FEDERAL REGISTER

Vol. 80 Wednesday,
No. 106 June 3, 2015

Part IV

Department of Commerce

National Oceanic and Atmospheric Administration

50 CFR Part 218

Takes of Marine Mammals Incidental to Specified Activities; U.S. Navy Training and Testing Activities in the Northwest Training and Testing Study Area; Proposed Rule

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 218

[Docket No. 140109018–5464–01]

RIN 0648–BD89

Takes of Marine Mammals Incidental to Specified Activities; U.S. Navy Training and Testing Activities in the Northwest Training and Testing Study Area

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

ACTION: Proposed rule; request for comments and information.

SUMMARY: NMFS has received a request from the U.S. Navy (Navy) for authorization to take marine mammals incidental to the training and testing activities conducted in the Northwest Training and Testing (NWTT) study area from November 2015 through November 2020. Pursuant to the Marine Mammal Protection Act (MMPA), NMFS is requesting comments on its proposal to issue regulations and subsequent Letters of Authorization (LOAs) to the Navy to incidentally harass marine mammals. The Navy has also requested that NMFS authorize modifications to watchstander requirements for observed behavior of marine mammals during Major Training Events (MTEs) in the Hawaii-Southern California Training and Testing (HSTT), Atlantic Fleet Training and Testing (AFTT), Mariana Islands Training and Testing (MITT), and Gulf of Alaska Training (GOA) study areas. Modifications to the Navy watchstander requirements would require a revision to regulatory text in current regulations governing the taking and importing of marine mammals during testing and/or training activities in these study areas. There are no MTEs associated with Navy training and testing activities in the NWTT study area.

DATES: Comments and information must be received no later than July 17, 2015.

ADDRESSES: You may submit comments, identified by NOAA–NMFS–2015–0031, by any of the following methods:

- *Electronic submissions:* submit all electronic public comments via the Federal eRulemaking Portal, Go to *www.regulations.gov/#!docketDetail;D=NOAA-NMFS-2015-0031,* click the ''Comment Now!'' icon, complete the required fields, and enter or attach your comments.
- *Mail:* Submit comments to Jolie Harrison, Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service, 1315 East-West Highway, Silver Spring, MD 20910–3225.
- *Fax: (301) 713–0376; Attn: Jolie Harrison.*

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

FOR FURTHER INFORMATION CONTACT: John Fiorentino, Office of Protected Resources, NMFS, (301) 427–8477.

SUPPLEMENTARY INFORMATION:

Availability

A copy of the Navy's LOA application, which contains a list of the references used in this document, may be obtained by visiting the internet at: *http://www.nmfs.noaa.gov/pr/permits/incidental/military.htm.* The Navy also prepared a Draft Environmental Impact Statement (DEIS)/Overseas Environmental Impact Statement (OEIS) to assess the environmental impacts associated with ongoing and proposed training and testing activities in the NWTT Study Area. The NWTT DEIS/OEIS was released to the public on January 24, 2014 (79 FR 4158) for review until April 15, 2014. On October 24, 2014 (79 FR 63610), the Navy published a Notice of Intent (NOI) to prepare a Supplement to the January 2014 NWTT DEIS/OEIS. The Supplement was released to the public on December 19, 2014 (79 FR 75800) for review until February 2, 2015. The Navy is the lead agency for the NWTT EIS/OEIS, and NMFS and the U.S. Coast Guard are cooperating agencies pursuant to 40 CFR 1501.6 and 1508.5. The January 2014 NWTT DEIS/OEIS and the December 2014 Supplement, which contain a list of the references used in this document, may be viewed at: *http://www.nwtteis.com.* Documents cited in this notice may also be viewed, by appointment, during regular business hours, at the aforementioned address.

Background

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

Authorization for incidental takings shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s), will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (where relevant), and if the permissible methods of taking and requirements pertaining to the mitigation, monitoring, and reporting of such takings are set forth. NMFS has defined ''negligible impact'' in 50 CFR 216.103 as ''an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival.''

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

Summary of Request

NWTT Proposed Rule

On December 18, 2013, NMFS received an application from the Navy requesting two LOAs for the take of 26 species of marine mammals incidental to Navy training and testing activities to be conducted in the NWTT Study Area over 5 years. On September 26, 2014, the Navy submitted a revised LOA application to reflect updates to exposure estimates based on emergent changes to specific types of training activities. The revised application also provided an update to the effects analysis for Guadalupe fur seals (summarized in the Analysis of Guadalupe Fur Seal Exposures section of this proposed rule) to more realistically reflect potential impacts from offshore Navy training and testing events. On November 7, 2014, the Navy submitted a revised LOA application to address: (a) An inadvertent error in the recommended mitigation zone for mine countermeasure and neutralization training events; (b) removal of the time delay firing underwater explosive training activity; and (c) correction or clarification of certain mitigation measures applied to testing. On April 2, 2015, the Navy submitted a final revision to the LOA application (hereinafter referred to as the LOA application) to incorporate and update population density estimates for the Hood Canal stock of harbor seals.

The Navy is requesting separate 5-year LOAs for training and testing activities to be conducted from 2015 through 2020. The Study Area includes the existing Northwest Training Range Complex, the Keyport Range Complex, Carr Inlet Operations Area, Southeast Alaska Acoustic Measurement Facility (SEAFAC), and Navy pierside locations where sonar maintenance or testing may occur (see Figure 1–1 of the LOA application for a map of the NWTT Study Area). The activities conducted within the NWTT Study Area are classified as military readiness activities. The Navy states that these activities may expose some of the marine mammals present within the NWTT Study Area to sound from underwater acoustic sources and explosives. The Navy is requesting authorization to take 26 marine mammal species by Level B (behavioral) harassment; 4 of those marine mammal species may be taken by injury (Level A harassment).

The LOA application and the January 2014 NWTT DEIS/OEIS contain proposed acoustic thresholds that were used to evaluate the Navy's AFTT and HSTT activities. The thresholds are based on evaluation of recent scientific studies; a detailed explanation of how they were derived is provided in the Criteria and Thresholds for Navy Acoustic Effects Analysis Technical Report (Finneran and Jenkins, 2012). NMFS is currently updating and revising all of its acoustic thresholds. Until that process is complete, NMFS will continue its long-standing practice of considering specific modifications to the acoustic thresholds currently employed for incidental take authorizations only after providing the public with an opportunity for review and comment. NMFS is requesting comments on all aspects of the proposed rule.

Modifications to HSTT, AFTT, MITT, and GOA Final Rules

The Navy is also requesting that NMFS authorize modifications to watchstander requirements, unrelated to implementation of mitigation measures, for observed behavior of marine mammals during MTEs in the HSTT, AFTT, MITT, and GOA study areas. With these proposed modifications the Navy would no longer be required to report individual marine mammal sighting information during MTEs when mitigation is not occurring in the study area. After 5 years of collecting marine mammal sighting data for all animals sighted during MTEs, NMFS and Navy have determined that without the ability to obtain species information this data set does not provide for any meaningful analysis beyond that which may be possible using mitigation-related observations alone. The Navy and NMFS have thoroughly investigated several potential uses for the data prior to reaching this conclusion. Additionally, this reporting requirement places an undue administrative burden on ships watch teams. The Navy will continue to collect marine mammal sighting data during MTEs for every instance when any form of mitigation is employed such as powering down or securing sonar, maneuvering the ship, or delaying an event—in other words, in instances where animals are closer to the sound source around which mitigation measures are implemented. This data is useful in supporting mitigation effectiveness analyses and also may be helpful in supporting an understanding of the frequency with which marine mammals (generally, not by species) may be encountered or detected in close proximity to a particular source (*e.g.,* where the likelihood of auditory or other injury is higher). Additionally, the Navy will continue to implement their separate Integrated Comprehensive Monitoring Program, which includes studies that are specifically designed to contribute to our understanding of the animals affected and how Navy training and testing impacts them.

These modifications would be implemented through the revision of regulatory text for existing regulations governing the taking of marine mammals incidental to testing and/or training activities in HSTT, AFTT, MITT, and GOA study areas. Proposed revisions to the regulatory text are provided in the regulatory text at the end of this proposed rule. Proposed revisions to MITT regulatory text will be made in the MITT final rule, which is currently being prepared concurrent with the NWTT proposed rule and is expected to publish in the **Federal Register** prior to the NWTT final rule. There are no MTEs or marine mammal sighting reporting requirements associated with Navy training and testing activities in the NWTT study area.

