccessible to the small boat surveys including a shore-station to survey waters on the windward side of Guam (Deakos *et al.,* 2016). When available, platforms of opportunity on large vessels were utilized for visual survey and tagging (Oleson and Hill, 2010b).

At the close of Phase II monitoring, establishing the fundamentals of marine mammal occurrence in the MITT Study Area has now been largely completed. The various visual and acoustic platforms have encountered nearly all of the species that are expected to occur in the MITT Study Area. The photographic catalogs have progressively grown to the point that abundance analyses may be attempted for the most commonly-encountered species. Beyond occurrence, questions related to exposure to Navy training have been addressed, such as utilizing satellite tag telemetry to evaluate overlap of habitat use with underwater detonation training sites. Also during Phase II monitoring, a pilot study to investigate reports of humpback whales occasionally occurring off Saipan has proven fruitful, yielding confirmation of this species there, photographic matches of individuals to other waters in the Pacific Ocean, as well as genetics data that provide clues as to the population identity of these animals (Hill *et al.,* 2016a; Hill *et al.,* 2017b). Importantly, the compiled data were also used to inform proposals for new mitigation areas for this proposed rule and associated consultations.

The ongoing regional species-specific study questions and results from recent efforts are publicly available on the Navy's Monitoring Program website. With basic occurrence information now well-established, the primary goal of monitoring in the MITT Study Area under this proposed rule would be to close out these studies with final analyses. As the collection and analysis of basic occurrence data across Navy ranges (including MITT) is completed, the focus of monitoring across all Navy range complexes will progressively move toward addressing the important questions of exposure and response to mid-frequency active sonar and other Navy training, as well as the consequences of those exposures, where appropriate. The Navy's hydrophone-instrumented ranges have proven to be a powerful tool towards this end and because of the lack of such an instrumented range in the MITT Study Area, monitoring investments are expected to begin shifting to other Navy range complexes as the currently ongoing research efforts in the Mariana Islands are completed. Any future monitoring results for the MITT Study Area will continue to be published on the Navy's Monitoring Program website, as well as discussed during annual adaptive management meetings between NMFS and the Navy.

The Navy's marine species monitoring program typically supports several monitoring projects in the MITT Study Area at any given time. Additional details on the scientific objectives for each project can be found at *https://www.navymarinespeciesmonitoring.us/regions/pacific/current-projects/.* Projects can be either major multi-year efforts, or one to two-year special studies. The Navy's proposed monitoring projects going into 2020 include:

- Significant funding to NMFS' Pacific Island Fisheries Science Center (PIFSC) for spring-summer 2021 large vessel visual and acoustic survey through the Mariana Islands;
- Humpback whale visual survey at FDM;
- Continued coordination with NMFS PIFSC for small boat humpback whale surveys at other Mariana Islands (*e.g.,* Saipan);
- Analysis of previously deployed passive acoustic sensors for detection of humpback whale vocalizations at other islands (*e.g..* Pagan);
- Funding to support long-term (weeks-months) satellite tag tracking of humpback whales (field work likely in winter 2021); and
- Funding to researchers with PIFSC for detailed necropsy support for select stranded marine mammals in Hawaii and the Mariana Islands.

Adaptive Management

The proposed regulations governing the take of marine mammals incidental to Navy training and testing activities in the MITT Study Area 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 seven-year regulations.

The reporting requirements associated with this 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. 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 more effectively accomplishing the goals of the mitigation and monitoring and if the measures are practicable. If the modifications to the mitigation, monitoring, or reporting measures are substantial, NMFS would publish a notice of the planned LOA in the **Federal Register** and solicit public comment.

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. The results from monitoring reports and other studies may be viewed at *https://www.navymarinespeciesmonitoring.us.*

Proposed Reporting

In order to issue 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. Reports from individual monitoring events, results of analyses, publications, and periodic progress reports for specific monitoring projects will be posted to the Navy's Marine Species Monitoring web portal: *http://www.navymarinespeciesmonitoring.us.*

Currently, there are several different reporting requirements pursuant to the regulations. All of these reporting requirements would be continued under this proposed rule for the seven-year period.

Notification of Injured, Live Stranded or Dead Marine Mammals

The Navy would consult 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 is available for review at *https://www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-military-readiness-activities.*

Annual MITT Monitoring Report

The Navy would submit an annual report to NMFS of the MITT monitoring describing the implementation and results from the previous calendar year. Data collection methods would be standardized across Pacific Range Complexes including the MITT, HSTT, NWTT, and GOA Study Areas to allow for comparison in different geographic locations. The draft of the annual monitoring report would be submitted either three months after the end of 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 MITT Study Area associated with the Integrated Comprehensive Monitoring Program. Similar study questions would be treated together so that summaries can be provided for each topic area. The report need not include analyses and content that do not provide direct assessment of cumulative progress on the monitoring plan study questions. NMFS would submit comments on the draft monitoring report, if any, within three months of receipt. The report would be considered final after the Navy has addressed NMFS' comments, or three months after the submittal of the draft if NMFS does not have comments.

As an alternative, the Navy may submit a Pacific-Range Complex annual Monitoring Plan report to fulfill this requirement. Such a report describes progress of knowledge made with respect to monitoring study questions across multiple Navy ranges associated with the ICMP. Similar study questions would be treated together so that progress on each topic is 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 would 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.

Annual MITT Training Exercise Report and Testing Activity Reports

Each year, the Navy would submit one preliminary report (Quick Look Report) 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 would also a submit detailed report (MITT Annual Training Exercise Report and Testing Activity Report) to NMFS within three months after the one-year anniversary of the date of issuance of the LOA. The annual report would 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 annual report will also contain cumulative sonar and explosive use quantity from previous years' reports through the current year. Additionally, if there were any changes to the sound source allowance in the reporting year, or cumulatively, the report would include a discussion of why the change was made and include analysis to support how the change did or did not affect the analysis in the MITT EIS/OEIS and MMPA final rule. The annual report would also include the details regarding specific requirements associated with specific mitigation areas. The analysis in the detailed report would be based on the accumulation of data from the current year's report and data collected from previous annual reports. The final annual/close-out report at the conclusion of the authorization period (year seven) would also serve as the comprehensive close-out report and include both the final year annual use compared to annual authorization as well as a cumulative seven-year annual use compared to seven-year authorization. Information included in the annual reports may be used to inform future adaptive management of activities within the MITT Study Area.

The Annual MITT Training Exercise Report and Testing Activity Navy report (classified or unclassified versions) could 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 would include:

▪ *Marpi Reef and Chalan Kanoa Reef Geographic Mitigation Areas:* The Navy would report the total hours of operation of MF1 surface ship hull-mounted mid-frequency active sonar used in the Marpi Reef and Chalan Kanoa Reef Geographic Mitigation Areas from December to April; and

▪ *Major Training Exercises Notification*

The Navy would submit an electronic report to NMFS within fifteen calendar days after the completion of any major training exercise indicating: Location of the exercise; beginning and end dates of the exercise; and type of exercise.

Other Reporting and Coordination

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

▪ Annual marine species monitoring technical review meetings that also include researchers and the Marine Mammal Commission (currently, every two years a joint Pacific-Atlantic meeting is held); and

▪ Annual Adaptive Management meetings that also include the Marine Mammal Commission (recently modified to occur in conjunction with the annual monitoring technical review meeting).

Preliminary Analysis and Negligible Impact Determination

General 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 by Level A or Level B harassment (as presented in Table 30), 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' 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, and ambient noise levels).

In the *Estimated Take of Marine Mammals* section, we identified the subset of potential effects that would be expected to rise to the level of takes both annually and over the seven-year period covered by this proposed rule, and then identified the maximum number of harassment takes that are reasonably expected to occur 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 a disturbance, the health of impacted animals, the status of a species that incurs fitness-level impacts to individuals, etc.). For this proposed rule we evaluated the likely impacts of the enumerated maximum number of harassment takes that are proposed for authorization and reasonably expected to occur, in the context of the specific circumstances surrounding these predicted takes. Last, we collectively evaluated this information, as well as other more taxa-specific information and mitigation measure effectiveness, in group-specific assessments that support our negligible impact conclusions for each species.

As explained in the *Estimated Take of Marine Mammals* section, no take by serious injury or mortality is requested or anticipated to occur.

The Specified Activities reflect representative levels of training and testing activities. The *Description of the Specified Activity* section describes annual activities. 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 seven-year totals indicated in Table 30. We base our analysis and negligible impact determination on the maximum number of takes that would be reasonably expected to occur and are proposed to be authorized, 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 Table 30, 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, or groups of species where relevant similarities exist, to provide more specific information related to the anticipated effects on individuals 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. Organizing our analysis by grouping species that share common traits or that will respond similarly to effects of the Navy's activities and then providing species-specific information allows us to avoid duplication while assuring that we have analyzed the effects of the specified activities on each affected species.

The Navy's harassment take request is based on its model and quantitative assessment of mitigation, which NMFS reviewed and concurs, and appropriately predicts the maximum amount of harassment that is likely to occur. 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, independently reviewed, 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, 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 harassment 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 seven-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, which means that the number of individuals taken is smaller than the total estimated takes. 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 of where a larger portion of a species is being taken by Navy activities, 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 or more likely sequential. Where the number of instances of take is less than 100 percent of the abundance and there is no information to specifically suggest that a small subset of animals is being repeatedly taken over a high number of sequential days, the overall magnitude is generally considered relatively low, as it could on one extreme mean that every individual in the population will be taken on one day (a very minimal impact) or, more likely, that some are taken on one day annually, some are taken on a few not likely sequential days annually, and some are not taken at all.

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, for some individuals of some species 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, for some species 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 that individuals from most species would be taken over more than a few sequential days. This means that even where repeated takes of individuals are likely to occur, they are more likely to result from non-sequential exposures from different activities, and, even if sequential, individual animals are not predicted to be taken for more than several 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 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 a significant portion of the days of the year, much less that many of the days of disturbance would be sequential.

Physiological Stress Response

Some of the lower level physiological stress responses (*e.g.,* orientation or startle response, change in respiration, change in heart rate) discussed earlier would 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 harassment 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 that could affect reproduction or survival.

Behavioral Response

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' 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). The Navy 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 Level B behavioral harassment occur in a day. Take estimates alone do not 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 individual animals from sonar and other active sound sources during testing and training activities would be primarily from ASW events. It is important to note that 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 high-power 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 of Level B behavioral harassment (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. A less severe exposure of this nature 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. More severe effects could occur 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. Such effects 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. However, such severe behavioral effects are expected to occur infrequently.

To help assess this, for sonar (LFAS/MFAS/HFAS) used in the MITT Study Area, the Navy provided information estimating the percentage of animals that may be taken by Level B harassment under each behavioral response function that would occur within 6-dB increments (percentages discussed below in the *Group and Species-Specific Analyses* 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 other contextual factors (such as distance) are important also. The majority of Level B harassment 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. Because species belonging to taxa that share common characteristics are likely to respond and be affected in similar ways, these discussions are presented within each species group below in the *Group and Species-Specific Analyses* section. As noted previously in this proposed rule, behavioral response is likely highly variable between species, individuals within a species, and context of the exposure. 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 from Navy activities might necessarily be expected to potentially result in more severe responses (see the *Group and Species-Specific Analyses* section below for more detailed information). To fully understand the likely impacts of the predicted/proposed 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.,* whether they will occur for a longer duration over sequential days or the comparative sound level that will be received). 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

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 NM from shore) and in waters greater than 600 ft deep. Additionally 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.

That said, the MITT Study Area is different than other Navy ranges where there can be a significant number of Navy surface ships with hull-mounted sonar homeported. In the MITT Study Area, there are no homeported surface ships with hull-mounted sonars permanently assigned. There is no local unit level training in the MITT Study Area for homeported ships such as the case for other ranges. Instead, Navy activities from visiting and transiting vessels are much more episodic in the MITT Study Area. Therefore, there could be long gaps between activities (*i.e.,* weeks, months) in the MITT Study Area.

Durations of Navy activities utilizing tactical sonar sources and explosives vary and are fully described in Appendix A (*Training and Testing Activity Descriptions*) of the 2019 MITT DSEIS/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 include hull-mounted, towed, line array, 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 MITT Study Area generally last for only a few hours. Some ASW training and testing can generally last for 2–10 days, or a 10-day exercise is typical for an MTE-Large Integrated ASW (see Table 3). For these multi-day exercises there will typically 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 Table 3). 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, or demonstrate sustained behavioral responses. 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 MITT training activities. They are stationary and conducted in deep, open water where fewer marine mammals would typically be expected to be encountered. They also have shutdown procedures and rigorous monitoring, *i.e.,* during the activity, the Navy conducts passive acoustic monitoring and visually observes for marine mammals 90 min prior to the first firing, during the event, and 2 hrs after sinking the vessel. All of these factors make it unlikely that individuals would be exposed to the exercise for extended periods or on consecutive days.

Assessing the Number of Individuals Taken and the Likelihood of Repeated Takes

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 by Level B harassment and the number of times those individuals are 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 species (or stock if applicable). For example, if there are 100 harassment 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 and expected 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 of where larger portions of the species 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. It also provides a relative picture of the scale of impacts to each species.

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 could occur over the year with more resident species. Nonetheless, the episodic nature of Navy activities in the MITT Study Area would mean less frequent exposures as compared to some other ranges. While select offshore areas in the MITT Study Area are used more frequently for ASW and other activities, these are generally further offshore than where most island associated resident population would occur and instead would be in areas with more transitory species. In short, we expect that the total anticipated takes represent exposures of a smaller number of individuals of which some could 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 several sequential days (with a few possible exceptions discussed in the species-specific conclusions).

When calculating the proportion of a population affected by takes (*e.g.,* the number of takes divided by population abundance), which can also be helpful in estimating the number of days over which some individuals may be taken, it is important to choose an appropriate population estimate against which to make the comparison. The SARs, where available, 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). When the stock is known to range well outside of U.S. EEZ boundaries, population estimates based on surveys conducted only within the U.S. EEZ are known to be underestimates. For marine mammal populations in the MITT Study Area there have been no specific stocks assigned to those populations and there are no associated SARs. There is also no information on trends for any of these species. The information used to estimate take includes the best available survey abundance data to model density layers. Accordingly, in calculating the percentage of takes versus abundance for each species in order to assist in understanding both the percentage of the species affected, as well as how many days across a year individuals could be taken, we use the data most appropriate for the situation. The survey data used to calculate abundance in the MITT Study Area is described in the *Navy Marine Species Density Database Phase III for the Mariana Islands Training and Testing Study Area* (Navy 2018). 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. For example, 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.