Background of Request

The Navy's mission is to maintain, train, and equip combat-ready naval forces capable of winning wars, deterring aggression, and maintaining freedom of the seas. Section 5062 of Title 10 of the United States Code directs the Chief of Naval Operations to train all military forces for combat. The Chief of Naval Operations meets that direction, in part, by conducting at-sea training exercises and ensuring naval forces have access to ranges, operating areas (OPAREAs) and airspace where they can develop and maintain skills for wartime missions and conduct research, development, testing, and evaluation (RDT&E) of naval systems.

The Navy proposes to continue conducting training and testing activities within the NWTT Study Area, which have been ongoing for decades with some activities dating back to at least the early 1900s. 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 war fighting doctrine and procedures, and force structure (organization of ships, submarines, aircraft, weapons, and personnel) changes. Such developments influence the frequency, duration, intensity, and location of required training and testing activities. The Navy analyzed many training and testing activities in the Study Area in the Tactical Training Theater Assessment and Planning Program Phase I and earlier documents, specifically the following environmental planning documents: Northwest Training Range Complex Final EIS/OEIS (U.S. Department of the Navy, 2010a), NAVSEA NUWC Keyport Range Complex Extension Final EIS/OEIS (U.S. Department of the Navy, 2010b), and the Final EIS for the Southeast Alaska Acoustic Measurement Facility (SEAFAC) (U.S. Department of the Navy, 1988). The Navy's LOA request covers training and testing activities that would occur for a 5-year period following the expiration of the first of the two current MMPA authorizations

(Northwest Training Range Complex; Keyport Range Complex). The Navy has also prepared and released to the public a January 2014 DEIS/OEIS analyzing the effects on the human environment of implementing their preferred alternative (among others). The January 2014 NWTT DEIS/OEIS (which is part of Phase II of the program) accounts for planned adjustments to tempo and types of activities dictated by military readiness requirements. A NOI to prepare a Supplement to the January 2014 NWTT DEIS/OEIS was published on October 24, 2014 and the draft Supplement was released to the public on December 19, 2014. The Supplement focused on changes to the Proposed Action due to updated training requirements and significant new information relevant to environmental concerns per 40 CFR 1502.9.

The Navy's LOA application differs from the January 2014 NWTT DEIS/OEIS in that it contains updated information on the Washington Inland Waters stocks of harbor seals (Carretta *et al.,* 2014) and their abundance in Hood Canal based on a new application of London *et al.* (2012). The January 2014 NWTT DEIS/OEIS analysis relied on NMFS' Stock Assessment Reports (SARs) through 2013 (Carretta *et al.,* 2014), which did not incorporate the London *et al.* findings. London *et al.* (2012) reported the variability of harbor seal haulout behavior in a sub-portion of Hood Canal, covering 5 months of the year (July-November). The paper provided a range of haulout probabilities in Hood Canal that differed from the single value (65 percent—Huber *et al.,* 2001) previously used by NMFS and Navy to calculate harbor seal abundance. Recently, in discussions between the Navy and NMFS it was determined that it is now appropriate to incorporate London *et al.* (2012) for the Hood Canal stock only. This resulted in increasing the population estimate of the Hood Canal stock of harbor seals by a factor of approximately 3.26, resulting in a new abundance estimate of 3,555. In addition, in calculating its exposure estimates, the Navy also applied the haulout probability of 20 percent derived from London *et al.* (2012) which changed the percentage of harbor seals in the water from 35 percent (Huber *et al.,* 2001) to 80 percent. These changes in assumptions result in a corresponding increase in estimated exposures because the Navy is assuming that there are more harbor seals present in Hood Canal and more of the animals will be in the water at any given time compared to the analysis presented in the January 2014 NWTT DEIS/OEIS.

The result of these changes in the best available science is that the Navy has estimated additional Level A and Level B takes for training and testing activities per year. These changes to the estimates presented in the January 2014 NWTT DEIS/OEIS do not reflect a change in the Navy's proposed action nor a significant change to Navy's methodology. The vast majority of the increased exposure estimates are Level B harassment exposures that derive from the Navy's already conservative acoustic effects model. The Navy has determined that these Level A and Level B harassment exposures are not biologically significant to the population because (1) none of the estimated exposures result in mortality; (2) the monitoring and mitigations employed would likely reduce the severity of Level A exposures; (3) there are no indications that the historically occurring activities resulting in these behavioral harassment exposures are having any effect on this population's survival by altering behavior patterns such as breeding, nursing, feeding, or sheltering; (4) the population has been stable and likely at carrying capacity (Jeffries *et al.,* 2003); (5) the population continues to use known large haulouts in Hood Canal and Dabob Bay that are adjacent to Navy testing and training activities; (6) the population continues to use known haulouts for pupping; and (7) the population continues to use the waters in and around Dabob Bay and Hood Canal. As such, the Navy has determined, and NMFS concurs, that it is not necessary to supplement the January 2014 NWTT DEIS/OEIS analysis as this information is not new significant information to the environmental impacts. However, the Navy has advised NMFS that all comments received on the proposed rule that address the changes in take estimates for the Hood Canal stock of harbor seals will be addressed by the Navy in its Final EIS/OEIS for NWTT.

Description of the Specified Activity

The Navy is requesting authorization to take marine mammals incidental to conducting training and testing activities. The Navy has determined that sonar use and underwater detonations are the stressors most likely to result in impacts on marine mammals that could rise to the level of harassment. Detailed descriptions of these activities are provided in the January 2014 NWTT DEIS/OEIS and in the LOA application (*http://www.nmfs.noaa.gov/pr/permits/incidental/military.htm*) and are summarized here.

Overview of Training Activities

The Navy routinely trains in the NWTT Study Area in preparation for national defense missions. Training activities and exercises covered in the Navy's LOA request are briefly described below, and in more detail within Chapter 2 of the January 2014 NWTT DEIS/OEIS. Training activities are categorized into eight functional warfare areas (anti-air warfare; amphibious warfare; strike warfare; anti-surface warfare; anti-submarine warfare; electronic warfare; mine warfare; and naval special warfare). The Navy determined that the following stressors used in these warfare areas are most likely to result in impacts on marine mammals:

- Anti-surface warfare (impulsive sources [underwater detonations])
- Anti-submarine warfare (non-impulsive sources [active sonar], impulsive underwater detonations)
- Mine warfare (non-impulsive sources, impulsive underwater detonations)

The Navy's activities in anti-air warfare, electronic warfare, and naval special warfare do not involve stressors that could result in harassment of marine mammals. Therefore, these activities are not discussed further. The analysis and rationale for excluding these warfare areas is contained in the January 2014 DEIS/OEIS.

Anti-Surface Warfare

The mission of anti-surface warfare (ASUW) is to defend against enemy ships or boats. When conducting anti-surface warfare, aircraft use cannons, air-launched cruise missiles, or other precision-guided munitions; ships use torpedoes, naval guns, and surface-to-surface missiles; and submarines use torpedoes or submarine-launched, anti-ship cruise missiles. Anti-surface warfare training includes surface-to-surface gunnery and missile exercises, air-to-surface gunnery and missile exercises, and submarine missile or exercise torpedo launch events.

Anti-Submarine Warfare

The mission of anti-submarine warfare (ASW) is to locate, neutralize, and defeat hostile submarine threats to surface forces. Anti-submarine warfare is based on the principle of a layered defense of surveillance and attack aircraft, ships, and submarines all searching for hostile submarines. These forces operate together or independently to gain early warning and detection, and to localize, track, target, and attack hostile submarine threats. Anti-submarine warfare training addresses basic skills such as detection and classification of submarines, distinguishing between sounds made by enemy submarines and those of friendly submarines, ships, and marine life. More advanced, integrated anti-submarine warfare training exercises are conducted in coordinated, at-sea training events involving submarines, ships, and aircraft. This training integrates the full spectrum of anti-submarine warfare from detecting and tracking a submarine to attacking a target using either exercise torpedoes or simulated weapons.

Mine Warfare

The mission of mine warfare is to detect, and avoid or neutralize mines to protect Navy ships and submarines and to maintain free access to ports and shipping lanes. Mine warfare also includes offensive mine laying to gain control or deny the enemy access to sea space. Naval mines can be laid by ships, submarines, or aircraft. Mine warfare training includes exercises in which ships, aircraft, submarines, underwater vehicles, or marine mammal detection systems search for mines. Certain personnel train to destroy or disable mines by attaching and detonating underwater explosives to simulated mines. Other neutralization techniques involve impacting the mine with a bullet-like projectile or intentionally triggering the mine to detonate.

Other Activities

Other activities include pierside and at-sea maintenance of submarine and surface ship sonar systems.

Overview of Testing Activities

Testing activities covered in the Navy's LOA request are briefly described below, and in more detail within Chapter 2 of the January 2014 NWTT DEIS/OEIS. The Navy researches, develops, tests, and evaluates new platforms, systems and technologies. Many tests are conducted in realistic conditions at sea, and can range in scale from testing new software to operating portable devices to conducting tests of live weapons (such as the Service Weapon Test of a torpedo) to ensure they function as intended. Testing activities may occur independently of or in conjunction with training activities.

Many testing activities are conducted similarly to Navy training activities and are also categorized under one of the primary mission areas described above. Other testing activities are unique and are described within their specific testing categories. Because each test is conducted by a specific component of the Navy's research and acquisition community, which includes the Navy's Systems Commands and the Navy's scientific research organizations, the testing activities described in the LOA application are organized first by that particular organization as described below and in the order as presented.

The Navy describes and analyzes the effects of its testing activities within the 2014 NWTT DEIS/OEIS. In its assessment, the Navy concluded that acoustic stressors from the use of underwater acoustic sources and underwater detonations resulted in impacts on marine mammals that rose to the level of harassment as defined under the MMPA. Therefore, the LOA application for NWTT provides the Navy's assessment of potential effects from these stressors in terms of the various activities in which they would be used.

The individual commands within the research and acquisition community included in the NWTT DEIS/OEIS and in the LOA application are:

- Naval Sea Systems Command (NAVSEA). Within NAVSEA are the following field activities:
  - Naval Undersea Warfare Center (NUWC) Division, Keyport
  - Naval Surface Warfare Center, Carderock Division (NSWCCD), Detachment Puget Sound
  - NSWCCD Southeast Alaska Acoustic Measurement Facility (SEAFAC)
  - Puget Sound Naval Shipyard and Intermediate Maintenance Facility
  - Various NAVSEA program offices
- Naval Air Systems Command (NAVAIR)

Naval Sea Systems Command Testing Events

NAVSEA is responsible for engineering, building, buying, and maintaining the Navy's ships and submarines and associated combat systems. NAVSEA is broken up into two types of warfare centers: NUWC and the Naval Surface Warfare Center (NSWC).

NUWC provides Fleet readiness support for submarines, surface ships, torpedoes, mines, land attack systems, and Fleet training systems. NAVSEA has several field activities operating out of Naval Base (NAVBASE) Kitsap, including NUWC Division Keyport, NSWCCD Detachment Puget Sound, and Puget Sound Naval Shipyard and Intermediate Maintenance Facility. NSWCCD Detachment Puget Sound also operates the SEAFAC facility in Alaska.

Each major category of NAVSEA activities in the Study Area is represented below. NUWC Division, Keyport and NSWCCD Detachment Puget Sound activities are grouped together in the discussion below to simplify review due to the diversity of activity types and locations they work in. Puget Sound Naval Shipyard and Intermediate Facility activities are grouped with the general activities conducted by NAVSEA. Numerous test activities and technical evaluations, in support of NAVSEA's systems development mission, often occur in conjunction with fleet activities within the Study Area.

Naval Undersea Warfare Center Division, Keyport Testing Activities

NUWC Division Keyport's mission is to provide test and evaluation services and expertise to support the Navy's evolving manned and unmanned vehicle program activities. NUWC Keyport has historically provided facilities and capabilities to support testing of torpedoes, other unmanned vehicles, submarine readiness, diver training, and similar activities that are critical to the success of undersea warfare. Range support requirements for such activities include testing, training, and evaluation of system capabilities such as guidance, control, and sensor accuracy in multiple marine environments (*e.g.*, differing depths, salinity levels, sea states) and in surrogate and simulated war-fighting environments. Technological advancements in the materials, instrumentation, guidance systems, and tactical capabilities of manned and unmanned vehicles continue to evolve in parallel with emerging national security priorities and threat assessments. However, NUWC Keyport does not utilize explosives in any testing scenarios.

Naval Surface Warfare Center, Carderock Division

NSWCCD includes two organizations that conduct testing activities: NSWCCD, Detachment Puget Sound and NSWCCD SEAFAC. Detachment Puget Sound testing activities are aligned with its mission to provide research, development, test, and evaluation (RDT&E), analysis, acquisition support, in-service engineering, logistics and integration of surface and undersea vehicles and associated systems; develop and apply science and technology associated with naval architecture and marine engineering; and provide support to the maritime industry. Activities and support include engineering, technical, operations, diving, and logistics required for the RDT&E associated with:

- Advanced Technology Concepts, Engineering and Proofing

- Experimental Underwater Vehicles, Systems, Subsystems and Components
- Specialized Underwater Systems, Equipment, Tools and Hardware
- Acoustic Data Acquisition, Analysis and Measurement Systems (required to measure U.S. Navy Acoustic Signatures).

These activities can be broken down into four major testing categories to include: System, Subsystem and Component Acoustic Testing Pierside; Performance Testing at Sea; Development Testing and Training; and Proof of Concept Testing.

NSWCCD SEAFAC makes high fidelity directive volumetric and line arrays passive acoustic signature measurements. The SEAFAC site includes directive line arrays and data collection and processing systems for real-time data analysis and signature evaluation.

SEAFAC provides the capability to perform RDT&E analyses to determine the sources of radiated acoustic noise, to assess vulnerability, and to develop quieting measures. Unforeseen emergent Navy requirements may influence actual testing activities during the time period under consideration. Testing activities that would occur at SEAFAC are identified to the extent practicable throughout this application.

Naval Sea Systems Command Program Office Sponsored Testing Activities

NAVSEA also conducts tests that are not associated with NUWC Keyport or NSWCCD. Activities are conducted at Navy piers at NAVBASE Kitsap, Bremerton; NAVBASE Kitsap, Bangor; and Naval Station Everett; and in conjunction with fleet activities off the coast of Washington, Oregon, and northern California. Tests within this category include, but are not limited to, Life Cycle Activities, Shipboard Protection Systems and Swimmer Defense Testing, Unmanned Vehicle Testing, ASUW/ASW Testing, and New Ship Construction.

Naval Air Systems Command Testing Events

NAVAIR testing events generally fall into the primary mission areas used by the fleets. NAVAIR events include, but are not limited to, the testing of new aircraft platforms, weapons, and systems before those platforms, weapons and systems are integrated into the fleet. In this application, NAVAIR testing activities are limited to ASW testing of sonobuoys. The sonobuoys tested include both passive and active non-impulsive, sonobuoys using impulsive sources, and high duty cycle sonobuoys.

Description of Sonar, Ordnance, Targets, and Other Systems

The Navy uses a variety of sensors, platforms, weapons, and other devices to meet its mission. Training and testing with these systems may introduce acoustic (sound) energy into the environment. This section describes and organizes sonar systems, ordnance, munitions, targets, and other systems to facilitate understanding of the activities in which these systems are used. Underwater sound is described as one of two types for the purposes of the LOA application: impulsive and non-impulsive. Underwater detonations of explosives and other percussive events are impulsive sounds. Sonar and similar sound producing systems are categorized as non-impulsive sound sources.

Sonar and Other Active Acoustic Sources

Modern sonar technology includes a variety of sonar sensor and processing systems. The simplest active sonar emits sound waves, or ''pings,'' sent out in multiple directions and the sound waves then reflect off of the target object in multiple directions. The sonar source calculates the time it takes for the reflected sound waves to return; this calculation determines the distance to the target object. More sophisticated active sonar systems emit a ping and then rapidly scan or listen to the sound waves in a specific area. This provides both distance to the target and directional information. Even more advanced sonar systems use multiple receivers to listen to echoes from several directions simultaneously and provide efficient detection of both direction and distance. The Navy rarely uses active sonar continuously throughout activities. When sonar is in use, the pings occur at intervals, referred to as a duty cycle, and the signals themselves are very short in duration. For example, sonar that emits a 1-second ping every 10 seconds has a 10-percent duty cycle. The Navy utilizes sonar systems and other acoustic sensors in support of a variety of mission requirements. Primary uses include the detection of and defense against submarines (anti-submarine warfare) and mines (mine warfare); safe navigation and effective communications; use of unmanned undersea vehicles; and oceanographic surveys. Sources of sonar and other active acoustic sources include surface ship sonar, sonobuoys, torpedoes, range pingers, and unmanned underwater vehicles.