Temporary Threshold Shift

NMFS and the Navy have estimated that all species of marine mammals may sustain some level of TTS from active sonar. As mentioned previously, in general, 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 51–55 indicates the number of takes by TTS that may be incurred by different species from exposure to active sonar 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, which are the highest power and most numerous sources and the ones that cause the most take, utilize the 1–10 kHz frequency band, which suggests that if TTS were to be induced by any of these MF sources it would be in a frequency band somewhere between approximately 2 and 20 kHz, which is in the range of communication calls for many odontocetes, but below the range of the echolocation signals used for foraging. 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), which could overlap with the range in which some odontocetes communicate or echolocate. 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 unlikely. There are fewer LF sources and the majority are used in the more readily mitigated testing environment, and TTS from LF sources would most likely occur below 2 kHz, which is in the range where many mysticetes communicate and also where other non-communication auditory cues are located (waves, snapping shrimp, fish prey). Also of note, the majority of sonar sources from which TTS may be incurred occupy a narrow frequency band, which means that the TTS incurred would also be across a narrower band (*i.e.,* not affecting the majority of an animal's hearing range). This frequency provides information about the cues to which a marine mammal may be temporarily less sensitive, but not the degree or duration of sensitivity loss. 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 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) and the relative motion between the sonar vessel and the animal. In the TTS studies discussed in the proposed rule, 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 seconds, incurring those levels of TTS is highly unlikely. Since any hull-mounted sonar, such as the SQS–53, engaged in anti-submarine warfare training would be moving at between 10 and 15 knots and nominally pinging every 50 seconds, the vessel will have traveled a minimum distance of approximately 257 m during the time between those pings. A scenario could occur where an animal does not leave the vicinity of a ship or travels a course parallel to the ship, however, the close distances required make TTS exposure unlikely. For a Navy vessel moving at a nominal 10 knots, it is unlikely a marine mammal could maintain speed parallel to the ship and receive adequate energy over successive pings to suffer TTS.

In short, given the anticipated duration and levels of sound exposure, we would not expect marine mammals to incur more than relatively low levels of TTS (*i.e.,* single digits of sensitivity loss). To add context to this degree of TTS, individual marine mammals may regularly experience variations of 6dB differences in hearing sensitivity across time (Finneran *et al.,* 2000, 2002; Schlundt *et al.,* 2000).

3. Duration of TTS (recovery time)—In the TTS laboratory studies (as discussed in the proposed rule), 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 MITT 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, especially given the fact that the higher power sources resulting in TTS are predominantly intermittent, which have been shown to result in shorter durations of TTS. Also, for the same reasons discussed in the *Preliminary Analysis and Negligible Impact Determination—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 would not usually span the entire frequency range of one vocalization type, much less span all types of vocalizations or other critical auditory cues.

Tables 51–55 indicates the number of incidental takes by TTS for each species that are likely to result from the Navy's activities. As a general point, the majority of these TTS takes are the result of exposure to hull-mounted MFAS (MF narrower band sources), with fewer from explosives (broad-band lower frequency sources), and even fewer from LF or HF sonar sources (narrower band). As described above, we expect the majority of these takes to be in the form of mild (single-digit), short-term (minutes to hours), narrower band (only affecting a portion of the animal's hearing range) TTS. This means that for one to several times per year, for several minutes to maybe a few hours (high end) each, a taken individual will have slightly diminished hearing sensitivity (slightly more than natural variation, but nowhere near total deafness). More often than not, such an exposure would occur within a narrower mid- to higher frequency band that may overlap part (but not all) of a communication, echolocation, or predator range, but sometimes across a lower or broader bandwidth. The significance of TTS is also related to the auditory cues that are germane within the time period that the animal incurs the TTS—for example, if an odontocete has TTS at echolocation frequencies, but incurs it at night when it is resting and not feeding, for example, it is not impactful. In short, the expected results of any one of these small number of mild TTS occurrences could be that (1) it does not overlap signals that are pertinent to that animal in the given time period, (2) it overlaps parts of signals that are important to the animal, but not in a manner that impairs interpretation, or (3) it reduces detectability of an important signal to a small degree for a short amount of time—in which case the animal may be aware and be able to compensate (but there may be slight energetic cost), or the animal may have some reduced opportunities (*e.g.,* to detect prey) or reduced capabilities to react with maximum effectiveness (*e.g.,* to detect a predator or navigate optimally). However, given the small number of times that any individual might incur TTS, the low degree of TTS and the short anticipated duration, and the low likelihood that one of these instances would occur in a time period in which the specific TTS overlapped the entirety of a critical signal, it is unlikely that TTS of the nature expected to result from the Navy activities would result in behavioral changes or other impacts that would impact any individual's (of any hearing sensitivity) reproduction or survival.

Auditory Masking or Communication Impairment

The ultimate potential impacts of masking on an individual (if it were to occur) are similar to those discussed for TTS, but an important difference is that masking only occurs during the time of the signal, versus TTS, which continues beyond the duration of the signal. Fundamentally, masking is referred to as a chronic effect because one of the key harmful components of masking is its duration—the fact that an animal would have reduced ability to hear or interpret critical cues becomes much more likely to cause a problem the longer it is occurring. Also inherent in the concept of masking is the fact that the potential for the effect is only present during the times that the animal and the source are in close enough proximity for the effect to occur (and further, this time period would need to coincide with a time that the animal was utilizing sounds at the masked frequency). As our analysis has indicated, because of the relative movement of vessels and the species involved in this rule, we do not expect the exposures with the potential for masking to be of a long duration. In addition, masking is fundamentally more of a concern at lower frequencies, because low frequency signals propagate significantly further than higher frequencies and because they are more likely to overlap both the narrower LF calls of mysticetes, as well as many non-communication cues such as fish and invertebrate prey, and geologic sounds that inform navigation. It should be noted that the Navy is only proposing authorization for a small subset of more narrow frequency LF sources and for less than 11 hours cumulatively annually. Masking is also more of a concern from continuous sources (versus intermittent sonar signals) where there is no quiet time between pulses within which auditory signals can be detected and interpreted. For these reasons, dense aggregations of, and long exposure to, continuous LF activity are much more of a concern for masking, whereas comparatively short-term exposure to the predominantly intermittent pulses of often narrow frequency range MFAS or HFAS, or explosions are not expected to result in a meaningful amount of masking. While the Navy occasionally uses LF and more continuous sources, it is not in the contemporaneous aggregate amounts that would accrue to a masking concern. Specifically, the nature of the activities and sound sources used by the Navy do not support the likelihood of a level of masking accruing that would have the potential to affect reproductive success or survival. Additional detail is provided below.

Standard hull-mounted MFAS typically pings every 50 seconds. Some 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) where 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 other sources, the pulse length is significantly shorter than hull-mounted active sonar, on the order of several microseconds to tens of milliseconds. Some of the vocalizations that many marine mammals make are less than one second long, so, for example with hull-mounted sonar, there would be a 1 in 50 chance (only if the source was in close enough proximity for the sound to exceed the signal that is being detected) that a single vocalization might be masked by a ping. However, when vocalizations (or series of vocalizations) are longer than one second, masking would not occur. Additionally, 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. A few systems operate with higher duty cycles or nearly continuously, but they typically use lower power, which means that an animal would have to be closer, or in the vicinity for a longer time, to be masked to the same degree as by a higher level source. Nevertheless, masking could occasionally occur at closer ranges to these high-duty cycle and continuous active sonar systems, but as described previously, it would be expected to be of a short duration when the source and animal are in close proximity. While data are lacking on behavioral responses of marine mammals to continuously active sonars, mysticete species are known to be able to habituate to novel and continuous sounds (Nowacek et al., 2004), suggesting that they are likely to have similar responses to high-duty cycle sonars. Furthermore, most of these systems are hull-mounted on surface ships and ships are moving at least 10 kn and it is unlikely that the ship and the marine mammal would continue to move in the same direction and it be subjected to the same exposure due to that movement. 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. HF signals (above 10 kHz) attenuate more rapidly in the water due to absorption than do lower frequency signals, thus producing only a very small zone of potential masking. If masking or communication impairment were to occur briefly, it would more likely be in the frequency range of MFAS (the more powerful source), which overlaps with some odontocete vocalizations (but few mysticete 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 single marine mammal species' vocalizations.

Other sources used in Navy training and testing that are not explicitly addressed above, 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.

In conclusion, masking is more likely to occur in the presence of broadband, relatively continuous noise sources such as from vessels, however, the duration of temporal and spatial overlap with any individual animal and the spatially separated sources that the Navy uses would not be expected to result in more than short-term, low impact masking that would not affect reproduction or survival.

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

Tables 51 through 55 indicate the number of individuals of each species for which Level A harassment in the form of PTS resulting from exposure to active sonar and/or explosives is estimated to occur. The number of individuals to potentially incur PTS annually (from sonar and explosives) for each species ranges from 0 to 50 (50 is for Dwarf sperm whale), but is more typically 0 or 1. No species have the potential to incur tissue damage from explosives.

Data suggest 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 has determined 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. 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. As discussed previously, the Navy utilized a post-modeling quantitative assessment to adjust the take estimates based on avoidance and the likely success of some portion of the mitigation measures. As is typical in predicting biological responses, it is challenging to predict exactly how avoidance and mitigation will affect the take of marine mammals, and therefore the Navy erred on the side of caution in choosing a method that would more likely still overestimate the take by PTS to some degree. Nonetheless, these modified Level A harassment take numbers represent the maximum number of instances in which marine mammals would be reasonably expected to incur PTS, and we have analyzed them accordingly.

If a marine mammal is able to approach a surface vessel within the distance necessary to incur PTS in spite of the mitigation measures, the likely speed of the vessel (nominally 10–15 kn) and relative motion of the vessel 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 discussed previously 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. The majority of any PTS incurred as a result of exposure to Navy sources would be expected to be in the 2–20 kHz range (resulting from the most powerful hull-mounted sonar) and could overlap a small portion of the communication frequency range of many odontocetes, whereas other marine mammal groups have communication calls at lower frequencies. Regardless of the frequency band though, the more important point in this case is that any PTS accrued as a result of exposure to Navy activities would be expected to be of a small amount (single digits). Permanent loss of some degree of hearing is a normal occurrence for older animals, and many animals are able to compensate for the shift, both in old age or at younger ages as the result of stressor exposure. While a small loss of hearing sensitivity may include some degree of energetic costs for compensating or may mean some small loss of opportunities or detection capabilities, at the expected scale it would be unlikely to impact behaviors, opportunities, or detection capabilities to a degree that would interfere with reproductive success or survival.

The Navy implements mitigation measures (described in the *Proposed Mitigation Measures* section) during explosive activities, including delaying detonations when a marine mammal is observed in the mitigation zone. Nearly all explosive events would occur during daylight hours to improve the sightability of marine mammals and thereby improve mitigation effectiveness. Observing for marine mammals during the explosive activities would include visual 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 NM for sinking exercise (see Tables 36–44). For all of these reasons, the proposed mitigation measures associated with explosives are expected to be effective in preventing tissue damage to any potentially affected species, and no species are anticipated to incur tissue damage during the period of the proposed rule.

Group and Species-Specific Analyses

The maximum amount and type of incidental take of marine mammals reasonably likely to occur from exposure to sonar and other active acoustic sources and explosions and therefore proposed to be authorized during the seven-year training and testing period are shown in Table 30. The vast majority of predicted exposures (greater than 99 percent) are expected to be Level B harassment (TTS and behavioral reactions) from acoustic and explosive sources during training and testing activities at relatively low received levels.

In the discussions below, the estimated Level B harassment takes represent instances of take, not the number of individuals taken (the much lower and less frequent Level A harassment takes are far more likely to be associated with separate individuals), and in some cases individuals may be taken more than one time. Below, we compare the total take numbers (including PTS, TTS, and behavioral disruption) for species to their associated abundance estimates to evaluate the magnitude of impacts across the species and to individuals. Specifically, when an abundance percentage comparison is below 100, it means that that percentage or less of the individuals will be affected (*i.e.,* some individuals will not be taken at all), that the average for those taken is one day per year, and that we would not expect any individuals to be taken more than a few times in a year.

To assist in understanding what this analysis means, we clarify a few issues related to estimated takes and the analysis here. An individual that incurs a PTS or TTS take may sometimes, for example, also be subject to behavioral disturbance at the same time. As described above in this section, the degree of PTS, and the degree and duration of TTS, expected to be incurred from the Navy's activities are not expected to impact marine mammals such that their reproduction or survival could be affected. Similarly, data do not suggest that a single instance in which an animal accrues PTS or TTS and is subject to behavioral disturbance would result in impacts to reproduction or survival. Alternately, we recognize that if an individual is subjected to behavioral disturbance repeatedly for a longer duration and on consecutive days, effects could accrue to the point that reproductive success is jeopardized, although those sorts of impacts are not expected to result from these activities. Accordingly, in analyzing the number of takes and the likelihood of repeated and sequential takes, we consider the total takes, not just the Level B harassment takes by behavioral disruption, so that individuals potentially exposed to both threshold shift and behavioral disruption are appropriately considered. The number of Level A harassment takes by PTS are so low (and zero in most cases) compared to abundance numbers that it is considered highly unlikely that any individual would be taken at those levels more than once.

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 that 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) and scale (*i.e.,* multiple sonar platforms) of the MTEs. On the less severe end, exposure to comparatively lower levels of sound at a detectably greater distance from the animal, for a few or several minutes, could result in a behavioral response such as avoiding an area that an animal would otherwise have moved through or fed in, or breaking off one or a few feeding bouts. More severe behavioral effects could occur when an animal gets close enough to the source to receive a comparatively higher level of sound, is exposed continuously to one source for a longer time, or is exposed intermittently to different sources throughout a day. Such effects 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. However, such severe behavioral effects are expected to occur infrequently.

Occasional, milder 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 severe responses, if they are not expected to be repeated over sequential days, impacts to individual fitness are not anticipated. Nearly all studies and experts agree that infrequent exposures of a single day or less are unlikely to impact an individual's overall energy budget (Farmer *et al.,* 2018; Harris e*t al.,* 2017; King *et al.,* 2015; NAS 2017; New *et al.,* 2014; Southall *et al.,* 2007; Villegas-Amtmann *et al.,* 2015).

The analyses below in some cases address species collectively if they occupy the same functional hearing group (*i.e.,* low, mid, and high-frequency cetaceans), share similar life history strategies, and/or are known to behaviorally respond similarly to acoustic stressors. Because some of these groups or species share characteristics that inform the impact analysis similarly, it would be duplicative to repeat the same analysis for each species. In addition, similar species typically have the same hearing capabilities and behaviorally respond in the same manner.

Thus, our analysis below considers the effects of the Navy's activities on each affected species even where discussion is organized by functional hearing group and/or information is evaluated at the group level. Where there are meaningful differences between a species that would further differentiate the analysis, they are either described within the section or the discussion for those species is included as a separate subsection. Specifically below, we first give broad descriptions of the mysticete and odontocete groups and then differentiate into further groups and species as appropriate.

Mysticetes

This section builds on the broader discussion above and brings together the discussion of the different types and amounts of take that different species will incur, the applicable mitigation for species, and the status of the species to support the negligible impact determinations. We have described (above in this section) the unlikelihood of any masking having effects that would impact the reproduction or survival of any of the individual marine mammals affected by the Navy's activities. For mysticetes, there is no predicted PTS from sonar or explosives and no predicted tissue damage from explosives for any species. Much of the discussion below focuses on the behavioral effects and the mitigation measures that reduce the probability or severity of effects. Because there are species-specific factors in relation to the status of the species, at the end of the section we break out our findings on a species-specific basis.

In Table 51 below for mysticetes, we indicate for each species the Level A and Level B harassment numbers, and a number indicating the instances of total take as a percentage of abundance in the MITT Study Area alone, as well as the MITT Study Area plus the transit corridor, which was calculated separately. While the density used to calculate take is the same for these two areas, the takes were calculated separately for the two areas for all species in this proposed rule, not just mysticetes, because the activity levels are higher in the MITT Study Area and it is helpful to understand the comparative impacts in the two areas.