Ordnance and Munitions

Most ordnance and munitions used during training and testing events fall into three basic categories: projectiles (such as gun rounds), missiles (including rockets), and bombs. Ordnance can be further defined by their net explosive weight, which considers the type and quantity of the explosive substance without the packaging, casings, bullets, etc. Net explosive weight (NEW) is the trinitrotoluene (TNT) equivalent of energetic material, which is the standard measure of strength of bombs and other explosives. For example, a 12.7-centimeter (cm) shell fired from a Navy gun is analyzed at about 9.5 pounds (lb) (4.3 kilograms (kg)) of NEW. The Navy also uses non-explosive ordnance in place of high explosive ordnance in many training and testing events. Non-explosive ordnance munitions look and perform similarly to high explosive ordnance, but lack the main explosive charge.

Defense Countermeasures

Naval forces depend on effective defensive countermeasures to protect themselves against missile and torpedo attack. Defensive countermeasures are devices designed to confuse, distract, and confound precision guided munitions. Defensive countermeasures analyzed in the LOA application include acoustic countermeasures, which are used by surface ships and submarines to defend against torpedo attack. Acoustic countermeasures are either released from ships and submarines, or towed at a distance behind the ship.

Mine Warfare Systems

The Navy divides mine warfare systems into two categories: Mine detection and mine neutralization. Mine detection systems are used to locate, classify, and map suspected mines, on the surface, in the water column, or on the sea floor. The Navy analyzed the following mine detection systems for potential impacts to marine mammals:

- Towed or hull-mounted mine detection systems. These detection systems use acoustic and laser or video sensors to locate and classify suspect mines. Fixed and rotary wing platforms, ships, and unmanned vehicles are used for towed systems, which can rapidly assess large areas.
- Airborne Laser Mine Detection Systems. Airborne laser detection systems work in concert with neutralization systems. The detection system initially locates mines and a neutralization system is then used to relocate and neutralize the mine.

• Unmanned/remotely operated vehicles. These vehicles use acoustic and video or lasers to locate and classify mines and provide unique capabilities in nearshore littoral areas, surf zones, ports, and channels.

Mine neutralization systems disrupt, disable, or detonate mines to clear ports and shipping lanes, as well as littoral, surf, and beach areas in support of naval amphibious operations. Mine neutralization systems can clear individual mines or a large number of mines quickly. The Navy analyzed the following mine neutralization systems for potential impacts to marine mammals:

• Towed influence mine sweep systems. These systems use towed equipment that mimic a particular ship's magnetic and acoustic signature triggering the mine and causing it to explode.

• Towed mechanical mine sweeping systems.These systems tow a sweep wire to snag the line that attaches a moored mine to its anchor and then uses a series of cables and cutters to sever those lines. Once these lines are cut, the mines float to the surface where Navy personnel can neutralize the mines.

• Unmanned/remotely operated mine neutralization systems. Surface ships and helicopters operate these systems, which place explosive charges near or directly against mines to destroy the mine.

• Projectiles. Small- and medium-caliber projectiles, fired from surface ships or hovering helicopters, are used to neutralize floating and near-surface mines.

• Diver emplaced explosive charges. Operating from small craft, divers put explosive charges near or on mines to destroy the mine or disrupt its ability to function.

Explosive charges are used during mine neutralization system training activities; however, only non-explosive mines or mine shapes would be used.

Classification of Non-Impulsive and Impulsive Sources Analyzed

In order to better organize and facilitate the analysis of about 300 sources of underwater non-impulsive sound or impulsive energy, the Navy developed a series of source classifications, or source bins. This method of analysis provides the following benefits:

• Allows for new sources to be covered under existing authorizations, as long as those sources fall within the parameters of a ''bin;''

• Simplifies the data collection and reporting requirements anticipated under the MMPA;

• Ensures a conservative approach to all impact analysis because all sources in a single bin are modeled as the loudest source (*e.g.*, lowest frequency, highest source level, longest duty cycle, or largest net explosive weight within that bin);

• Allows analysis to be conducted more efficiently, without compromising the results;

• Provides a framework to support the reallocation of source usage (hours/explosives) between different source bins, as long as the total number and severity of marine mammal 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.

A description of each source classification is provided in Tables 1–3. Non-impulsive sources are grouped into bins based on the frequency, source level when warranted, and how the source would be used. Impulsive bins are based on the net explosive weight of the munitions or explosive devices. The following factors further describe how non-impulsive sources are divided:

• Frequency of the non-impulsive source:

○ Low-frequency sources operate below 1 kilohertz (kHz)

○ Mid-frequency sources operate at or 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

• Source level of the non-impulsive source:

○ Greater than 160 decibels (dB), but less than 180 dB

○ Equal to 180 dB and up to 200 dB

○ Greater than 200 dB

How a sensor is used determines how the sensor's acoustic emissions are analyzed. Factors to consider include pulse length (time source is on); beam pattern (whether sound is emitted as a narrow, focused beam, or, as with most explosives, in all directions); and duty cycle (how often a transmission occurs in a given time period during an event).

There are also non-impulsive sources with characteristics that are not anticipated to result in takes of marine mammals. These sources have low source levels, narrow beam widths, downward directed transmission, short pulse lengths, frequencies beyond known hearing ranges of marine mammals, or some combination of these factors. These sources were not modeled by the Navy, but are qualitatively analyzed in Table 1–4 of the LOA application and in the January 2014 NWTT DEIS/OEIS. These sources generally meet the following criteria:

• Acoustic sources with frequencies greater than 200 kHz (based on known marine mammal hearing ranges)

• Sources with source levels less than 160 dB

TABLE 1—IMPULSIVE TRAINING AND TESTING SOURCE CLASSES ANALYZED

Source class	Representative munitions	Net explosive weight (lbs)
E1	Medium-caliber projectiles	0.1–0.25 (45.4–113.4 g).
E3	Large-caliber projectiles	>0.5–2.5 (>226.8 g–1.1 kg).
E4	Improved Extended Echo Ranging Sonobuoy	>2.5–5.0 (1.1–2.3 kg).
E5	5 in. (12.7 cm) projectiles	>5–10 (>2.3–4.5 kg).
E8	250 lb. (113.4 kg) bomb	>60–100 (>27.2–45.4 kg).
E10	1,000 lb. (453.6 kg) bomb	>250–500 (>113.4–226.8 kg).
E11	650 lb. (294.8 kg) mine	>500–650 (>226.8–294.8 kg).
E12	2,000 lb. (907.2 kg) bomb	>650–1,000 (>294.8–453.6 kg).

TABLE 2—NON-IMPULSIVE TRAINING SOURCE CLASSES ANALYZED

Source class category	Source class	Description
Mid-Frequency (MF): Tactical and non-tactical sources that produce mid-frequency (1 to 10 kHz) signals.	MF1	Active hull-mounted surface ship sonar (*e.g.*, AN/SQS–53C and AN/SQS–60).
	MF3	Active hull-mounted submarine sonar (*e.g.*, AN/BQQ–10).
	MF4	Active helicopter-deployed dipping sonar (*e.g.*, AN/AQS–22 and AN/AQS–13).
	MF5	Active acoustic sonobuoys (*e.g.*, AN/SSQ–62 DICASS[2]).
	MF11	Hull-mounted surface ship sonar with an active duty cycle greater than 80%.
High-Frequency (HF) and Very High-Frequency (VHF): Tactical and non-tactical sources that produce high-frequency (greater than 10 kHz but less than 200 kHz) signals.	HF1	Active hull-mounted submarine sonar (*e.g.*, AN/BQQ–15).
	HF4	Active mine detection, classification, and neutralization sonar (*e.g.*, AN/SQS–20).
	HF6	Active sources (equal to 180 dB and up to 200 dB).
Anti-Submarine Warfare (ASW): Tactical sources such as active sonobuoys and acoustic countermeasures systems used during ASW training activities.	ASW2	MF active Multistatic Active Coherent (MAC) sonobuoy (*e.g.*, AN/SSQ–125).
	ASW3	MF active towed active acoustic countermeasure systems (*e.g.*, AN/SLQ–25 NIXIE).

TABLE 3—NON-IMPULSIVE TESTING SOURCE CLASSES ANALYZED

Source class category	Source class	Description
Low-Frequency (LF): Sources that produce low-frequency (less than 1 kilohertz [kHz]) signals.	LF4	Low-frequency sources equal to 180 dB and up to 200 dB.
	LF5	Low-frequency sources less than 180 dB.
Mid-Frequency (MF): Tactical and non-tactical sources that produce mid-frequency (1 to 10 kHz) signals.	MF3	Hull-mounted submarine sonar (*e.g.*, AN/BQQ–10).
	MF4	Helicopter-deployed dipping sonar (*e.g.*, AN/AQS–22 and AN/AQS–13).
	MF5	Active acoustic sonobuoys (*e.g.*, DICASS).
	MF6	Active underwater sound signal devices (*e.g.*, MK–84).
	MF8	Active sources (greater than 200 dB).
	MF9	Active sources (equal to 180 dB and up to 200 dB).
	MF10	Active sources (greater than 160 dB, but less than 180 dB) not otherwise binned.
	MF11	Hull-mounted surface ship sonar with an active duty cycle greater than 80%.
	MF12	High duty cycle—variable depth sonar.
High-Frequency (HF) and Very High-Frequency (VHF): Tactical and non-tactical sources that produce high-frequency (greater than 10 kHz but less than 200 kHz) signals.	HF1	Hull-mounted submarine sonar (*e.g.*, AN/BQQ–10).
	HF3	Hull-mounted submarine sonar (classified).
	HF5 [1]	Active sources (greater than 200 dB).
	HF6	Active sources (equal to 180 dB and up to 200 dB).
	VHF2	Active sources with a frequency greater than 100 kHz, up to 200 kHz with a source level less than 200 dB.
Anti-Submarine Warfare (ASW): Tactical sources such as active sonobuoys and acoustic countermeasures systems used during the conduct of ASW testing activities.	ASW1	Mid-frequency Deep Water Active Distributed System (DWADS).
	ASW2	Mid-frequency Multistatic Active Coherent sonobuoy (*e.g.*, AN/SSQ–125)—sources analyzed by number of items (sonobuoys).
	ASW2	Mid-frequency sonobuoy (*e.g.*, high duty cycle)—Sources that are analyzed by hours.
	ASW3	Mid-frequency towed active acoustic countermeasure systems (*e.g.*, AN/SLQ–25).
	ASW4	Mid-frequency expendable active acoustic device countermeasures (*e.g.*, MK–3).
Torpedoes (TORP): Source classes associated with the active acoustic signals produced by torpedoes.	TORP1	Lightweight torpedo (*e.g.*, MK–46, MK–54).
	TORP2	Heavyweight torpedo (*e.g.*, MK–48, electric vehicles).
Acoustic Modems (M): Systems used to transmit data acoustically through water.	M3	Mid-frequency acoustic modems (greater than 190 dB) (*e.g.*, Underwater Emergency Warning System, Aid to Navigation).
Swimmer Detection Sonar (SD): Systems used to detect divers and submerged swimmers.	SD1	High-frequency sources with short pulse lengths, used for the detection of swimmers and other objects for the purpose of port security.
Synthetic Aperture Sonar (SAS): Sonar in which active acoustic signals are post-processed to form high-resolution images of the seafloor.	SAS2	High frequency unmanned underwater vehicle (UUV) (*e.g.*, UUV payloads).

Notes: [1] For this analysis, HF5 consists of only one source; the modeling was conducted specifically for that source.
[2] DICASS = Directional Command Activated Sonobuoy System Proposed Action.

Training and Testing

The training and testing activities that the Navy proposes to conduct in the NWTT Study Area are listed in Tables 4–6. Detailed information about each proposed activity (stressor, training or testing event, description, sound source, duration, and geographic location) can be found in the LOA application and in Appendix A of the January 2014 NWTT DEIS/OEIS. NMFS used the detailed information in the LOA application and in Appendix A of the January 2014 NWTT DEIS/OEIS to analyze the potential impacts from training and testing activities on marine mammals. The Navy's proposed activities are anticipated to meet training and testing needs in the years 2015–2020.

Summary of Impulsive and Non-Impulsive Sources

Table 4 provides a quantitative annual summary of training activities by sonar and other active acoustic source class analyzed in the Navy's LOA request.

TABLE 4—ANNUAL HOURS OF SONAR AND OTHER ACTIVE ACOUSTIC SOURCES USED DURING TRAINING WITHIN THE NWTT STUDY AREA

Source class category	Source class	Annual use
Mid-Frequency (MF) Active sources from 1 to 10 kHz	MF1	166 hours.
	MF3	70 hours.
	MF4	4 hours.
	MF5	896 items.
	MF11	16 hours.
High-Frequency (HF) Tactical and non-tactical sources that produce signals greater than 10 kHz but less than 100 kHz.	HF1	48 hours.
	HF4	384 hours.
	HF6	192 hours.
Anti-Submarine Warfare (ASW)	ASW2	720 items.
	ASW3	78 hours.

Table 5 provides a quantitative annual summary of testing activities by sonar and other active sources analyzed in the Navy's LOA request.

TABLE 5—ANNUAL HOURS OF SONAR AND OTHER ACTIVE ACOUSTIC SOURCES USED DURING TESTING WITHIN THE NWTT STUDY AREA

Source class category	Source class	Annual use
Low-Frequency (LF): Sources that produce signals less than 1 kHz	LF4	110 hours.
	LF5	71 hours.
Mid-Frequency (MF): Tactical and non-tactical sources that produce signals from 1 to 10 kHz.	MF3	161 hours.
	MF4	10 hours.
	MF5	273 items.
	MF6	12 items.
	MF8	40 hours.
	MF9	1,183 hours.
	MF10	1,156 hours.
	MF11	34 hours.
	MF12	24 hours.
High-Frequency (HF) and Very High-Frequency (VHF): Tactical and non-tactical sources that produce signals greater than 10 kHz but less than 200 kHz.	HF1	161 hours.
	HF3	145 hours.
	HF5 [1]	360 hours.
	HF6	2,099 hours.
Very High-Frequency (VHF): Tactical and non-tactical sources that produce signals greater than 100 kHz but less than 200 kHz.	VHF2	35 hours.
Anti-Submarine Warfare (ASW): Tactical sources used during ASW training and testing activities.	ASW1	16 hours.
	ASW2 [2]	64 hours.
	ASW2 [2]	170 items.
	ASW3	444 hours.
	ASW4	1,182 hours.
Torpedoes (TORP): Source classes associated with active acoustic signals produced by torpedoes.	TORP1	315 items.
	TORP2	299 items.
Acoustic Modems (M): Transmit data acoustically through the water	M3	1,519 hours.
Swimmer Detection Sonar (SD): Used to detect divers and submerged swimmers	SD1	757 hours.
Synthetic Aperture Sonar (SAS): Sonar in which active acoustic signals are post-processed to form high-resolution images of the seafloor.	SAS2	798 hours.

[1] For this analysis, HF5 consists of only one source; the modeling was conducted specifically for that source.
[2] The ASW2 bin contains sources that are analyzed by hours and some that are analyzed by count of items. There is no overlap of the numbers in the two rows.

Table 6 provides a quantitative annual summary of training explosive source classes analyzed in the Navy's LOA request.

TABLE 6—PROPOSED ANNUAL NUMBER OF IMPULSIVE SOURCE DETONATIONS DURING TRAINING IN THE NWTT STUDY AREA

Explosive class	Net explosive weight (NEW)	Annual in-water detonations (training)
E1	(0.1 lb.–0.25 lb.)	48
E3	(>0.5 lb.–2.5 lb.)	6
E5	(>5 lb.–10 lb.)	80
E10	(>250 lb.–500 lb.)	4
E12	(>650 lb.–1000 lb.)	10

Table 7 provides a quantitative annual summary of testing explosive source classes analyzed in the Navy's LOA request.

TABLE 7—PROPOSED ANNUAL NUMBER OF IMPULSIVE SOURCE DETONATIONS DURING TESTING IN THE NWTT STUDY AREA

Explosive class	Net explosive weight (NEW)	Annual In-Water Detonations (testing)
E3	(>0.5 lb.–2.5 lb.)	72
E4	(>2.5 lb.–5 lb.)	70
E8	(>60 lb.–100 lb.)	3
E11	(>500 lb.–650 lb.)	3

Other Stressors—Vessel Strikes

In addition to potential impacts to marine mammals from activities using explosives or sonar and other active acoustic sources, the Navy also considered ship strike impacts to marine mammals. The Navy assessed that no additional stressors would result in a take and require authorization under the MMPA.

Vessel strikes may occur from surface operations and sub-surface operations (excluding bottom crawling, unmanned underwater vehicles). Vessels used as part of the Navy's proposed NWTT training and testing activities (proposed action) include ships, submarines and boats ranging in size from small, 16-foot (ft.) (5-meter [m]) rigid hull inflatable boats to aircraft carriers with lengths up to 1,092 ft. (333 m). Representative Navy vessel types, lengths, and speeds used in both training and testing activities are shown in Table 8.