TABLE 51—ANNUAL ESTIMATED TAKES BY LEVEL B HARASSMENT AND LEVEL A HARASSMENT FOR MYSTICETES AND NUMBER INDICATING THE INSTANCES OF TOTAL TAKE AS A PERCENTAGE OF SPECIES ABUNDANCE

Species	Instances of indicated types of incidental take (not all takes represent separate individuals, especially for disturbance)					Abundance		Instances of total take as percentage of abundance	
	Level B harassment		Level A harassment	Total takes		MITT study area	MITT study area + transit corridor	MITT study area	MITT study area + transit corridor
	Behavioral disturbance	TTS	PTS	MITT study area	MITT study area + transit corridor				
Blue whale	4	20	0	24	24	179	200	13	12
Bryde's whale	40	258	0	296	297	1,470	1,595	20	19
Fin whale	5	20	0	25	25	215	240	12	10
Humpback whale	57	422	0	476	479	3,190	3,563	15	13
Minke whale	10	85	0	95	95	538	601	18	16
Omura's whale	4	25	0	28	28	143	160	20	18
Sei whale	19	136	0	154	155	1,040	1,094	15	14

Note: Abundance was calculated using the following formulas: Density from the Technical Report in animals/km² × spatial extent of the MITT Study Area transit corridor = Abundance in the transit corridor and Density from the Technical Report in animals/km² × spatial extent of the MITT Study Area = Abundance in the MITT Study. In addition, the total annual takes described here may be off by a digit due to rounding. This occurred here as the Level B harassment takes are broken down further into Behavioral Disturbance and TTS compared to the Level B harassment takes presented as one number in the *Estimated Take of Marine Mammals* section.

The majority of takes by harassment of mysticetes in the MITT Study Area are caused by sources from the MF1 active sonar bin (which includes hull-mounted sonar) because they are high level, narrowband sources in the 1–10 kHz range, which intersect what is estimated to be the most sensitive area of hearing for mysticetes. They also are used in a large portion of exercises (see Table 1.5–1 in the Navy's application). Most of the takes (66 percent) from the MF1 bin in the MITT Study Area would result from received levels between 154 and 172 dB SPL, while another 33 percent would result from exposure between 172 and 178 dB SPL. For the remaining active sonar bin types, the percentages are as follows: LF4 = 97 percent between 124 and 136 dB SPL, MF4 = 99 percent between 136 and 154 dB SPL, MF5 = 98 percent between 118 and 142 dB SPL, and HF4 = 98 percent between 100 and 148 dB SPL. These values may be derived from the information in Tables 6.4–8 through 6.4–12 in the Navy's rulemaking/LOA application (though they were provided directly to NMFS upon request). No blue whales or fin whales will be taken by Level B harassment or PTS as a result of exposure to explosives. For other mysticetes, exposure to explosives will result in small numbers of take: 1–6 Level B behavioral harassment takes per species, 0–3 TTS takes per species (0 for sei whales), and 0 PTS takes.

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 feeding or breeding grounds. Behavioral reactions may include alerting, breaking off feeding dives and surfacing, diving or swimming away, or no response at all (DOD, 2017; Nowacek, 2007; Richardson, 1995; Southall *et al.,* 2007). Overall, mysticetes have been observed to be more reactive to acoustic disturbance when a noise source is located directly on their migration route. Mysticetes disturbed while migrating could pause their migration or route around the disturbance, while males en route to breeding grounds have been shown to be less responsive to disturbances. Although some may pause temporarily, they will resume migration shortly after the exposure ends. 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. Alternately, adult females with calves may be more responsive to stressors. As noted in the *Potential Effects of Specified Activities on Marine Mammals and Their Habitat* section, 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 than when traveling. However, Goldbogen *et al.* (2013) indicated some horizontal displacement of deep foraging blue whales in response to simulated MFA sonar. Most Level B behavioral harassment of mysticetes is likely to be short-term and of low to sometimes moderate severity, with no anticipated effect on reproduction or survival from Level B harassment.

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 do not typically use the same training locations day-after-day during multi-day activities, except periodically in instrumented ranges. Therefore, displaced animals could return quickly after the MTE finishes. Due to the limited number and geographic scope of MTEs, it is unlikely that most mysticetes would encounter an MTE more than once per year and additionally, total hull-mounted sonar hours would be limited in several areas that are important to mysticetes (described below). In the ocean, the use of Navy sonar and other active acoustic sources is transient and is unlikely to expose the same population of animals repeatedly over a short period of time, especially given the broader-scale movements of mysticetes.

The implementation of procedural mitigation and the sightability of mysticetes (due to their large size) further reduces the potential for a significant behavioral reaction or a threshold shift to occur (*i.e.,* shutdowns are expected to be successfully implemented), which is reflected in the amount and type of incidental take that is anticipated to occur and proposed to be authorized.

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 the vast majority of threshold shifts caused by Navy sonar sources will typically occur in the range of 2–20 kHz (from the 1–10 kHz MF1 bin, though in a specific narrow band within this range as the sources are narrowband), 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. Additionally, many of the other critical sounds that serve as cues for navigation and prey (*e.g.,* waves, fish, invertebrates) occur below a few kHz, which means that detection of these signals will not be inhibited by most threshold shift either. 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 reproduction or survival rates of mysticetes from exposure to sonar and other active acoustic sources.

All the species discussed in this section would benefit from the procedural mitigation measures described earlier in the *Proposed Mitigation Measures* section. In addition, the Navy would limit activities and employ other measures in mitigation areas that would avoid or reduce impacts to mysticetes. The Navy would implement time/area mitigation for explosives for humpback whales in the Marpi and Chalan Kanoa Reef Geographic Mitigation Areas as by prohibiting explosives year-round. The Navy would also implement the Marpi and Chalan Kona Reef Awareness Notification Message Areas that would avoid interactions with large whales that may be vulnerable to vessel strikes. This is especially important for humpback whales that are concentrated in these areas for breeding and calving.

Below we compile and summarize the information that supports our preliminary determination that the Navy's activities would not adversely affect any species through effects on annual rates of recruitment or survival for any of the affected mysticete species.

Humpback whale— Effective as of October 11, 2016, NMFS changed the status of all humpback whales from an endangered species to a specific status for each of the 14 identified distinct population segments (DPSs) (81 FR 62259). The humpback whales in the MITT Study Area are indirectly addressed in the Alaska SAR, given that the historic range of humpbacks in the ''Asia wintering area'' includes the Mariana Islands. The observed presence of humpback whales in the Mariana Islands (Hill et al., 2016a; Hill et al., 2017a; Hill et al., 2018; Klinck et al., 2016a; Munger et al., 2014; NMFS, 2018; Oleson et al., 2015; Uyeyama, 2014) are consistent with the MITT Study Area as a plausible migratory destination for humpback whales from Alaska (Muto et al., 2017a). It is likely that humpback whales in the Mariana Islands are part of the endangered Western North Pacific DPS (WNP DPS) based on the best available science (Bettridge et al., 2015; Calambokidis et al., 2008; Calambokidis et al., 2010; Carretta et al., 2017b; Hill et al., 2017b; Muto et al., 2017a; NMFS, 2016a; NOAA, 2015b; Wade et al., 2016) although the breeding range of the WNP DPS is not fully resolved. Individual photo-identification data for whales sampled off Saipan within the Mariana Archipelago in February–March 2015 to 2018, suggest that these whales belong to the WNP DPS (Hill et al., in review). Specifically, comparisons with existing WNP humpback whale photo-identification catalogs showed that 11 of 41 (27 percent) whales within the Mariana Archipelago humpback whale catalog were previously sighted in WNP breeding areas (Japan and Philippines) and/or in a WNP feeding area off Russia (Hill et al., in review). No ESA designated critical habitat has been proposed for the WNP DPS in the MITT Study Area, although critical habitat has been proposed in Alaska (84 FR 54534; October 9, 2019). There are no designated biologically important areas; however, it is known that the areas of Marpi and Chalan Kanoa Reefs (out to the 400 m isobath) are being specifically used by mother/calf pairs of humpback whales (Hill et al., 2016, 2017, 2018, *in-press*). Currently, no other areas have been identified for mother/calf pairs of humpback whales in the Mariana Islands.

The shallower water (less than 400 m) surrounding the Chalan Kanoa Reef and Marpi Reef Geographic Mitigation Areas have not been a high-use area for Navy MTEs and ASW training events as the area is considered generally unsuitable for training needs. These areas encompass water depths less than 400 m, with significant parts of the mitigation areas less than 200 m. The distance between 400 and 200 m isobaths is very small (between 0.5 and 2 nm). Most humpback whale sightings in or near the mitigation areas were within the 200 m isobath. The Navy typically conducts ASW that would also include the use of surface ship hull-mounted sonar such as MF1 in water depths greater than 200 m. Small scale and unit level ASW training is not conducted within 3 nm of land (*e.g.,* Small Joint Coordinated ASW exercise, Tracking Exercise-surface ship). MTEs almost always use established range subareas far offshore and well outside of 3 nm of land. Close to half of the Chalan Kanoa Reef Geographic Mitigation Area is 3 nm from land making this area less suitable to current Navy ASW training needs. In addition, portions of the Chalan Kanoa Reef area have established anchorages and presence of anchored vessels is not conducive for ASW training with MF1 MFAS. Similarly, water depths less than 200 m at Marpi Reef are also typically unsuited for current ASW training needs, especially for group events. As part of proposed mitigation, the Navy would not use explosives in these two Geographic Mitigation Areas. Reducing exposure of humpback whales to explosive detonations in these areas and at this time is expected to reduce the likelihood of impacts that could affect reproduction or survival, by minimizing impacts on calves during this sensitive life stage, avoiding the additional energetic costs to mothers of avoiding the area during explosive exercises, and minimizing the chances that important breeding behaviors are interrupted to the point that reproduction is inhibited or abandoned for the year, or otherwise interfered with.

Regarding the magnitude of Level B harassment takes (TTS and behavioral disruption), the number of estimated total instances of take compared to the abundance (measured against both the MITT Study Area abundance and the MITT Study Area plus the transit corridor combined) is 15 and 13 percent, respectively (Table 51). Regarding the severity of those individual takes by Level B behavioral harassment, we have explained that the duration of any exposure is expected to be between minutes and hours (*i.e.,* relatively short) and the received sound levels largely below 172 dB with a portion up to 178 dB (*i.e.,* of a moderate or lower level, less likely to evoke a severe response). Regarding the severity of TTS takes, they are expected to be low-level, of short duration, and mostly not in a frequency band that would be expected to interfere with communication or other important low-frequency cues. Therefore the associated lost opportunities and capabilities are not at a level that would impact reproduction or survival.

Given the general lack of suitability of the shallow waters of Marpi and Chalan Kanoa Reefs for Navy's activities, it is predicated that only a small portion of individuals would be taken and disturbed at a low-moderate level, with those individuals disturbed only once. There is no expected Level A harassment. This low magnitude and severity of harassment effects is not expected to result in impacts on the reproduction or survival of any individuals and, therefore, the total take is not expected to adversely affect this species through impacts on annual rates of recruitment or survival. No mortality or tissue damage is anticipated or proposed to be authorized. For these reasons, we have determined, in consideration of all of the effects of the Navy's activities combined, that the proposed authorized take would have a negligible impact on humpback whales.

Blue whale—Blue whales are listed as endangered under the ESA throughout their range, but there is no ESA designated critical habitat or biologically important areas identified for this species in the MITT Study Area. There are no recent sighting records for blue whales in the MITT Study Area (Fulling et al., 2011; Hill et al., 2017a; Uyeyama, 2014). Some acoustic detections from passive monitoring devices deployed at Saipan and Tinian have recorded the presence of blue whales over short periods of time (a few days) (Oleson et al., 2015). However, since blue whale calls can travel very long distances (up to 621 mi (1,000 km)), it is unknown whether the animals were within the MITT Study Area. Blue whales would be most likely to occur in the MITT Study Area during the winter and are expected to be few in number.

Regarding the magnitude of Level B harassment takes (TTS and behavioral disruption), the number of estimated total instances of take compared to the abundance (measured against both the MITT Study Area abundance and the MITT Study Area plus the transit corridor combined) is 13 and 12 percent, respectively (Table 51). Regarding the severity of those individual takes by Level B behavioral harassment, we have explained that the duration of any exposure is expected to be between minutes and hours (*i.e.,* relatively short) and the received sound levels largely below 172 dB with a portion up to 178 dB (*i.e.,* of a moderate or lower level, less likely to evoke a severe response). Regarding the severity of TTS takes, they are expected to be low-level, of short duration, and mostly not in a frequency band that would be expected to interfere with communication or other important low-frequency cues. Therefore the associated lost opportunities and capabilities are not at a level that would impact reproduction or survival.

Given the range of blue whales and the low abundance in the MITT Study Area, this information suggests that a very small portion of individuals would be taken and disturbed at a low-moderate level, with those individuals disturbed only once. There is no expected Level A harassment. This low magnitude and severity of harassment effects is not expected to result in impacts on the reproduction or survival of any individuals and, therefore, the total take is not expected to adversely affect this species through impacts on annual rates of recruitment or survival. No mortality or tissue damage is anticipated or proposed to be authorized. For these reasons, we have determined, in consideration of all of the effects of the Navy's activities combined, that the proposed authorized take would have a negligible impact on blue whales.

Fin whale—Fin whales are listed as endangered under the ESA throughout their range, but there is no ESA designated critical habitat or biologically important areas identified for this species in the MITT Study Area. There are no sighting records for fin whales in the MITT Study Area (Fulling *et al.,* 2011; Hill *et al.,* 2017a; Oleson *et al.,* 2015; Uyeyama, 2014). Based on acoustic detections, fin whales are expected to be present in the MITT Study Area although few in number. Acoustic detections from passive monitoring devices deployed at Saipan and Tinian have recorded the presence of fin whales over short (a few days) periods of time (Oleson *et al.,* 2015), and fin whale vocalizations were detected in January 2010 in the Transit Corridor between Hawaii and Guam (Oleson and Hill, 2010a). Regarding the magnitude of Level B harassment takes (TTS and behavioral disruption), the number of estimated total instances of take compared to the abundance (measured against both the MITT Study Area abundance and the MITT Study Area plus the transit corridor combined) is 12 and 10 percent, respectively (Table 51). Regarding the severity of those individual takes by Level B behavioral harassment, we have explained that the duration of any exposure is expected to be between minutes and hours (*i.e.,* relatively short) and the received sound levels largely below 172 dB with a portion up to 178 dB (*i.e.,* of a moderate or lower level, less likely to evoke a severe response). Regarding the severity of TTS takes, they are expected to be low-level, of short duration, and mostly not in a frequency band that would be expected to interfere with communication or other important low-frequency cues. Therefore, the associated lost opportunities and capabilities are not at a level that would impact reproduction or survival.

Given the low abundance of fin whales in the MITT Study Area, this information suggests that a very small portion of individuals would be taken and disturbed at a low-moderate level, with those individuals disturbed only once. There is no expected Level A harassment. This low magnitude and severity of harassment effects is not expected to result in impacts on the reproduction or survival of any individuals and, therefore, the total take is not expected to adversely affect this species through impacts on annual rates of recruitment or survival. No mortality or tissue damage is anticipated or proposed to be authorized. For these reasons, we have determined, in consideration of all of the effects of the Navy's activities combined, that the proposed authorized take would have a negligible impact on fin whales.