TABLE 8—REPRESENTATIVE NAVY VESSEL TYPES, LENGTHS, AND SPEEDS USED WITHIN THE NWTT STUDY AREA

Vessel type	Example(s)	Length	Typical operating speed	Max speed
Aircraft Carrier	Aircraft Carrier	>900 ft (>300 m)	10–15 knots	30+ knots
Surface Combatants	Cruisers, Destroyers, Frigates, Littoral Combat Ships.	330–660 ft (100–200 m)	10–15 knots	30+ knots
Support Craft/Other	Range Support Craft, Combat Rubber Raiding Craft, Landing Craft, Utility; Submarine Tenders, Yard Patrol Craft, Protection Vessels, Barge.	16–250 ft (5–80 m)	Variable	20 knots
Support Craft/Other—Specialized High Speed.	Patrol Coastal Ships, Patrol Boats, Rigid Hull Inflatable Boat, High Speed Protection Vessels.	33–130 ft (10–40 m)	Variable	50+ knots
Submarines	Fleet Ballistic Missile Submarines, Attack Submarines, Guided Missile Submarines.	330–660 ft (100–200 m)	8–13 knots	20+ knots

Large Navy ships greater than 65 ft. (20 m) generally operate at speeds in the range of 10–15 knots for fuel conservation when cruising. Submarines generally operate at speeds in the range of 8–13 knots during transit and slower for certain tactical maneuvers. Small craft (for purposes of this discussion less than 65 ft. [20 m] in length) have much more variable speeds, dependent on the mission. While these speeds are representative, some vessels operate outside of these speeds due to unique training or safety requirements for a given event. Examples include increased speeds needed for flight operations, full speed runs to test engineering equipment, time critical positioning needs, etc. Examples of decreased speeds include speeds less than 5 knots or completely stopped for launching small boats, certain tactical maneuvers, target launch or retrievals, etc.

The number of Navy vessels in the Study Area varies based on training and testing schedules. Most activities include either one or two vessels, with an average of one vessel per activity, and last from a few hours up to 2 weeks. Vessel movement and the use of in-water devices as part of the proposed action would be concentrated in certain portions of the Study Area (such as Western Behm Canal [Alaska] or Hood Canal in the inland waters portion of the Study Area) but may occur anywhere within the Study Area.

The Navy is analyzing the potential environmental impacts of approximately 226 ongoing annual Maritime Security Operations events in Puget Sound and the Strait of Juan de Fuca. These critical events have been occurring since 2006 and exercise the Navy's Transit Protection System, where up to nine escort vessels provide protection during all nuclear ballistic missile submarine (SSBN) transits between the vessel's homeport and the dive/surface point in the Strait of Juan de Fuca or Dabob Bay. During a Transit Protection System event, the security escorts enforce a moving 1,000 yard security zone around the SSBN to prevent other vessels from approaching while the SSBN is in transit on the surface. These events include security escort vessels, U.S. Coast Guard personnel and their ancillary equipment and weapons systems. The Transit Protection System involves the movement of security vessels and also includes periodic exercises and firearms training (with blank rounds). Given the relative slow speed of the escorted and blocking vessels and multiple lookouts, no marine mammal vessel strikes are expected as a result of these events.

Navy policy (Chief of Naval Operations Instruction 3100.6H) requires Navy vessels to report all whale strikes. That information is collected by the Office of the Chief of Naval Operations Energy and Environmental Readiness Division (OPNAV N45) and cumulatively provided to NMFS on an annual basis. In addition, the Navy and NMFS also have standardized regional reporting protocols for communicating to regional NMFS stranding coordinators information on any Navy vessel strikes as soon as possible. These communication procedures will remain in place for the duration of the LOAs. There are no records of any Navy vessel strikes to marine mammals during training or testing activities in the NWTT Study Area.

Duration and Location

Training and testing activities would be conducted in the Study Area throughout the year from November 2015 through November 2020.

The Study Area is composed of established maritime operating and warning areas in the eastern North Pacific Ocean region, including areas of the Strait of Juan de Fuca, Puget Sound, and Western Behm Canal in southeastern Alaska. The Study Area includes air and water space within and outside Washington state waters, and outside state waters of Oregon and Northern California. The Study Area includes four existing range complexes and facilities: The Northwest Training Range Complex (NWTRC), the Keyport Range Complex, Carr Inlet Operations Area, and SEAFAC. In addition to these range complexes, the Study Area also includes Navy pierside locations where sonar maintenance and testing occurs as part of overhaul, modernization, maintenance and repair activities at NAVBASE Kitsap, Bremerton; NAVBASE Kitsap, Bangor; and Naval Station Everett.

A range complex is a designated set of specifically bounded geographic areas and encompasses a water component (above and below the surface), and may encompass airspace and a land component where training and testing of military platforms, tactics, munitions, explosives, and EW systems occurs. Range complexes include established OPAREAs, Restricted Areas, and special use airspace (SUA), which may be further divided to provide better control of the area and events for safety reasons. These designations are further described in Chapter 2 of the LOA application.

The Study Area includes only the at-sea components of the training and testing areas and facilities. The Navy is using ''at-sea'' to cover activity in, on, and over the water, but not activity on or over the land, which may include activities in the surf zone or supported from shore-side locations.

Military activities in the Study Area occur (1) on the ocean surface, (2) beneath the ocean surface, and (3) in the air. To aid in the description of the ranges covered in the January 2014 NWTT DEIS/OEIS, the ranges are divided into three distinct geographic and functional subdivisions. All of the training and testing activities proposed in this application would occur in one or more of these three range subdivisions:

- The Offshore Area
- The Inland Waters
- Western Behm Canal, Alaska

Offshore Area

The Offshore Area of the Study Area includes air, surface, and subsurface OPAREAs extending generally west from the coastline of Washington, Oregon, and Northern California for a distance of approximately 250 nm into international waters. The eastern boundary of the Offshore Area is 12 nm off the coastline for most of the Study Area, including southern Washington, Oregon, and Northern California. The Offshore Area includes the ocean all the way to the coastline only along the Washington coast beneath the airspace of W–237 and the Olympic Military Operations Area (MOA) and the Washington coastline north of the Olympic MOA. The components of the Offshore Area are described below.

Airspace

The SUA in the Offshore Area is comprised of Warning Area 237 (W–237), which extends westward off the coast of Northern Washington State and is divided into nine sub-areas (A–H, and J). The eastern boundary of W–237 lies 3 nm off the coast of Washington. The floor of W–237 extends to the ocean surface and the ceiling of the airspace varies between 27,000 ft. (8,200 m) in areas E, H, and J; 50,000 ft. (15,200 m) in areas A and B; and unlimited in areas C, D, F, and G, with a total area of 25,331 square nautical miles (nm^2).

The Olympic MOA overlays both land (the Olympic Peninsula) and sea (extending to 3 nm off the coast of Washington into the Pacific Ocean). The MOA lower limit is 6,000 ft. (1,800 m) above mean sea level but not below 1,200 ft. above ground level, and the upper limit is up to, but not including, 18,000 ft. (5,500 m), with a total area coverage of 1,614 nm^2.

Above the Olympic MOA is the Olympic Air Traffic Controlled Assigned Airspace (ATCAA), which has a floor coinciding with the Olympic MOA ceiling. The ATCAA has an upper limit of 35,000 ft. (10,700 m).

For the LOA application, the Olympic MOA and the Olympic ATCAA Are components of the Offshore Area

Inland Waters

The Inland Waters includes air, sea, and undersea space inland of the coastline, from buoy ''J'' at 48° 29.6′ N, 125° W, eastward to include all waters of the Strait of Juan de Fuca and the Puget Sound. None of this area extends into Oregon or California. Within the Inland Waters are specific geographic components in which training and testing occur. The Inland Waters and its component areas are described below.

Airspace

Restricted Area 6701 (R–6701, Admiralty Bay) is a Restricted Area over Admiralty Bay, Washington with a lower limit at the ocean surface and an upper limit of 5,000 ft. This airspace covers a total area of 56 nm^2.

Chinook A and B MOAs are 56 nm^2 of airspace south and west of Admiralty Bay. The Chinook MOAs extend from 300 ft. to 5,000 ft. above the ocean surface.

Sea and Undersea Space

Explosive Ordnance Disposal Underwater Ranges—Two active EOD ranges are located in the Inland Waters at the following locations:

- Hood Canal EOD Training Range
- Crescent Harbor EOD Training Range

Surface and Subsurface Testing Sites—There are three geographically distinct range sites in the Inland Waters where the Navy conducts surface and subsurface testing and some limited training. The Keyport Range Site is located in Kitsap County and includes portions of Liberty Bay and Port Orchard Reach (also known as Port Orchard Narrows). The Dabob Bay Range Complex (DBRC) Site is located in Hood Canal and Dabob Bay, in Jefferson, Kitsap, and Mason counties. The Carr Inlet OPAREA is located in southern Puget Sound.