Sei whale—Sei whales are listed as endangered under the ESA throughout their range, but there is no ESA designated critical habitat or biologically important areas identified for this species in the MITT Study Area. In the 2007 survey of the Mariana Islands (Fulling *et al.,* 2011), a total of 16 sei whales were sighted in coverage of approximately 24 percent of the MITT Study Area. Sei whales were also visually detected in the Transit Corridor between the MITT Study Area and Hawaii during a NMFS survey in January 2010 (Oleson and Hill, 2010a). Regarding the magnitude of Level B harassment takes (TTS and behavioral disruption), the number of estimated total instances of take compared to the abundance (measured against both the MITT Study Area abundance and the MITT Study Area plus the transit corridor combined) is 15 and 14 percent, respectively (Table 51). Regarding the severity of those individual takes by Level B behavioral harassment, we have explained that the duration of any exposure is expected to be between minutes and hours (*i.e.,* relatively short) and the received sound levels largely below 172 dB with a portion up to 178 dB (*i.e.,* of a moderate or lower level, less likely to evoke a severe response). Regarding the severity of TTS takes, they are expected to be low-level, of short duration, and mostly not in a frequency band that would be expected to interfere with communication or other important low-frequency cues. Therefore the associated lost opportunities and capabilities are not at a level that would impact reproduction or survival.

Given the low occurrence of sei whales in the MITT Study Area, this information suggests that a very small portion of individuals would be taken and disturbed at a low-moderate level, with those individuals disturbed only once. There is no expected Level A harassment. This low magnitude and severity of harassment effects is not expected to result in impacts on the reproduction or survival of any individuals and, therefore, the total take is not expected to adversely affect this species through impacts on annual rates of recruitment or survival. No mortality or tissue damage is anticipated or proposed to be authorized. For these reasons, we have determined, in consideration of all of the effects of the Navy's activities combined, that the proposed authorized take would have a negligible impact on sei whales.

Bryde's whale, Minke whale, Omura's whale—These whales are not listed as endangered or threatened under the ESA. Bryde's whale are expected to be present in the MITT Study Area based on sighting records (Fulling *et al.,* 2011; Hill *et al.,* 2017a; Mobley, 2007; Oleson and Hill, 2010a; Uyeyama, 2014). Bryde's whales were detected in the Transit Corridor between the MITT Study Area and Hawaii during a NMFS survey in January 2010 (Oleson and Hill, 2010a). Bryde's whales were also encountered off Rota during a small boat non-systematic survey in August–September 2015 (Hill *et al.,* 2017a). Minke whales have not been visually detected in the MITT Study Area during any known survey efforts within approximately the last decade (Fulling *et al.,* 2011; Hill *et al.,* 2011; Hill *et al.,* 2013; Hill *et al.,* 2014; Hill *et al.,* 2015; Hill *et al.,* 2017a; Mobley, 2007; Oleson and Hill, 2010a; Tetra Tech Inc., 2014; Uyeyama, 2014). However, acoustic data collected during line-transect surveys did detect calling minke whales (Norris *et al.,* 2017). Omura's whale is thought to be present in the MITT Study Area, but no data is available to estimate abundance.

Regarding the magnitude of Level B harassment takes (TTS and behavioral disruption), the number of estimated total instances of take compared to the abundance (measured against both the MITT Study Area abundance and the MITT Study Area plus the transit corridor combined) is 18–20 and 16–19 percent, respectively (Table 51). Regarding the severity of those individual takes by Level B behavioral harassment, we have explained that the duration of any exposure is expected to be between minutes and hours (*i.e.,* relatively short) and the received sound levels largely below 172 dB with a portion up to 178 dB (*i.e.,* of a moderate or lower level, less likely to evoke a severe response). Regarding the severity of TTS takes, they are expected to be low-level, of short duration, and mostly not in a frequency band that would be expected to interfere with communication or other important low-frequency cues. Therefore the associated lost opportunities and capabilities are not at a level that would impact reproduction or survival.

Given the low occurrence of Bryde's whales and minke whales and the low abundance of Omura's whales in the MITT Study Area, this information suggests that a small portion of individuals would be taken and disturbed at a low-moderate level, with those individuals disturbed only once. There is no expected Level A harassment. This low magnitude and severity of harassment effects is not expected to result in impacts on the reproduction or survival of any individuals and, therefore, the total take is not expected to adversely affect these species through impacts on annual rates of recruitment or survival. No mortality or tissue damage is anticipated or proposed to be authorized. For these reasons, we have determined, in consideration of all of the effects of the Navy's activities combined, that the proposed authorized take would have a negligible impact on Bryde's whales, minke whales, and Omura's whales.

Altogether, no mortality or Level A harassment is anticipated or proposed to be authorized. Regarding the magnitude of Level B harassment takes (TTS and behavioral disruption), the number of estimated total instances of take compared to the abundance is 20 percent or less for all mysticetes in the MITT Study Area and 19 percent or less in the MITT Study Area and transit corridor combined (Table 51). Regarding the severity of those individual Level B harassment takes by behavioral disruption, the duration of any exposure is expected to be between minutes and hours (*i.e.,* relatively short) and the received sound levels largely below 172 dB with a portion up to 178 dB (*i.e.,* of a moderate or lower level, less likely to evoke a severe response). Regarding the severity of TTS takes, they are expected to be low-level, of short duration, and mostly not in a frequency band that would be expected to interfere with communication or other important low-frequency cues. Therefore, the associated lost opportunities and capabilities are not at a level that would impact reproduction or survival.

Only a small portion of any mysticete population is anticipated to be impacted, and any individual whale is likely to be disturbed at a low-moderate level, with the taken individuals likely exposed on one day or perhaps over a few days for a small number of individuals, with little chance that any are taken across sequential days. This low magnitude and severity of harassment effects is unlikely to result in impacts on individual reproduction or survival, much less annual rates of recruitment or survival of any of the species. For these reasons, we have preliminarily determined, in consideration of all of the effects of the Navy's activities combined, that the proposed authorized take would have a negligible impact on all of the mysticete species.

Odontocetes

This section builds on the broader discussion above and brings together the discussion of the different types and amounts of take that different species would incur, the applicable mitigation for each species, and the status of the species to support the negligible impact determinations for each species. We have previously described the unlikelihood of any masking or habitat impacts having effects that would impact the reproduction or survival of any of the individual marine mammals affected by the Navy's activities. Here, we include information that applies to all of the odontocete species, which are then further divided and discussed in more detail in the following subsections: Dwarf sperm whales and pygmy sperm whales; sperm whales; beaked whales; and dolphins and small whales. These subsections include more specific information about the groups, as well as conclusions for each species represented.

The majority of takes by harassment of odontocetes in the MITT Study Area are caused by sources from the MF1 active sonar bin (which includes hull-mounted sonar) because they are high level, typically narrowband sources at a frequency (in the 1–10 kHz range) that overlaps a more sensitive portion (though not the most sensitive) of the MF hearing range and they are used in a large portion of exercises (see Table 1.5–1 in the Navy's rulemaking/LOA application). For odontocetes other than beaked whales (for which these percentages are indicated separately in that section), most of the takes (98 percent) from the MF1 bin in the MITT Study Area would result from received levels between 154 and 172 dB SPL. For the remaining active sonar bin types, the percentages are as follows: LF4 = 97 percent between 124 and 136 dB SPL, MF4 = 99 percent between 136 and 160 dB SPL, MF5 = 97 percent between 118 and 142 dB SPL, and HF4 = 88.6 percent between 100 and 130 dB SPL. These values may be derived from the information in Tables 6.4–8 through 6.4–12 in the Navy's rulemaking/LOA application (though they were provided directly to NMFS upon request). Based on this information, the majority of the takes by Level B behavioral harassment are expected to be low to sometimes moderate in nature, but still of a generally shorter duration.

For all odontocetes, takes from explosives (Level B behavioral harassment, TTS, or PTS) comprise a very small fraction (and low number) of those caused by exposure to active sonar. For the following odontocetes, zero takes from explosives are expected to occur: Blainville's beaked whales, Cuvier's beaked whales, bottlenose dolphins, false killer whales, killer whales, spinner dolphins, sperm whales, rough-toothed dolphins, and pygmy killer whale. For Level B behavioral disruption from explosives, 1 to 4 takes are expected to occur for all but three of the remaining odontocetes, 0 takes for spinner dolphins, and 25 and 64 takes for pygmy and dwarf sperm whales, respectively. The instances of PTS expected to occur from explosives are 0–1 per species and instances of TTS expected to occur from explosives are 0–5 per species, except for pygmy and dwarf sperm whales. Because of the lower PTS threshold for HF species, pygmy and dwarf sperm whales are expected to have 25 and 64 Level B behavioral harassment takes, 8 and 21 PTS takes, and 37 and 100 TTS takes from explosives, respectively.

Because the majority of harassment takes of odontocetes result from the sources in the MF1 bin, the vast majority of threshold shift would occur at a single frequency within the 1–10 kHz range and, therefore, the vast majority of threshold shift caused by Navy sonar sources would be at a single frequency within the range of 2–20 kHz. The frequency range within which any of the anticipated narrowband threshold shift would occur would fall directly within the range of most odontocete vocalizations (2–20kHz). For example, the most commonly used hull-mounted sonar has a frequency around 3.5 kHz, and any associated threshold shift would be expected to be at around 7 kHz. However, odontocete vocalizations typically span a much wider range than this, and alternately, threshold shift from active sonar will often be in a narrower band (reflecting the narrower band source that caused it), which means that TTS incurred by odontocetes would typically only interfere with communication within a portion of their range (if it occurred during a time when communication with conspecifics was occurring) and, as discussed earlier, it would only be expected to be of a short duration and relatively small degree. Odontocete echolocation occurs predominantly at frequencies significantly higher than 20 kHz, though there may be some small overlap at the lower part of their echolocating range for some species, which means that there is little likelihood that threshold shift, either temporary or permanent would interfere with feeding behaviors. Many of the other critical sounds that serve as cues for navigation and prey (*e.g.,* waves, fish, invertebrates) occur below a few kHz, which means that detection of these signals will not be inhibited by most threshold shift either. The low number of takes by threshold shift that might be incurred by individuals exposed to explosives would likely be lower frequency (5 kHz or less) and spanning a wider frequency range, which could slightly lower an individual's sensitivity to navigational or prey cues, or a small portion of communication calls, for several minutes to hours (if temporary) or permanently. There is no reason to think that any of the individual odontocetes taken by TTS would incur these types of takes over more than one day, or over a few days at most, and therefore they are unlikely to incur impacts on reproduction or survival. PTS takes from these sources are very low, and while spanning a wider frequency band, are still expected to be of a low degree (*i.e.,* low amount of hearing sensitivity loss) and unlikely to affect reproduction or survival.

The range of potential behavioral effects of sound exposure on marine mammals generally, and odontocetes specifically, has been discussed in detail previously. There are behavioral patterns that differentiate the likely impacts on odontocetes as compared to mysticetes. First, odontocetes echolocate to find prey, which means that they actively send out sounds to detect their prey. While there are many strategies for hunting, one common pattern, especially for deeper diving species, is many repeated deep dives within a bout, and multiple bouts within a day, to find and catch prey. As discussed above, studies demonstrate that odontocetes may cease their foraging dives in response to sound exposure. If enough foraging interruptions occur over multiple sequential days, and the individual either does not take in the necessary food, or must exert significant effort to find necessary food elsewhere, energy budget deficits can occur that could potentially result in impacts to reproductive success, such as increased cow/calf intervals (the time between successive calving). Second, while many mysticetes rely on seasonal migratory patterns that position them in a geographic location at a specific time of the year to take advantage of ephemeral large abundances of prey (*i.e.,* invertebrates or small fish, which they eat by the thousands), odontocetes forage more homogeneously on one fish or squid at a time. Therefore, if odontocetes are interrupted while feeding, it is often possible to find more prey relatively nearby.

Dwarf Sperm Whales and Pygmy Sperm Whales

In this section, we bring together the discussion of marine mammals generally and odontocetes in particular regarding the different types and amounts of take that different species will incur, the applicable mitigation for each species, and the status of the species to support the negligible impact determinations for each. We have previously described the unlikelihood of any masking or habitat impacts to any marine mammals that would rise to the level of affecting individual fitness.

In Table 52 below for dwarf sperm whales and pygmy sperm whales, we indicate the total annual numbers of take by Level A and Level B harassment, and a number indicating the instances of total take as a percentage of abundance.

TABLE 52—ANNUAL ESTIMATED TAKES BY LEVEL B HARASSMENT AND LEVEL A HARASSMENT FOR DWARF SPERM WHALES AND PYGMY SPERM WHALES AND NUMBER INDICATING THE INSTANCES OF TOTAL TAKE AS A PERCENTAGE OF SPECIES ABUNDANCE

Species	Instances of indicated types of incidental take (not all takes represent separate individuals, especially for disturbance)					Abundance		Instances of total take as percentage of abundance	
	Level B harassment		Level A harassment	Total takes		MITT study area	MITT study area + transit corridor	MITT study area	MITT study area + transit corridor
	Behavioral disturbance	TTS	PTS	MITT study area	MITT study area + transit corridor				
Dwarf sperm whale	1,353	7,147	50	8,502	8,550	25,594	27,396	33	31
Pygmy sperm whale	534	2,876	20	3,412	3,430	10,431	11,169	33	31

Note: Abundance was calculated using the following formulas: Density from the Technical Report in animals/km² × spatial extent of the MITT Study Area transit corridor = Abundance in the transit corridor and Density from the Technical Report in animals/km² × spatial extent of the MITT Study Area = Abundance in the MITT Study. In addition, the total annual takes described here may be off by a digit due to rounding. This occurred here as the Level B harassment takes are broken down further into Behavioral Disturbance and TTS compared to the Level B harassment takes presented as one number in the *Estimated Take of Marine Mammals* section.

As discussed above, the majority of Level B harassment behavioral takes of odontocetes, and thereby dwarf and pygmy sperm whales, is expected to be in the form of low to occasionally moderate severity of a generally shorter duration. As mentioned earlier in this section, we anticipate more severe effects from takes when animals are exposed to higher received levels or for longer durations. Occasional milder Level B behavioral harassment, as is expected here, is unlikely to cause long-term consequences for either individual animals or populations, even if some smaller subset of the takes are in the form of a longer (several hours or a day) and more moderate response.

We note that dwarf and pygmy sperm whales, as HF-sensitive species, have a lower PTS threshold than all other groups and therefore are likely to experience larger amounts of TTS and PTS, and NMFS accordingly has evaluated and would authorize higher numbers. However, Kogia whales are still likely to avoid sound levels that would cause higher levels of TTS (greater than 20 dB) or PTS. Therefore, even though the number of TTS and PTS takes are higher than for other odontocetes, for all of the reasons described above TTS and PTS are not expected to impact reproduction or survival of any individual.

Below we compile and summarize the information that supports our preliminary determination that the Navy's activities would not adversely affect pygmy and dwarf sperm whales through effects on annual rates of recruitment or survival.

Neither pygmy sperm whales nor dwarf sperm whales are listed under the ESA. The stock structure for both pygmy and dwarf sperm whales remains uncertain in the western Pacific, and dwarf sperm whales in the MITT Study Area have not been assigned to a stock in the current SAR (Carretta *et al.,* 2017c; Carretta *et al.,* 2017d). Due to their pelagic distribution, small size, and cryptic behavior, pygmy sperm whales and dwarf sperm whales are rarely sighted during at-sea surveys and are difficult to distinguish between when visually observed in the field. There were no species of *Kogia* sighted during the 2007 shipboard survey within the MITT Study Area (Fulling *et al.,* 2011), but three *Kogia* were observed during marine mammal monitoring for Valiant Shield 2007 about 8 NM east of Guam (Mobley, 2007). In total, during Navy-funded 2010–2016 small boat surveys in the Mariana Islands, five dwarf sperm whales have been encountered on four occasions in a median depth of approximately 750 m and at a median distance of approximately 3 km from shore (Hill *et al.,* 2017a). The stranding of a pygmy sperm whale in 1997 (Trianni and Tenorio, 2012) is the only other confirmed occurrence of this species in the MITT Study Area.

No mortality or tissue damage is anticipated or proposed to be authorized. Both pygmy and dwarf sperm whales would benefit from the procedural mitigation measures described earlier in the *Proposed Mitigation Measures* section. Regarding the magnitude of Level B harassment takes (TTS and behavioral disruption), the number of estimated total instances of take compared to the abundance is 33 percent for both dwarf and pygmy sperm whales in the MITT Study Area and 31 percent in the MITT Study Area and the transit corridor combined, which suggest that some portion of these two species would be taken on one to a few days per year (Table 52). As to the severity of those individual Level B harassment takes by behavioral disruption, the duration of any exposure is expected to be between minutes and hours (*i.e.,* relatively short) and the received sound levels largely below 172 dB (*i.e.,* of a lower, to occasionally moderate, level and less likely to evoke a severe response). As to the severity of TTS takes, they are expected to be low-level, of short duration, and mostly not in a frequency band that would be expected to interfere with dwarf or pygmy sperm whale communication or other important low-frequency cues, and the associated lost opportunities and capabilities are not at a level that would impact reproduction or survival. Some Level A harassment by PTS is anticipated annually (50 and 20 takes for Dwarf and pygmy whale, respectively, see Table 52). For these same reasons (low level and frequency band), while a small permanent loss of hearing sensitivity (PTS) may include some degree of energetic costs for compensating or may mean some small loss of opportunities or detection capabilities, at the expected scale the estimated Level A harassment takes by PTS for dwarf and pygmy sperm whales would be unlikely to impact behaviors, opportunities, or detection capabilities to a degree that would interfere with reproductive success or survival of any individuals, let alone affect annual rates of recruitment or survival. For these reasons, in consideration of all of the effects of the Navy's activities combined, we have preliminary determined that the proposed authorized take will have a negligible impact on pygmy and dwarf sperm whales.

Sperm Whale

In this section, we bring together the discussion of marine mammals generally and odontocetes in particular to evaluate the different types and amounts of take that sperm whales would incur, the applicable mitigation, and the status of the species to support the negligible impact determination. We have previously described the unlikelihood of any masking or habitat impacts to any marine mammals that would rise to the level of affecting individual fitness. In Table 53 below for sperm whales, we indicate the total annual numbers of take by Level A and Level B harassment, and a number indicating the instances of total take as a percentage of abundance.

TABLE 53—ANNUAL ESTIMATED TAKES BY LEVEL B HARASSMENT AND LEVEL A HARASSMENT FOR SPERM WHALES AND NUMBER INDICATING THE INSTANCES OF TOTAL TAKE AS A PERCENTAGE OF SPECIES ABUNDANCE

Species	Instances of indicated types of incidental take (not all takes represent separate individuals, especially for disturbance)					Abundance		Instances of total take as percentage of abundance	
	Level B harassment		Level A harassment	Total takes		MITT study area	MITT study area + transit corridor	MITT study area	MITT study area + transit corridor
	Behavioral disturbance	TTS	PTS	MITT Study area	MITT study area + transit corridor				
Sperm whale	192	11	0	189	203	705	1,635	27	12

Note: Abundance was calculated using the following formulas: Density from the Technical Report in animals/km^2 x spatial extent of the MITT Study Area transit corridor = Abundance in the transit corridor and Density from the Technical Report in animals/km^2 × spatial extent of the MITT Study Area = Abundance in the MITT Study. In addition, the total annual takes described here may be off by a digit due to rounding. This occurred here as the Level B harassment takes are broken down further into Behavioral Disturbance and TTS compared to the Level B harassment takes presented as one number in the *Estimated Take of Marine Mammals* section.

The stock structure for sperm whales remains uncertain in the Pacific (Mesnick *et al.,* 2011; Mizroch and Rice, 2013; NMFS, 2015a), and sperm whales in the MITT Study Area have not been assigned to a stock in the current Pacific SAR (Carretta *et al.,* 2017b; Carretta *et al.,* 2017c). Sperm whales have been routinely sighted in the MITT Study Area and detected in acoustic monitoring records. Acoustic recordings in August 2013 at Pagan Island indicated the presence of sperm whales within 20 NM of the island (Tetra Tech Inc., 2014). Although it has been reported that sperm whales are generally found far offshore in deep water (Mizroch and Rice, 2013), sightings in the MITT Study Area have included animals close to shore in relatively shallow water as well as in areas near steep bathymetric relief (Fulling *et al.,* 2011; Hill *et al.,* 2017a; Uyeyama, 2014). A total of 23 sperm whale sightings and 93 acoustic encounters were made during the 2007 survey in water depths between approximately 400 and 1,000 m depth (Fulling et al., 2011; Yack et al., 2016). During the Navy-funded 2010–2016 small boat surveys in the Mariana Islands, six sperm whales were encountered on three occasions in a median depth of approximately 1,200 m and median approximate distance from shore of 12 km (Hill *et al.,* 2017a). Vocalizations classified as sperm whales were also detected on 20 occasions to the east and south of Guam by passive acoustic recorders during an underwater glider survey in 2014 (Klinck *et al.,* 2016b).

Below we compile and summarize the information that supports our preliminary determination that the Navy's activities would not adversely affect sperm whales through effects on annual rates of recruitment or survival.

The sperm whale is listed as endangered under the ESA. No mortality or Level A harassment is anticipated or proposed to be authorized. Sperm whales would benefit from the procedural mitigation measures described earlier in the *Proposed Mitigation Measures* section. Regarding the magnitude of Level B harassment takes (TTS and behavioral disruption), the number of estimated total instances of take compared to the abundance is 27 percent in the MITT Study Area and 12 percent in the MITT Study Area and transit corridor combined (Table 53), which suggests that some portion of the sperm whales in the MITT Study Area would be taken on one to a few days per year. Regarding the severity of those individual Level B harassment takes by behavioral disruption, the duration of any exposure is expected to be between minutes and hours (*i.e.,* relatively short) and the received sound levels largely below 172 dB (*i.e.,* of a lower, to occasionally moderate, level and less likely to evoke a severe response). Regarding the severity of TTS takes, they are expected to be low-level, of short duration, and mostly not in a frequency band that would be expected to interfere with important low-frequency cues. While the narrowband/single frequency threshold shift incurred may overlap with parts of the frequency range that sperm whales use for communication, any associated lost opportunities and capabilities would not be at a level that would impact reproduction or survival. Any individual whale is likely to be disturbed at a low-moderate level, with the taken individuals likely exposed on one day. This low magnitude and severity of harassment effects is not expected to result in impacts on individual reproduction or survival. For these reasons, we have preliminarily determined, in consideration of all of the effects of the Navy's activities combined, that the proposed authorized take would have a negligible impact on sperm whales.

Beaked Whales

In this section, we build on the broader odontocete discussion above (*i.e.,* that information applies to beaked whales as well), except where we offer alternative information about the received levels for beaked whale Level B behavioral harassment. We bring together the discussion of the different types and amounts of take that different species will incur, the applicable mitigation for each species, and the status of each species to support the negligible impact determination for each species.

We have previously described the unlikelihood of any masking or habitat impacts to any groups that would rise to the level of affecting individual fitness. The discussion below focuses on additional information that is specific to beaked whales (in addition to the general information on odontocetes provided above, which is relevant to these species) to support the conclusions for each species.

In Table 54 below for beaked whales, we indicate the total annual numbers of take by Level A and Level B harassment, and a number indicating the instances of total take as a percentage of abundance.

TABLE 54—ANNUAL ESTIMATED TAKES BY LEVEL B HARASSMENT AND LEVEL A HARASSMENT FOR BEAKED WHALES AND NUMBER INDICATING THE INSTANCES OF TOTAL TAKE AS A PERCENTAGE OF SPECIES ABUNDANCE

Species	Instances of indicated types of incidental take (not all takes represent separate individuals, especially for disturbance)					Abundance		Instances of total take as percentage of abundance	
	Level B Harassment		Level A harassment	Total Takes		MITT study area	MITT study area + transit corridor	MITT study area	MITT study area + transit corridor
	Behavioral disturbance	TTS	PTS	MITT study area	MITT study area + transit corridor				
Blainville's beaked whale	1,691	27	0	1,698	1,719	3,083	3,376	55	51
Cuvier's beaked whale	642	4	0	534	647	1,075	2,642	50	24
Ginkgo-toothed beaked whale	3,660	65	0	3,662	3,725	6,775	7,567	54	49
Longman's beaked whale	5,959	107	0	6,056	6,066	11,148	11,253	54	54

Note: Abundance was calculated using the following formulas: Density from the Technical Report in animals/km^2 x spatial extent of the MITT Study Area transit corridor = Abundance in the transit corridor and Density from the Technical Report in animals/km^2 × spatial extent of the MITT Study Area = Abundance in the MITT Study. In addition, the total annual takes described here may be off by a digit due to rounding. This occurred here as the Level B harassment takes are broken down further into Behavioral Disturbance and TTS compared to the Level B harassment takes presented as one number in the *Estimated Take of Marine Mammals* section.

This first paragraph provides specific information that is in lieu of the parallel information provided for odontocetes as a whole. The majority of takes by harassment of beaked whales in the MITT Study Area are caused by sources from the MF1 active sonar bin (which includes hull-mounted sonar) because they are high level narrowband sources that fall within the 1–10 kHz range, which overlap a more sensitive portion (though not the most sensitive) of the MF hearing range. Also, of the sources expected to result in take, they are used in a large portion of exercises (see Table 1.5–1 in the Navy's rulemaking/LOA application). Most of the takes (96 percent) from the MF1 bin in the MITT Study Area would result from received levels between 148 and 160 dB SPL. For the remaining active sonar bin types, the percentages are as follows: LF4 = 99 percent between 124 and 136 dB SPL, MF4 = 98 percent between 130 and 148 dB SPL, MF5 = 97 percent between 100 and 142 dB SPL, and HF4 = 95 percent between 100 and 148 dB SPL. These values may be derived from the information in Tables 6.4–8 through 6.4–12 in the Navy's rulemaking/LOA application (though they were provided directly to NMFS upon request). Given the levels they are exposed to and their sensitivity, some responses would be of a lower severity, but many would likely be considered moderate.

Research has shown that beaked whales are especially sensitive to the presence of human activity (Pirotta *et al.,* 2012; Tyack *et al.,* 2011) and therefore have been assigned a lower harassment threshold, with lower received levels resulting in a higher percentage of individuals being harassed and a more distant distance cutoff (50 km for high source level, 25 km for moderate source level).

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). 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, although few definitive causal relationships between MFAS use and strandings have been documented (see *Potential Effects of Specified Activities on Marine Mammals and their Habitat* section).

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 1 µPa. 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. 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; McCarthy *et al.,* 2011; Moretti *et al.,* 2009, 2010; Tyack *et al.,* 2010, 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 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 (De Ruiter *et al.,* 2013; Manzano-Roth *et al.,* 2013; Moretti *et al.,* 2014; Tyack *et al.,* 2011). 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 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. More than eight years of passive acoustic monitoring on the Navy's instrumented range west of San Clemente Island documented no significant changes in annual and monthly beaked whale echolocation clicks, with the exception of repeated fall declines likely driven by natural beaked whale life history functions (DiMarzio *et al.,* 2018). Finally, results from passive acoustic monitoring estimated that regional Cuvier's beaked whale densities were higher than indicated by the NMFS' broad scale visual surveys for the U.S. west coast (Hildebrand and McDonald, 2009).

Below we compile and summarize the information that supports our preliminary determination that the Navy's activities would not adversely affect beaked whales through effects on annual rates of recruitment or survival.

These beaked whale species are not listed as endangered or threatened species under the ESA. No mortality or Level A harassment is expected or proposed for authorization. All of the beaked whales species discussed in this section would benefit from the procedural mitigation measures described earlier in the *Proposed Mitigation Measures* section. Regarding the magnitude of Level B harassment takes (TTS and behavioral disruption), the number of estimated instances of take compared to the abundance is 50 to 55 percent in the MITT Study Area and 24 to 54 percent in the MITT Study Area and transit corridor combined (Table 54). This information suggests that up to half of the individuals of these species could be impacted, if each were taken only one day per year, though the more likely scenario is that a smaller portion than that would be taken, and a subset of them would be taken on a few days. Regarding the severity of those individual Level B harassment takes by behavioral disruption, the duration of any exposure is expected to be between minutes and hours (*i.e.,* relatively short) and the received sound levels largely below 160 dB, though with beaked whales, which are considered somewhat more sensitive, this could mean that some individuals will leave preferred habitat for a day (*i.e.,* moderate level takes). However, while interrupted feeding bouts are a known response and concern for odontocetes, we also know that there are often viable alternative habitat options nearby. Regarding the severity of TTS takes, they are expected to be low-level, of short duration, and mostly not in a frequency band that would be expected to interfere with beaked whale communication or other important low-frequency cues, and that the associated lost opportunities and capabilities are not at a level that would impact reproduction or survival.

As mentioned earlier in the odontocete overview, we anticipate more severe effects from takes when animals are exposed to higher received levels or sequential days of impacts. Occasional instances of take by Level B behavioral harassment of a low to moderate severity are unlikely to affect reproduction or survival. Here, some small number of takes by Level B behavioral harassment could be in the form of a longer (several hours or a day) and more moderate response, and/or some small number could be taken over several days, but not at a level that would impact reproduction or survival.

This low magnitude and low to moderate severity of harassment effects is not expected to result in impacts on individual reproduction or survival. For these reasons, we have preliminarily determined, in consideration of all of the effects of the Navy's activities combined, that the proposed authorized take would have a negligible impact on beaked whales.

Small Whales and Dolphins

This section builds on the broader discussion above and compiles the discussion of the different types and amounts of take that different small whale and dolphin species may incur, the applicable mitigation for dolphin and small whale species, and the status of the species to support the negligible impact determinations. We have previously described the unlikelihood of any masking or habitat impacts to any groups that would rise to the level of affecting individual fitness. The discussion below focuses on additional information that is specific to these species (in addition to the general information on odontocetes provided above, which is relevant to these species) to support the conclusions for each species.

In Table 55 below for dolphins and small whales, we indicate the total annual numbers of take by Level A and Level B harassment, and a number indicating the instances of total take as a percentage of abundance.