The Keyport Range Site is located adjacent to NAVBASE Kitsap, Keyport, providing approximately 3.2 nm² for testing, including in-shore shallow water sites and a shallow lagoon to support integrated undersea warfare systems and vehicle maintenance and engineering activities. Water depth at the Keyport Range Site is less than 100 ft. (30.5 m). Underwater tracking of test activities can be accomplished by using temporary or portable range equipment. The Navy has conducted testing at the Keyport Range Site since 1914.

The DBRC Site includes the Dabob Bay and the Hood Canal from 1 mi. (1.6 km) south of the Hood Canal Bridge to the Hamma Hamma River, a total area of approximately 45.7 nm². The Navy has conducted underwater testing at the DBRC Site since 1956, beginning with a control center at Whitney Point. The control center was subsequently moved to Zelatched Point.

Dabob Bay is a deep-water area in Jefferson County approximately 14.5 nm² in size and contains an acoustic tracking range. The acoustic tracking space within the range is approximately 7.3 nm by 1.3 nm (9 nm²) with a maximum depth of 600 ft. (182.9 m). The Dabob Bay tracking range, the only component of the DBRC Site with extensive acoustic monitoring instrumentation installed on the seafloor, provides for object tracking, communications, passive sensing, and target simulation. Many activities conducted within Dabob Bay are supported by land-based facilities at Zelatched Point.

Hood Canal averages a depth of 200 ft. (61 m) and is used for vessel sensor accuracy tests and launch and recovery of test systems where tracking is optional.

The Carr Inlet OPAREA is a quiet deep-water inland range approximately 12 nm² in size. It is located in an arm of water between Key Peninsula and Gig Harbor Peninsula. Its southern end is connected to the southern basin of Puget Sound. Northward, it separates McNeil Island and Fox Island as well as the peninsulas of Key and Gig Harbor. The acoustic tracking space within the range is approximately 6 nm by 2 nm with a maximum depth of 545 ft. (166 m). The Navy performed underwater acoustic testing at Carr Inlet from the 1950s through 2009, when activities were relocated to NAVBASE Kitsap, Bangor. While no permanently installed structures are present in the Carr Inlet OPAREA, the waterway remains a Navy-restricted area.

Pierside Testing Facilities—In addition to the training and testing ranges, at which most of the training and testing assessed in this document occurs, the Navy conducts some testing at or near Navy piers. Most of this testing is sonar maintenance and testing while ships are in port for maintenance or system re-fitting. These piers within the Study Area are all within Puget Sound and include the NAVBASE Kitsap, Bremerton in Sinclair Inlet; NAVBASE Kitsap, Bangor Waterfront in Hood Canal, and Naval Station Everett.

Navy Surface Operations Areas—In addition to the areas mentioned above, there are two surface and subsurface operations areas used for Navy training and testing within the Inland Waters. Navy 3 OPAREA is a surface and subsurface area off the west coast of northern Whidbey Island. Navy 7 OPAREA is the surface and subsurface area that lies beneath R–6701. This area covers a total area of 61 nm².

Western Behm Canal, Alaska

The Western Behm Canal is located in Southeast Alaska, near the city of Ketchikan, Alaska. SEAFAC is located in the Western Behm Canal and covers an area of 48 nm². The Navy has been conducting testing activities at SEAFAC since 1992. The facility replaced the Santa Cruz Acoustic Range Facility in Southern California and is now the location for some acoustic testing previously conducted at the NSWC Carr Inlet Acoustic Range in Washington State.

SEAFAC is comprised of land-based facilities and in-water assets. The land-based facilities are located within 5.5 acres (2 hectares) on Back Island and are not included in the scope of this analysis. The in-water assets include two sites: the underway site and the static site. These assets and the operational area of SEAFAC are located in five restricted areas. The underway site arrays are in Area 1. The static site is in Area 2. All associated underwater cabling and other devices associated with the underway site are located in Area 3. Area 4 provides a corridor for utility power and a phone cable. Area 5 is an operational area to allow for safe passage of local vessel traffic. Notifications of invoking restriction of Area 5 occur at least 72 hours prior to SEAFAC operations in accordance with 33 CFR 34.1275. During test periods, all vessels entering Area 5 are requested to contact SEAFAC to coordinate safe passage through the area. Area 5 defines the SEAFAC Study Area boundary, which is comprised only of the in-water area and excludes the land-based supporting facilities and operations.

The SEAFAC at-sea areas are:

- Restricted Areas 1 through 5. The five restricted areas are located within Western Behm Canal. The main purposes of the restricted areas are to provide for vessel and public safety, lessen acoustic encroachment from non-participating vessels, and prohibit certain activities that could damage SEAFAC's sensitive in-water acoustic instruments and associated cables. Area 5 encompasses the entire SEAFAC operations area.
- Underway Measurement Site. The underway measurement site is in the center of Western Behm Canal and is 5,000 yards (yd.) (4,572 m) wide and 12,000 yd. (10,973 m) long. The acoustic arrays are located at the center of this area (Area 1).
- Static Site. The static site is approximately 2 nm northwest of Back Island. During testing, a vessel is tethered between two surface barges. In most scenarios, the vessel submerges to conduct acoustic measurements. The static site is located at the center of Area 2.
- Area 3 and Area 4. These restricted areas provide protection to underwater cables and bottom-mounted equipment they encompass.

Bottom-moored acoustic measurement arrays are located in the middle of the site. These instrumented arrays are established for measuring vessel signatures when a vessel is underway (underway site) and is at rest and moored (static site). The instruments are passive arrays of hydrophones sensing the acoustic signature of the vessels (*i.e.,* the sounds emitted when sonar units are not in operation). Hydrophones on the arrays pick up noise in the water and transmit it to shore facilities, where the data are processed. SEAFAC's sensitive and well-positioned acoustic measurement equipment provides the ability to listen to and record the radiated signature of submarines, as well as other submerged manned and unmanned vehicles, selected NOAA surface vessels, and cruise ships.

The sensors at SEAFAC are passive and measure radiated noise in the water, such as machinery on submarines and other underwater vessels. Vessels do not use tactical mid-frequency active sonar while undergoing testing at SEAFAC. Active acoustic sources are used for communications, range calibration, and to provide position information for units operating submerged on the range.

Description of Marine Mammals in the Area of the Specified Activities

Twenty-nine marine mammal species are known to occur in the Study Area, including seven mysticetes (baleen whales), 16 odontocetes (dolphins and toothed whales), and six pinnipeds (seals and sea lions). Among these species, there are 50 stocks managed by NMFS or the U.S. Fish and Wildlife Service (USFWS) in the U.S. Exclusive Economic Zone (EEZ). These species and their numbers are presented in Table 9. Consistent with NMFS most recent Pacific Stock Assessment Report, a single species may include multiple stocks recognized for management purposes (e.g., killer whale), while other species are grouped into a single stock due to limited species-specific information (e.g., beaked whales belonging to the genus Mesoplodon).