TABLE 55—ANNUAL ESTIMATED TAKES BY LEVEL B HARASSMENT AND LEVEL A HARASSMENT FOR DOLPHINS AND SMALL WHALES AND NUMBER INDICATING THE INSTANCES OF TOTAL TAKE AS A PERCENTAGE OF SPECIES ABUNDANCE

Species	Instances of indicated types of incidental take (not all takes represent separate individuals, especially for disturbance)					Abundance		Instances of total take as percentage of abundance	
	Level B harassment		Level A harassment	Total takes		MITT study area	MITT study area + transit corridor	MITT study area	MITT study area + transit corridor
	Behavioral disturbance	TTS	PTS	MITT study area	MITT study area + transit corridor				
Bottlenose dolphin	116	21	0	132	137	753	1,075	17	13
False killer whale	641	121	0	759	762	3,979	4,218	19	18
Fraser's dolphin	11,327	1,952	1	13,261	13,280	75,420	76,476	18	17
Killer whale	36	8	0	44	44	215	253	20	17
Melon-headed whale	2,306	508	0	2,798	2,814	15,342	16,461	18	17
Pantropical spotted dolphin	12,078	2,818	1	14,820	14,897	81,013	85,755	18	17

TABLE 55—ANNUAL ESTIMATED TAKES BY LEVEL B HARASSMENT AND LEVEL A HARASSMENT FOR DOLPHINS AND SMALL WHALES AND NUMBER INDICATING THE INSTANCES OF TOTAL TAKE AS A PERCENTAGE OF SPECIES ABUNDANCE—Continued

Species	Instances of indicated types of incidental take (not all takes represent separate individuals, especially for disturbance)					Abundance		Instances of total take as percentage of abundance	
	Level B harassment		Level A harassment	Total takes		MITT study area	MITT study area + transit corridor	MITT study area	MITT study area + transit corridor
	Behavioral disturbance	TTS	PTS	MITT study area	MITT study area + transit corridor				
Pygmy killer whale	87	17	0	103	104	502	527	21	20
Risso's dolphin	2,650	519	0	3,166	3,169	16,991	17,184	19	18
Rough-toothed dolphin	161	36	0	185	197	1,040	1,815	18	11
Short-finned pilot whale	987	177	0	1,150	1,164	5,700	6,583	20	18
Spinner dolphin	1,185	229	1	1,404	1,415	2,975	3,759	47	38
Striped dolphin	3,256	751	0	3,956	4,007	22,081	24,528	18	16

Note: Abundance was calculated using the following formulas: Density from the Technical Report in animals/km^2 × spatial extent of the MITT Study Area transit corridor = Abundance in the transit corridor and Density from the Technical Report in animals/km^2 × spatial extent of the MITT Study Area = Abundance in the MITT Study. In addition, the total annual takes described here may be off by a digit due to rounding. This occurred here as the Level B harassment takes are broken down further into Behavioral Disturbance and TTS compared to the Level B harassment takes presented as one number in the *Estimated Take of Marine Mammals* section.

As described above, the large majority of Level B behavioral harassment to odontocetes, and thereby dolphins and small whales, from hull-mounted sonar (MF1) in the MITT Study Area would result from received levels between 160 and 172 dB SPL. Therefore, the majority of Level B harassment takes are expected to be in the form of low to occasionally moderate responses of a generally shorter duration. As mentioned earlier in this section, we anticipate more severe effects from takes when animals are exposed to higher received levels. Occasional milder occurrences of Level B behavioral harassment are unlikely to cause long-term consequences for individual animals or populations that have any effect on reproduction or survival.

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. Some dolphin species (the more surface-dwelling taxa—typically those with "dolphin" in the common name, such as bottlenose dolphins, spotted dolphins, spinner dolphins, rough-toothed dolphins, etc., but not Risso's dolphin), especially those residing in more industrialized or busy areas, have demonstrated more tolerance for disturbance and loud sounds and many of these species are known to approach vessels to bow-ride. These species are often considered generally less sensitive to disturbance. Dolphins and small whales that reside in deeper waters and generally have fewer interactions with human activities are more likely to demonstrate more typical avoidance reactions and foraging interruptions as described above in the odontocete overview.

All the dolphin and small whale species discussed in this section would benefit from the procedural mitigation measures described earlier in the *Proposed Mitigation Measures* section. Additionally, the Agat Bay Nearshore Geographic Mitigation Area will provide protection for spinner dolphins as the Navy will not use in-water explosives or MF1 ship hull-mounted mid-frequency active sonar in this area. High use areas for spinner dolphins including Agat Bay are where animals congregate during the day to rest (Amesbury *et al.,* 2001; Eldredge, 1991). Behavioral disruptions during resting periods can adversely impact health and energetic budgets by not allowing animals to get the needed rest and/or by creating the need to travel and expend additional energy to find other suitable resting areas. Avoiding sonar and explosives in this area reduces the likelihood of impacts that would affect reproduction and survival.

Below we compile and summarize the information that supports our preliminary determination that the Navy's activities would not adversely affect dolphins and small whales through effects on annual rates of recruitment or survival.

None of the small whale and dolphin species are listed as endangered or threatened species under the ESA. No mortality or Level A harassment is anticipated or proposed to be authorized, with the exception of one Level A harassment take by PTS each for spinner dolphin, pantropical spotted dolphin, and Fraser's dolphin. No tissue damage is anticipated or proposed to be authorized for any species. Regarding the magnitude of Level B harassment takes (TTS and behavioral disruption), the number of estimated total instances of take compared to the abundance is 47 percent for spinner dolphins and 17 to 21 percent for the remaining dolphins and small whales in the MITT Study Area, which suggests that some portion of these species would be taken on one to a few days per year. Additionally, the number of estimated total instances of take compared to the abundance is 38 percent for spinner dolphins and 20 percent or less for the remaining dolphins and small whales in the MITT Study and transit corridor combined, which would also suggest that some portion of these species would be taken on one to a few days per year (Table 55). As to the severity of those individual Level B harassment takes by behavioral disruption, the duration of any exposure is expected to be between minutes and hours (*i.e.,* relatively short) and the received sound levels largely below 172 dB (*i.e.,* of a lower, to occasionally moderate, level and less likely to evoke a severe response). As to the severity of TTS takes, they are expected to be low-level, of short duration, and mostly not in a frequency band that would be expected to interfere with communication or other important low-frequency cues. The associated lost opportunities and capabilities are not at a level that would impact reproduction or survival. Any individual dolphin or small whale is likely to be disturbed at a low-moderate level, with the taken individuals likely exposed on one to a few days. This low magnitude and severity of harassment effects is not expected to result in impacts on individual reproduction or survival. Three species (spinner dolphin, Fraser's dolphin, and pantropical spotted dolphin) could be taken by one PTS annually of likely low severity. A small permanent loss of hearing sensitivity (PTS) may include some degree of energetic costs for compensating or may mean some small loss of opportunities or detection capabilities, but at the expected scale the estimated Level A harassment takes by PTS for spinner dolphin, Fraser's dolphin, and pantropical spotted dolphin would be unlikely to impact behaviors, opportunities, or detection capabilities to a degree that would interfere with reproductive success or survival of any individuals, let alone affect annual rates of recruitment or survival. For these reasons, we have preliminarily determined, in consideration of all of the effects of the Navy's activities combined, that the proposed authorized take would have a negligible impact on small whales and dolphins.

Altogether, only a small portion of any odontocete population is anticipated to be impacted, and any individual whale or dolphin is likely to be disturbed at a low-moderate level, with the taken individuals likely exposed on one day or a few days. This low magnitude and severity of harassment effects is unlikely to result in impacts on individual reproduction or survival, much less annual rates of recruitment or survival of any of the species. For these reasons, we have preliminarily determined, in consideration of all of the effects of the Navy's activities combined, that the proposed authorized take would have a negligible impact on all of the odontocete species.

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.

Subsistence Harvest of Marine Mammals

There are no subsistence uses or harvest of marine mammals in the geographic area affected by the specified activities. Therefore, NMFS has preliminarily determined that the total taking affecting species would not have an unmitigable adverse impact on the availability of the species for taking for subsistence purposes.

Classifications

Endangered Species Act

There are five marine mammal species under NMFS jurisdiction that are listed as endangered or threatened under the ESA with confirmed or possible occurrence in the MITT Study Area: Blue whale, fin whale, humpback whale, sei whale, and sperm whale. There is no ESA-designated critical habitat for any species in the MITT Study Area. The Navy will consult with NMFS pursuant to section 7 of the ESA for MITT Study Area activities. NMFS will also consult internally on the issuance of the regulations and LOA under section 101(a)(5)(A) of the MMPA. NMFS' Permits and Conservation Division is currently discussing the Navy rulemaking/LOA application with NMFS' ESA Interagency Cooperation Division.

National Marine Sanctuaries Act

There are no national marine sanctuaries in the MITT Study Area. Therefore, no consultation under the National Marine Sanctuaries Act is required.

National Environmental Policy Act

To comply with the National Environmental Policy Act of 1969 (NEPA; 42 U.S.C. 4321 *et seq.*) and NOAA Administrative Order (NAO) 216–6A, NMFS must evaluate our proposed actions and alternatives with respect to potential impacts on the human environment. Accordingly, NMFS plans to adopt the Navy's EIS/OEIS for the MITT 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 an LOA under the MMPA. NMFS is a cooperating agency on the 2019 MITT DEIS/OEIS and has worked extensively with the Navy in developing the document. The 2019 MITT DEIS/OEIS was made available for public comment at *http://www.MITT-eis.com,* January 2019. We will review all comments submitted in response to this notice prior to concluding our NEPA process or making a final decision on the MMPA rule and LOA request.

Regulatory Flexibility Act

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 that 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: January 9, 2020.

Samuel D. Rauch III,

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

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

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

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

Authority: 16 U.S.C. 1361 *et seq.,* unless otherwise noted.

■ 2. Revise subpart J to part 218 to read as follows:

Subpart J—Taking and Importing Marine Mammals; U.S. Navy's Mariana Islands Training and Testing (MITT)

Sec.

Subpart J—Taking and Importing Marine Mammals; U.S. Navy's Mariana Islands Training and Testing (MITT)

§ 218.90 Specified activity and geographical region.

(a) Regulations in this subpart apply only to the U.S. Navy (Navy) for the taking of marine mammals that occurs in the area described in paragraph (b) of this section and that occurs incidental to the activities listed in paragraph (c) of this section.

(b)(1) The taking of marine mammals by the Navy under this subpart may be authorized in a Letter of Authorization (LOA) only if it occurs within the Mariana Islands Training and Testing (MITT) Study Area. The MITT Study Area is comprised of three components:

(i) The Mariana Islands Range Complex (MIRC);

(ii) Additional areas on the high seas; and

(iii) A transit corridor between the MIRC and the Hawaii Range Complex (HRC).

(2) The MIRC includes the waters south of Guam to north of Pagan (Commonwealth of the Northern Mariana Islands (CNMI)), and from the Pacific Ocean east of the Mariana Islands to the Philippine Sea to the west, encompassing 501,873 square nautical miles (NM^2) of open ocean. For the additional areas of the high seas, this includes the area to the north of the MIRC that is within the U.S. Exclusive Economic Zone (EEZ) of the CNMI and the areas to the west of the MIRC. The transit corridor is outside the geographic boundaries of the MIRC and represents a great circle route (*i.e.,* the shortest distance) across the high seas for Navy ships transiting between the MIRC and the HRC. Additionally, the MITT Study Area includes pierside locations in the Apra Harbor Naval Complex.

(c) The taking of marine mammals by the Navy is only authorized if it occurs incidental to the Navy conducting training and testing activities, including:

(1) *Training.* (i) Amphibious warfare;

(ii) Anti-submarine warfare;

(iii) Mine warfare;

(vi) Surface warfare; and

(vii) Other training activities.

(2) *Testing.* (i) Naval Air Systems Command Testing Activities;

(ii) Naval Sea System Command Testing Activities; and

(iii) Office of Naval Research Testing Activities.

§ 218.91 Effective dates.

Regulations in this subpart are effective from *[DATE OF PUBLICATION OF FINAL RULE IN THE* ***Federal Register****]* through August 3, 2027.

§ 218.92 Permissible methods of taking.

(a) Under an LOA issued pursuant to §§ 216.106 of this chapter and 218.96, the Holder of the LOA (hereinafter "Navy") may incidentally, but not intentionally, take marine mammals within the area described in § 218.90(b) by Level A harassment and Level B harassment associated with the use of active sonar and other acoustic sources and explosives, provided the activity is in compliance with all terms, conditions, and requirements of these regulations in this subpart and the applicable LOAs.

(b) The incidental take of marine mammals by the activities listed in § 218.90(c) is limited to the following species:

TABLE 1 TO § 218.92

Species	Scientific Name
Blue whale	*Balaenoptera musculus*
Bryde's whale	*Balaenoptera edeni*
Fin whale	*Balaenoptera physalus*
Humpback whale	*Megaptera novaeangliae*
Minke whale	*Balaenoptera acutorostrata*
Omura's whale	*Balaenoptera omurai*
Sei whale	*Balaenoptera borealis*
Blainville's beaked whale	*Mesoplodon densirostris*
Common bottlenose dolphin	*Tursiops truncatus*
Cuvier's beaked whale	*Ziphius cavirostris*
Dwarf sperm whale	*Kogia sima*
False killer whale	*Pseudorca crassidens*
Fraser's dolphin	*Lagenodelphis hosei*
Ginkgo-toothed beaked whale	*Mesoplodon ginkgodens*
Killer whale	*Orcinus orca*
Longman's beaked whale	*Indopacetus pacificus*
Melon-headed whale	*Peponocephala electra*
Pantropical spotted dolphin	*Stenella attenuata*
Pygmy killer whale	*Feresa attenuata*
Pygmy sperm whale	*Kogia breviceps*
Risso's dolphin	*Grampus griseus*
Rough-toothed dolphin	*Steno bredanensis*
Short-finned pilot whale	*Globicephala macrorhynchus*
Sperm whale	*Physeter macrocephalus*
Spinner dolphin	*Stenella longirostris*
Striped dolphin	*Stenella coeruleoalba*

§ 218.93 Prohibitions.

Notwithstanding incidental takings contemplated in § 218.92(a) and authorized by LOAs issued under §§ 216.106 of this chapter and 218.96, no person in connection with the activities listed in § 218.90(c) 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 218.96;

(b) Take any marine mammal not specified in § 218.92(b);

(c) Take any marine mammal specified in § 218.92(b) in any manner other than as specified in the LOAs; or

(d) Take a marine mammal specified in § 218.92(b) if NMFS determines such taking results in more than a negligible impact on the species or stocks of such marine mammal.

§ 218.94 Mitigation requirements.

When conducting the activities identified in § 218.90(c), the mitigation measures contained in any LOAs issued under §§ 216.106 of this chapter and 218.96 must be implemented. These mitigation measures include, but are not limited to:

(a) *Procedural mitigation.* Procedural mitigation is mitigation that the Navy must implement whenever and wherever an applicable training or testing activity takes place within the MITT Study Area for each applicable activity category or stressor category and includes acoustic stressors (*i.e.,* active sonar and other transducers, 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 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; and non-explosive bombs and mine shapes).

(1) *Environmental awareness and education.* Appropriate Navy personnel (including civilian 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, Marine Species Awareness Training; U.S. Navy Protective Measures Assessment Protocol; and U.S. Navy Sonar Positional Reporting System and Marine Mammal Incident Reporting.

(2) *Active sonar.* Active sonar includes low-frequency active sonar, mid-frequency active sonar, and high-frequency active sonar. For vessel-based 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 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).

(i) *Number of Lookouts and observation platform*—(A) *Hull-mounted sources.* One Lookout for platforms with space or manning restrictions while underway (at the forward part of a small boat or ship) and platforms using active sonar while moored or at anchor (including pierside); and two Lookouts for platforms without space or manning restrictions while underway (at the forward part of the ship).

(B) *Sources that are not hull-mounted sources.* One Lookout on the ship or aircraft conducting the activity.

(ii) *Mitigation zone and requirements.* (A) During the activity, at 1,000 yards (yd) Navy personnel must power down 6 decibels (dB), at 500 yd Navy personnel must power down an additional 4 dB (for a total of 10 dB), and at 200 yd Navy personnel must shut down for low-frequency active sonar ≥200 dB and hull-mounted mid-frequency active sonar; or at 200 yd Navy personnel must shut down for low-frequency active sonar <200 dB, mid-frequency active sonar sources that are not hull-mounted, and high-frequency active sonar.

(B) Prior to the start of the activity (*e.g.,* when maneuvering on station), Navy personnel must observe the mitigation zone for marine mammals; if marine mammals are observed, Navy personnel must relocate or delay the start of active sonar transmission.

(C) During the activity for low-frequency active sonar at or above 200 dB and hull-mounted mid-frequency active sonar, Navy personnel must observe the mitigation zone for marine mammals and power down active sonar transmission by 6 dB if marine mammals are observed within 1,000 yd of the sonar source; power down by an additional 4 dB (for a total of 10 dB total) if marine mammals are observed within 500 yd of the sonar source; and cease transmission if marine mammals are observed within 200 yd of the sonar source.

(D) During the activity for low-frequency active sonar below 200 dB, mid-frequency active sonar sources that are not hull mounted, and high-frequency active sonar, Navy personnel must observe the mitigation zone for marine mammals and cease active sonar transmission if marine mammals are observed within 200 yd of the sonar source.

(E) Commencement/recommencement conditions after a marine mammal sighting before or during the activity. Navy personnel must allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing or powering up active sonar transmission) until one of the following 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 minutes (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 where a dolphin(s) is observed in the mitigation zone, the Lookout concludes that the dolphin(s) is deliberately closing in on the ship to ride the ship's bow wave, and is therefore out of the main transmission axis of the sonar (and there are no other marine mammal sightings within the mitigation zone).

(3) *Weapons firing noise.* Weapons firing noise associated with large-caliber gunnery activities.

(i) *Number of Lookouts and observation platform.* One Lookout must be positioned on the ship conducting the firing. Depending on the activity, the Lookout could be the same as the one provided for under ''Explosive medium-caliber and large-caliber projectiles'' or under ''Small-, medium-, and large-caliber non-explosive practice munitions'' in paragraphs (a)(8)(i) and (a)(17)(i) of this section.

(ii) *Mitigation zone and requirements.* (A) Thirty degrees on either side of the firing line out to 70 yd from the muzzle of the weapon being fired.

(B) Prior to the start of the activity, Navy personnel must observe the mitigation zone for marine mammals; if marine mammals are observed, Navy personnel must relocate or delay the start of weapons firing.

(C) During the activity, Navy personnel must observe the mitigation zone for marine mammals; if marine mammals are observed, Navy personnel must cease weapons firing.

(D) Commencement/recommencement conditions after a marine mammal sighting before or during the activity. Navy personnel must allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing weapons firing) until one of the following 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 must be positioned in an aircraft or on a small boat. If additional platforms are participating in the activity, Navy personnel positioned in those assets (*e.g.,* safety observers, evaluators) must support observing the mitigation zone for applicable biological resources while performing their regular duties.

(ii) *Mitigation zone and requirements.* (A) 600 yd around an explosive sonobuoy.

(B) Prior to the initial start of the activity (*e.g.,* during deployment of a sonobuoy field, which typically lasts 20–30 min), Navy personnel must conduct passive acoustic monitoring for marine mammals and use information from detections to assist visual observations. Navy personnel also must visually observe the mitigation zone for marine mammals; if marine mammals are observed, Navy personnel must relocate or delay the start of sonobuoy or source/receiver pair detonations.

(C) During the activity, Navy personnel must observe the mitigation zone for marine mammals; if marine mammals are observed, Navy personnel must cease sonobuoy or source/receiver pair detonations.

(D) Commencement/recommencement conditions after a marine mammal sighting before or during the activity. Navy personnel must allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing detonations) until one of the following 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 (*e.g.,* helicopter), or 30 min when the activity involves aircraft that are not typically fuel constrained.

(E) After completion of the activity (*e.g.,* prior to maneuvering off station), when practical (*e.g.,* when platforms are not constrained by fuel restrictions or mission-essential follow-on commitments), Navy personnel must observe for marine mammals in the vicinity of where detonations occurred; if any injured or dead marine mammals are observed, Navy personnel must follow established incident reporting procedures. If additional platforms are supporting this activity (*e.g.,* providing range clearance), these Navy assets must assist in the visual observation of the area where detonations occurred.

(7) *Explosive torpedoes*—(i) *Number of Lookouts and observation platform.* One Lookout positioned in an aircraft. If additional platforms are participating in the activity, Navy personnel positioned in those assets (*e.g.,* safety observers, evaluators) must support observing the mitigation zone for applicable biological resources while performing their regular duties.

(ii) *Mitigation zone and requirements.* (A) 2,100 yd around the intended impact location.

(B) Prior to the initial start of the activity (*e.g.,* during deployment of the target), Navy personnel must conduct passive acoustic monitoring for marine mammals and use the information from detections to assist visual observations. Navy personnel also must visually observe the mitigation zone for marine mammals; if marine mammals are observed, Navy personnel must relocate or delay the start of firing.

(C) During the activity, Navy personnel must observe for marine mammals. If marine mammals are observed, Navy personnel must cease firing.

(D) Commencement/recommencement conditions after a marine mammal sighting before or during the activity. Navy personnel must allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing firing) until one of the following 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.

(E) After completion of the activity (*e.g.,* prior to maneuvering off station), Navy personnel must when practical (*e.g.,* when platforms are not constrained by fuel restrictions or mission-essential follow-on commitments), observe for marine mammals in the vicinity of where detonations occurred; if any injured or dead marine mammals are observed, Navy personnel must follow established incident reporting procedures. If additional platforms are supporting this activity (*e.g.,* providing range clearance), these Navy assets must assist in the visual observation of the area where detonations occurred.

(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 must be 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)(3)(i) of this section. If additional platforms are participating in the activity, Navy personnel positioned in those assets (*e.g.,* safety observers, evaluators) must support observing the mitigation zone for applicable biological resources while performing their regular duties.

(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.

(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), Navy personnel must observe the mitigation zone for marine mammals; if marine mammals are observed, Navy personnel must relocate or delay the start of firing.

(E) During the activity, Navy personnel must observe for marine mammals; if marine mammals are observed, Navy personnel must cease firing.

(F) Commencement/recommencement conditions after a marine mammal sighting before or during the activity. Navy personnel must allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing firing) until one of the following 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.

(G) After completion of the activity (*e.g.,* prior to maneuvering off station), Navy personnel must, when practical (*e.g.,* when platforms are not constrained by fuel restrictions or mission-essential follow-on commitments), observe for marine mammals in the vicinity of where detonations occurred; if any injured or dead marine mammals are observed, Navy personnel must follow established incident reporting procedures. If additional platforms are supporting this activity (*e.g.,* providing range clearance), these Navy assets must assist in the visual observation of the area where detonations occurred.

(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 must be positioned in an aircraft. If additional platforms are participating in the activity, Navy personnel positioned in those assets (*e.g.,* safety observers, evaluators) must support observing the mitigation zone for applicable biological resources while performing their regular duties.

(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.

(B) 2,000 yd around the intended impact location for missiles with 21–500 lb net explosive weight.

(C) Prior to the initial start of the activity (*e.g.,* during a fly-over of the mitigation zone), Navy personnel must observe the mitigation zone for marine mammals; if marine mammals are observed, Navy personnel must relocate or delay the start of firing.

(D) During the activity, Navy personnel must observe for marine mammals; if marine mammals are observed, Navy personnel must cease firing.

(E) Commencement/recommencement conditions after a marine mammal sighting before or during the activity. Navy personnel must allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing firing) until one of the following 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.

(F) After completion of the activity (*e.g.,* prior to maneuvering off station), Navy personnel must, when practical (*e.g.,* when platforms are not constrained by fuel restrictions or mission-essential follow-on commitments), observe for marine mammals in the vicinity of where detonations occurred; if any injured or dead marine mammals are observed, Navy personnel must follow established incident reporting procedures. If additional platforms are supporting this activity (*e.g.,* providing range clearance), these Navy assets will assist in the visual observation of the area where detonations occurred.

(10) *Explosive bombs*—(i) *Number of Lookouts and observation platform.* One Lookout must be positioned in an aircraft conducting the activity. If additional platforms are participating in the activity, Navy personnel positioned in those assets (*e.g.,* safety observers, evaluators) must support observing the mitigation zone for applicable biological resources while performing their regular duties.

(ii) *Mitigation zone and requirements.* (A) 2,500 yd around the intended target.

(B) Prior to the initial start of the activity (*e.g.,* when arriving on station), Navy personnel must observe the mitigation zone for marine mammals; if marine mammals are observed, Navy personnel must relocate or delay the start of bomb deployment.

(C) During the activity (*e.g.,* during target approach), Navy personnel must observe the mitigation zone for marine mammals; if marine mammals are observed, Navy personnel must cease bomb deployment.

(D) Commencement/recommencement conditions after a marine mammal sighting before or during the activity. Navy personnel must allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing bomb deployment) until one of the following 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.

(E) After completion of the activity (*e.g.,* prior to maneuvering off station), Navy personnel must, when practical (*e.g.,* when platforms are not constrained by fuel restrictions or mission-essential follow-on commitments), observe for marine mammals in the vicinity of where detonations occurred; if any injured or dead marine mammals are observed, Navy personnel must follow established incident reporting procedures. If additional platforms are supporting this activity (*e.g.,* providing range clearance), these Navy assets must assist in the visual observation of the area where detonations occurred.

(11) *Sinking exercises*—(i) *Number of Lookouts and observation platform.* Two Lookouts (one must be positioned in an aircraft and one must be positioned on a vessel). If additional platforms are participating in the activity, Navy personnel positioned in those assets (*e.g.,* safety observers, evaluators) must support observing the mitigation zone for applicable biological resources while performing their regular duties.

(ii) *Mitigation zone and requirements.* (A) 2.5 NM around the target ship hulk.

(B) Prior to the initial start of the activity (90 min prior to the first firing), Navy personnel must conduct aerial observations of the mitigation zone for marine mammals; if marine mammals are observed, Navy personnel must delay the start of firing.

(C) During the activity, Navy personnel must conduct passive acoustic monitoring for marine mammals and use the information from detections to assist visual observations. Navy personnel must visually observe the mitigation zone for marine mammals from the vessel; if marine mammals are observed, Navy personnel must cease firing. Immediately after any planned or unplanned breaks in weapons firing of longer than two hours, Navy personnel must observe the mitigation zone for marine mammals from the aircraft and vessel; if marine mammals are observed, Navy personnel must delay recommencement of firing.

(D) Commencement/recommencement conditions after a marine mammal sighting before or during the activity. Navy personnel must allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing firing) until one of the following 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) After completion of the activity (for two hours after sinking the vessel or until sunset, whichever comes first), Navy personnel must observe for marine mammals in the vicinity of where detonations occurred; if any injured or dead marine mammals are observed, Navy personnel must follow established incident reporting procedures. If additional platforms are supporting this activity (*e.g.,* providing range clearance), these Navy assets will assist in the visual observation of the area where detonations occurred.

(12) *Explosive mine countermeasure and neutralization activities*—(i) *Number of Lookouts and observation platform.* (A) One Lookout must be positioned on a vessel or in an aircraft.

(B) If additional platforms are participating in the activity, Navy personnel positioned in those assets (*e.g.,* safety observers, evaluators) must support observing the mitigation zone for applicable biological resources while performing their regular duties.

(ii) *Mitigation zone and requirements.* (A) 600 yd around the detonation site.

(B) Prior to the initial 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), Navy personnel must observe the mitigation zone for marine mammals; if marine mammals are observed, Navy personnel must relocate or delay the start of detonations.

(C) During the activity, Navy personnel must observe the mitigation zone for marine mammals; if marine mammals are observed, Navy personnel must cease detonations.

(D) Commencement/recommencement conditions after a marine mammal sighting before or during the activity. Navy personnel must allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing detonations) until one of the following 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 (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), Navy personnel must observe for marine mammals in the vicinity of where detonations occurred; if any injured or dead marine mammals are observed, Navy personnel must follow established incident reporting procedures. If additional platforms are supporting this activity (*e.g.,* providing range clearance), these Navy assets must assist in the visual observation of the area where detonations occurred.

(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 must be on a small boat and one must be 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 must serve as an additional Lookout if aircraft are used during the activity, when implementing the larger mitigation zone.

(C) All divers placing the charges on mines will support the Lookouts while performing their regular duties and will report applicable sightings to their supporting small boat or Range Safety Officer.

(D) If additional platforms are participating in the activity, Navy personnel positioned in those assets (*e.g.,* safety observers, evaluators) must support observing the mitigation zone for applicable biological resources while performing their regular duties.

(ii) *Mitigation zone and requirements.* (A) 500 yd around the detonation site during activities under positive control using.

(B) 1,000 yd around the detonation site during all activities using time-delay fuses.

(C) Prior to the initial start of the activity (*e.g.,* when maneuvering on station for activities under positive control; 30 min for activities using time-delay firing devices), Navy personnel must observe the mitigation zone for marine mammals; if marine mammals are observed, Navy personnel must relocate or delay the start of detonations or fuse initiation.

(D) During the activity, Navy personnel must observe the mitigation zone for marine mammals; if marine mammals are observed, Navy personnel must cease detonations or fuse initiation. To the maximum extent practicable depending on mission requirements, safety, and environmental conditions, Navy personnel must position boats near the mid-point of the mitigation zone radius (but outside of the detonation plume and human safety zone), must position themselves on opposite sides of the detonation location (when two boats are used), and must 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, Navy aircraft must travel in a circular pattern around the detonation location to the maximum extent practicable. Navy personnel must not set time-delay firing devices to exceed 10 min.

(E) Commencement/recommencement conditions after a marine mammal sighting before or during the activity. Navy personnel must allow a sighted animal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing detonations) until one of the following 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.

(F) After completion of an activity, the Navy must observe for marine mammals for 30 min. Navy personnel must observe for marine mammals in the vicinity of where detonations occurred; if any injured or dead marine mammals are observed, Navy personnel must follow established incident reporting procedures. If additional platforms are supporting this activity (*e.g.,* providing range clearance), these Navy assets must assist in the visual observation of the area where detonations occurred.

(14) *Maritime security operations—anti-swimmer grenades*—(i) *Number of Lookouts and observation platform.* One Lookout must be positioned on the small boat conducting the activity. If additional platforms are participating in the activity, Navy personnel positioned in those assets (*e.g.,* safety observers, evaluators) must support observing the mitigation zone for applicable biological resources while performing their regular duties.

(ii) *Mitigation zone and requirements.* (A) 200 yd around the intended detonation location.

(B) Prior to the initial start of the activity (*e.g.,* when maneuvering on station), Navy personnel must observe the mitigation zone for marine mammals; if marine mammals are observed, Navy personnel must relocate or delay the start of detonations.

(C) During the activity, Navy personnel must observe the mitigation zone for marine mammals; if marine mammals are observed, Navy personnel must cease detonations.

(D) Commencement/recommencement conditions after a marine mammal sighting before or during the activity. Navy personnel must allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing detonations) until one of the following 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.

(E) After completion of the activity (*e.g.,* prior to maneuvering off station), Navy personnel must, when practical (*e.g.,* when platforms are not constrained by fuel restrictions or mission-essential follow-on commitments), observe for marine mammals in the vicinity of where detonations occurred; if any injured or dead marine mammals are observed, Navy personnel must follow established incident reporting procedures. If additional platforms are supporting this activity (*e.g.,* providing range clearance), these Navy assets will assist in the visual observation of the area where detonations occurred.

(15) *Vessel movement.* The mitigation will 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); the vessel is

operated autonomously; or when impracticable based on mission requirements (*e.g.,* during Amphibious Assault and Amphibious Raid exercises).

(i) *Number of Lookouts and observation platform.* One Lookout must be on the vessel that is underway.

(ii) *Mitigation zone and requirements.* (A) 500 yd around whales.

(B) 200 yd around all other marine mammals (except bow-riding dolphins).

(C) During the activity, Navy personnel must observe the mitigation zone for marine mammals; if marine mammals are observed, Navy personnel must maneuver to maintain distance.

(iv) *Incident reporting procedures.* If a marine mammal vessel strike occurs, Navy personnel must follow the established incident reporting procedures.

(16) *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.

(i) *Number of Lookouts and observation platform.* One Lookout must be positioned on a manned towing platform.

(ii) *Mitigation zone and requirements.* (A) 250 yd around marine mammals.

(B) During the activity (*i.e.,* when towing an in-water device), Navy personnel must observe the mitigation zone for marine mammals; if marine mammals are observed, Navy personnel must maneuver to maintain distance.

(17) *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 must be 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)(3)(i) of this section.

(ii) *Mitigation zone and requirements.* (A) 200 yd around the intended impact location.

(B) Prior to the start of the activity (*e.g.,* when maneuvering on station), Navy personnel must observe the mitigation zone for marine mammals; if marine mammals are observed, Navy personnel must relocate or delay the start of firing.

(C) During the activity, Navy personnel must observe the mitigation zone for marine mammals; if marine mammals are observed, Navy personnel must cease firing.

(D) Commencement/recommencement conditions after a marine mammal sighting before or during the activity. Navy personnel must allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing firing) until one of the following 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.

(18) *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 must be positioned in an aircraft.

(ii) *Mitigation zone and requirements.* (A) 900 yd around the intended impact location.

(B) Prior to the initial start of the activity (*e.g.,* during a fly-over of the mitigation zone), Navy personnel must observe the mitigation zone for marine mammals; if marine mammals are observed, Navy personnel must relocate or delay the start of firing.

(C) During the activity, Navy personnel must observe the mitigation zone for marine mammals; if marine mammals are observed, Navy personnel must cease firing.

(D) Commencement/recommencement conditions after a marine mammal sighting prior to or during the activity. Navy personnel must allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing firing) until one of the following 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.

(19) *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 must be positioned in an aircraft.

(ii) *Mitigation zone and requirements.* (A) 1,000 yd around the intended target.

(B) Prior to the initial start of the activity (*e.g.,* when arriving on station), Navy personnel must observe the mitigation zone for marine mammals; if marine mammals are observed, Navy personnel must relocate or delay the start of bomb deployment or mine laying.

(C) During the activity (*e.g.,* during approach of the target or intended minefield location), Navy personnel must observe the mitigation zone for marine mammals and, if marine mammals are observed, Navy personnel must cease bomb deployment or mine laying.

(D) Commencement/recommencement conditions after a marine mammal sighting prior to or during the activity. Navy personnel must allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing bomb deployment or mine laying) until one of the following 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, Navy personnel must implement mitigation measures within mitigation areas to avoid or reduce potential impacts on marine mammals.

(1) *Mitigation areas for marine mammals off Saipan in MITT Study Area for sonar, explosives, and vessel strikes*—(i) *Mitigation area requirements*—(A) *Marpi Reef Geographic Mitigation Area.* (*1*) Navy personnel must not use explosives that could potentially result in takes of marine mammals during training and testing.

(*2*) The Navy will also report the total hours of MF1 surface ship hull-mounted mid-frequency active sonar from December through April used in this area in its annual training and testing activity reports submitted to NMFS.

(*3*) Should national security require the use of explosives that could potentially result in the take of marine mammals during training or testing, Naval units must obtain permission from the appropriate designated Command authority prior to commencement of the activity. Navy personnel must provide NMFS with advance notification and include the information (*e.g.,* explosive usage) in its annual activity reports submitted to NMFS.

(B) *Chalan Kanoa Geographic Mitigation Area.* (*1*) Navy personnel must not use explosives that could potentially result in takes of marine mammals during training and testing.

(*2*) The Navy will also report the total hours of MF1 surface ship hull-mounted mid-frequency active sonar from December through April used in this area in its annual training and testing activity reports submitted to NMFS.

(*3*) Should national security require the use of explosives that could potentially result in the take of marine mammals during training or testing, Naval units must obtain permission from the appropriate designated Command authority prior to commencement of the activity. Navy personnel must provide NMFS with advance notification and include the information (*e.g.,* explosive usage) in its annual activity reports submitted to NMFS.

(C) *Marpi Reef and Chalan Kanoa Reef Awareness Notification Message Area (December–April).* (*1*) Navy personnel must issue a seasonal awareness notification message to alert ships and aircraft operating in the area to the possible presence of concentrations of large whales, or increased concentrations of humpback whales.

(*2*) To maintain safety of navigation and to avoid interactions with large whales during transits, Navy personnel must 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.

(*3*) Platforms must 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) [Reserved]

(2) *Mitigation areas for marine mammals off Guam of the MITT Study Area for sonar and explosives*—(i) *Mitigation area requirements*—(A) *Agat Bay Nearshore Geographic Mitigation Area.* (*1*) Navy personnel must not conduct MF1 surface ship hull-mounted mid-frequency active sonar year-round.

(*2*) Should national security require the use of MF1 surface ship hull-mounted mid-frequency active sonar during training and testing within the Agat Bay Nearshore Geographic Mitigation Area, Naval units must obtain permission from the appropriate designated Command authority prior to commencement of the activity. Navy personnel must provide NMFS with advance notification and include the information (*e.g.,* sonar hours) in its annual activity reports submitted to NMFS.

(*3*) Navy personnel must not use in-water explosives year-round.

(*4*) Should national security require the use of explosives that could potentially result in the take of marine mammals during training or testing within the Agat Bay Nearshore Geographic Mitigation Area, Naval units must obtain permission from the appropriate designated Command authority prior to commencement of the activity. Navy personnel must provide NMFS with advance notification and include the information (*e.g.,* explosives usage) in its annual activity reports submitted to NMFS.

(B) [Reserved]

§ 218.95 Requirements for monitoring and reporting.

(a) *Unauthorized take.* Navy personnel must notify NMFS immediately (or as soon as operational security considerations allow) if the specified activity identified in § 218.90 is thought to have resulted in the mortality or serious injury of any marine mammals, or in any Level A harassment or Level B harassment take of marine mammals not identified in this subpart.

(b) *Monitoring and reporting under the LOA.* The Navy must conduct all monitoring and reporting required under the LOA, including abiding by the MITT Study Area monitoring program. Details on program goals, objectives, project selection process, and current projects are available at *www.navymarinespeciesmonitoring.us.*

(c) *Notification of injured, live stranded, or dead marine mammals.* The Navy must consult the Notification and Reporting Plan, which sets out notification, reporting, and other requirements when dead, injured, or live stranded marine mammals are detected. The Notification and Reporting Plan is available at *https://www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-military-readiness-activities.*

(d) *Annual MITT Study Area marine species monitoring report.* The Navy must submit an annual report of the MITT Study Area monitoring describing the implementation and results from the previous calendar year. Data collection methods must be standardized across range complexes and study areas to allow for comparison in different geographic locations. The report must be submitted to the Director, Office of Protected Resources, NMFS, either within three months after the end of the calendar year, or within three months after the conclusion of the monitoring year, to be determined by the Adaptive Management process. This report will describe progress of knowledge made with respect to intermediate scientific objectives within the MITT Study Area associated with the Integrated Comprehensive Monitoring Program (ICMP). Similar study questions must be treated together so that progress on each topic can 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 will describe progress of knowledge made with respect to monitoring study questions across multiple Navy ranges associated with the ICMP. Similar study questions must be treated together so that progress on each topic can 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 the Navy to provide a cohesive monitoring report covering multiple ranges (as per ICMP goals), rather than entirely separate reports for the MITT, Hawaii-Southern California, Gulf of Alaska, and Northwest Study Areas.

(e) *Annual MITT Study Area training exercise report and testing activity reports.* Each year, the Navy must 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 the LOA to the Director, Office of Protected Resources, NMFS. Each year, the Navy must submit a detailed report to the Director, Office of Protected Resources, NMFS, within three months after the one-year anniversary of the date of issuance of the LOA. The MITT Annual Training Exercise Report and Testing Activity

Report 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 report must contain information on the total hours of operation of MFI surface ship hull-mounted mid-frequency active sonar used in the Marpi Reef and Chalan Kanoa Reef Geographic Mitigation Areas, major training exercises (MTEs), Sinking Exercise (SINKEX) events, and a summary of all sound sources used, including within specific mitigation reporting areas as described in paragraph (e)(3) of this section. The analysis in the detailed report must be based on the accumulation of data from the current year's report and data collected from previous annual reports. The annual report will also contain cumulative sonar and explosive use quantity from previous years' reports through the current year. Additionally, if there were any changes to the sound source allowance in a given year, or cumulatively, the report would include a discussion of why the change was made and include analysis to support how the change did or did not affect the analysis in the MITT EIS/OEIS and MMPA final rule. The annual report would also include the details regarding specific requirements associated with specific mitigation areas. The analysis in the detailed report would be based on the accumulation of data from the current year's report and data collected from previous reports. The final annual/close-out report at the conclusion of the authorization period (year seven) would also serve as the comprehensive close-out report and include both the final year annual use compared to annual authorization as well as a cumulative seven-year annual use compared to seven-year authorization. The detailed reports must contain information identified in paragraphs (e)(1) through (6) of this section.

(1) *MTEs.* This section of the report must contain the following information for MTEs conducted in the MITT 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, and other platforms participating in exercise.

(G) Total hours of all active sonar source operation.

(H) Total hours of each active sonar source bin.

(I) Wave height (high, low, and average) during exercise.

(ii) Individual marine mammal sighting information for each sighting in each exercise where mitigation was implemented:

(A) Date/Time/Location of sighting.

(B) Species (if not possible, indication of whale or dolphin).

(C) Number of individuals.

(D) Initial Detection Sensor (*e.g.,* sonar, Lookout).

(E) Indication of specific type of platform observation was 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 was less than 200 yd, 200 to 500 yd, 500 to 1,000 yd, 1,000 to 2,000 yd, or greater than 2,000 yd from sonar source.

(K) Whether operation of sonar sensor was delayed, or sonar was powered or shut down, and how long the delay.

(L) If source in use was hull-mounted, true bearing of animal from the vessel, true direction of vessel's travel, and estimation of animal's motion relative to vessel (opening, closing, parallel).

(M) Lookouts must 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.) and if any calves were 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 must identify the specific observations that support any conclusions the Navy reaches about the effectiveness of the mitigation.

(2) *SINKEXs.* This section of the report must 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, and other platforms, participating in exercise.

(H) Wave height in feet (high, low, and average) during exercise.

(I) 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 for each sighting where mitigation was implemented.

(A) Date/Time/Location of sighting.

(B) Species (if not possible, indicate whale or dolphin).

(C) Number of individuals.

(D) Initial detection sensor (*e.g.,* sonar or Lookout).

(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 (or target spot if not yet detonated): Less than 200 yd, 200 to 500 yd, 500 to 1,000 yd, 1,000 to 2,000 yd, or greater than 2,000 yd.

(J) Lookouts must 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 were present.

(K) The report must indicate whether explosive detonations were delayed, ceased, modified, or not modified due to marine mammal presence and for how long.

(L) If observation occurred while explosives were detonating in the water, indicate munition type in use at time of marine mammal detection.

(3) *Summary of sources used.* This section of the report must 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 transducers and

(ii) Total annual expended/detonated ordinance (missiles, bombs, sonobuoys, etc.) for each explosive bin.

(4) *MITT Study Area Mitigation Areas.* The Navy must 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 MITT Study Area.

(5) *Geographic information presentation.* The reports must present an annual (and seasonal, where practical) depiction of training and testing bin usage geographically across the MITT Study Area.

(6) *Sonar exercise notification.* The Navy must submit to NMFS (contact as specified in the LOA) an electronic report within fifteen calendar days after the completion of any MTE indicating: (i) Location of the exercise; (ii) Beginning and end dates of the exercise; and (iii) Type of exercise.

(f) *Seven-year annual/close-out report.* The final (year seven) draft annual/close-out report must be submitted within three months after the expiration of this subpart to the Director, Office of Protected Resources, NMFS. NMFS must submit comments on the draft close-out report, if any, within three months of receipt. The report will be considered final after the Navy has addressed NMFS' comments, or three months after the submittal of the draft if NMFS does not provide comments.

§ 218.96 Letters of Authorization.

(a) To incidentally take marine mammals pursuant to the regulations in this subpart, the Navy must apply for and obtain an LOA in accordance with § 216.106 of this chapter.

(b) An LOA, unless suspended or revoked, may be effective for a period of time not to exceed August 3, 2027.

(c) If an LOA expires prior to August 3, 2027, the Navy may apply for and obtain a renewal of the LOA.

(d) In the event of projected changes to the activity or to mitigation, monitoring, or reporting (excluding changes made pursuant to the adaptive management provision of § 218.97(c)(1)) required by an LOA issued under this subpart, the Navy must apply for and obtain a modification of the LOA as described in § 218.97.

(e) Each LOA will set forth:

(1) Permissible methods of incidental taking;

(2) Geographic areas for incidental taking;

(3) Means of effecting the least practicable adverse impact (*i.e.,* mitigation) on the species or stocks of marine mammals and their habitat; and

(4) Requirements for monitoring and reporting.

(f) Issuance of the LOA(s) must be based on a determination that the level of taking is consistent with the findings made for the total taking allowable under the regulations in this subpart.

(g) Notice of issuance or denial of the LOA(s) will be published in the **Federal Register** within 30 days of a determination.

§ 218.97 Renewals and modifications of Letters of Authorization.

(a) An LOA issued under §§ 216.106 of this chapter and 218.96 for the activity identified in § 218.90(c) may be renewed or modified upon request by the applicant, provided that:

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

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

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

(c) An LOA issued under §§ 216.106 of this chapter and 218.96 may be modified by NMFS under the following circumstances:

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

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

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

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

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

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

(2) *Emergencies.* If NMFS determines that an emergency exists that poses a significant risk to the well-being of the species or stocks of marine mammals specified in LOAs issued pursuant to §§ 216.106 of this chapter and 218.96, 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.

§ 218.98 [Reserved]

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