TABLE 9—MARINE MAMMALS WITH POSSIBLE OR CONFIRMED PRESENCE WITHIN THE NWTT STUDY AREA

Common name	Scientific name	Stock	Stock abundance	ESA/MMPA
North Pacific right whale	*Eubalaena japonica*	Eastern North Pacific	31	Endangered/Depleted.
Humpback whale	*Megaptera novaeangliae*	Central North Pacific	10,103	Endangered/Depleted.
		California, Oregon, & Washington.	1,918	Endangered/Depleted.
Blue whale	*Balaenoptera musculus*	Eastern North Pacific	1,647	Endangered/Depleted.
Fin whale	*Balaenoptera physalus*	Northeast Pacific	1,214 (minimum estimate)	Endangered/Depleted.
		California, Oregon, & Washington.	3,051	Endangered/Depleted.
Sei whale	*Balaenoptera borealis*	Eastern North Pacific	126	Endangered/Depleted.
Minke whale	*Balaenoptera acutorostrata*	Alaska	Not available.	
		California, Oregon, & Washington.	478.	
Gray whale	*Eschrichtius robustus*	Eastern North Pacific	19,126.	
		Western North Pacific	155	Endangered/Depleted.
Sperm whale	*Physeter macrocephalus*	North Pacific	Not available	Endangered/Depleted.
		California, Oregon, & Washington.	971	Endangered/Depleted.
Pygmy sperm whale	*Kogia breviceps*	California, Oregon, & Washington.	579.	
Dwarf sperm whale	*Kogia sima*	California, Oregon, & Washington.	Not available.	
Killer whale	*Orcinus orca*	Alaskan Resident	2,347.	
		Northern Resident	261.	
		West Coast Transient	243.	
		Eastern North Pacific Offshore.	240.	
		Eastern North Pacific Southern Resident.	85 (direct count)	Endangered/Depleted.
Short-finned pilot whale	*Globicephala macrorhynchus.*	California, Oregon, & Washington.	760.	
Short-beaked common dolphin.	*Delphinus delphis*	California, Oregon, & Washington.	411,211.	
Bottlenose dolphin	*Tursiops truncatus*	California, Oregon, & Washington Offshore.	1,006.	
Striped dolphin	*Stenella coeruleoalba*	California, Oregon, & Washington.	10,908.	
Pacific white-sided dolphin	*Lagenorhynchus obliquidens.*	North Pacific	26,880.	
		California, Oregon, & Washington.	26,930.	
Northern right whale dolphin	*Lissodelphis borealis*	California, Oregon, & Washington.	8,334.	
Risso's dolphin	*Grampus griseus*	California, Oregon, & Washington.	6,272.	
Harbor porpoise	*Phocoena phocoena*	Southeast Alaska	11,146.	
		Northern Oregon/WA Coast	21,487.	
		Northern CA/southern OR	35,769.	
		WA Inland Waters	10,682.	
		Alaska	83,400.	
Dall's porpoise	*Phocoenoides dalli*	California, Oregon, & Washington.	42,000.	
Cuvier's beaked whale	*Ziphius cavirostris*	Alaska	Not available.	
		California, Oregon, & Washington.	6,590.	
Baird's beaked whale	*Berardius bairdii*	Alaska	Not available.	
		California, Oregon, & Washington.	847.	

TABLE 9—MARINE MAMMALS WITH POSSIBLE OR CONFIRMED PRESENCE WITHIN THE NWTT STUDY AREA—Continued

Common name	Scientific name	Stock	Stock abundance	ESA/MMPA
Mesoplodont beaked whales[1].	*Mesoplodon spp.*	California, Oregon, & Washington.	694.	
Steller sea lion	*Eumetopias jubatus*	Eastern U.S.	63,160–78,198.	
California sea lion	*Zalophus californianus*	U.S.	296,750.	
Northern fur seal	*Callorhinus ursinus*	Eastern Pacific	639,545	Depleted.
		California Breeding	12,844.	
Guadalupe fur seal	*Arctocephalus townsendi*	Mexico	14,000–15,000	Threatened/Depleted.
Northern elephant seal	*Mirounga angustirostris*	California Breeding	124,000.	
Harbor seal	*Phoca vitulina*	Southeast Alaska (Clarence Strait).	152,602.	
		OR/WA Coast	24,732.	
		California	30,196.	
		WA Northern Inland Waters	11,036.	
		Southern Puget Sound	1,568.	
		Hood Canal	3,555.[2]	

[1] In waters off the U.S. west coast, the *Mesoplodon* species *M. carlhubbsi, M. ginkgodens, M. perrini, M. peruvianus, M. stejnegeri* and *M. densirostris* have been grouped by NMFS into a single management unit (*Mesoplodon* spp.) in the 2014 Pacific Stock Assessment report (Carretta *et al.,* 2014).

[2] The most recent SAR (2014) divided the harbor seals within the Inland Waters into three stocks: The Washington Northern Inland Waters stock; the Southern Puget Sound stock, and the Hood Canal stock.

Based on recent discussion with regional NMFS subject matter experts and subsequent to the publication of the 2014 SAR, the Navy and NMFS applied research presented in London *et al.* (2012) to reevaluate the Hood Canal stock abundance. Using updated tag data from London *et al.* 2012, the count of harbor seals collected in 1999 (n=711) from aerial surveys (Jeffries *et al.,* 2003) was corrected to account for harbor seal haulout behavior that most closely aligned with the season and time of day in which the original survey was conducted. The tag data showed that during this month and time of day, approximately 80 percent of the animals would be in the water. Therefore, the corrected Hood Canal stock abundance (based on the 1999 aerial survey) is calculated as 711/0.20 or 711*5 = 3,555. While this aerial survey data is considered out of date based on the standards of NOAA stock assessment reports, this revised Hood Canal harbor seal abundance represents the best available science based on publically available data.

Information on the status, distribution, abundance, and vocalizations of marine mammal species in the Study Area may be viewed in Chapter 4 of the LOA application (*http://www.nmfs.noaa.gov/pr/permits/incidental/military.htm*). Further information on the general biology and ecology of marine mammals is included in the NWTT DEIS/OEIS. In addition, NMFS publishes annual SARs for marine mammals, including stocks that occur within the Study Area (*http://www.nmfs.noaa.gov/pr/species/mammals;* Carretta *et al.,* 2014; Allen and Angliss, 2014).

Marine Mammal Hearing and Vocalizations

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

Marine mammal vocalizations often extend both above and below the range of human hearing; vocalizations with frequencies lower than 20 Hz are labeled as infrasonic and those higher than 20 kHz as ultrasonic (National Research Council (NRC), 2003; Figure 4–1). Measured data on the hearing abilities of cetaceans are sparse, particularly for the larger cetaceans such as the baleen whales. The auditory thresholds of some of the smaller odontocetes have been determined in captivity. It is generally believed that cetaceans should at least be sensitive to the frequencies of their own vocalizations. Comparisons of the anatomy of cetacean inner ears and models of the structural properties and the response to vibrations of the ear's components in different species provide an indication of likely sensitivity to various sound frequencies. The ears of small toothed whales are optimized for receiving high-frequency sound, while baleen whale inner ears are best in low to infrasonic frequencies (Ketten, 1992; 1997; 1998).

Baleen whale vocalizations are composed primarily of frequencies below 1 kHz, and some contain fundamental frequencies as low as 16 Hz (Watkins *et al.,* 1987; Richardson *et al.,* 1995; Rivers, 1997; Moore *et al.,* 1998; Stafford *et al.,* 1999; Wartzok and Ketten, 1999) but can be as high as 24 kHz (humpback whale; Au *et al.,* 2006). Clark and Ellison (2004) suggested that baleen whales use low-frequency sounds not only for long-range communication, but also as a simple form of echo ranging, using echoes to navigate and orient relative to physical features of the ocean. Information on auditory function in baleen whales is extremely lacking. Sensitivity to low-frequency sound by baleen whales has been inferred from observed vocalization frequencies, observed reactions to playback of sounds, and anatomical analyses of the auditory system. Although there is apparently much variation, the source levels of most baleen whale vocalizations lie in the range of 150–190 dB re 1 microPascal (μPa) at 1 m. Low-frequency vocalizations made by baleen whales and their corresponding auditory anatomy suggest that they have good low-frequency hearing (Ketten, 2000), although specific data on sensitivity, frequency or intensity discrimination, or localization abilities are lacking. Marine mammals, like all mammals, have typical U-shaped audiograms that begin with relatively low sensitivity (high threshold) at some specified low frequency with increased sensitivity (low threshold) to a species specific optimum followed by a generally steep rise at higher frequencies (high threshold) (Fay, 1988).

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

Brief Background on Sound

An understanding of the basic properties of underwater sound is necessary to comprehend many of the concepts and analyses presented in this document. A summary is included below.

Sound is a wave of pressure variations propagating through a medium (*e.g.,* water). Pressure variations are created by compressing and relaxing the medium. Sound measurements can be expressed in two forms: intensity and pressure. Acoustic intensity is the average rate of energy transmitted through a unit area in a specified direction and is expressed in watts per square meter (W/m^2). Acoustic intensity is rarely measured directly, but rather from ratios of pressures; the standard reference pressure for underwater sound is 1 μPa; for airborne sound, the standard reference pressure is 20 μPa (Richardson *et al.,* 1995).

Acousticians have adopted a logarithmic scale for sound intensities, which is denoted in decibels (dB). Decibel measurements represent the ratio between a measured pressure value and a reference pressure value (in this case 1 μPa or, for airborne sound, 20 μPa). The logarithmic nature of the scale means that each 10-dB increase is a ten-fold increase in acoustic power (and a 20-dB increase is then a 100-fold increase in power; and a 30-dB increase is a 1,000-fold increase in power). A ten-fold increase in acoustic power does not mean that the sound is perceived as being ten times louder, however. Humans perceive a 10-dB increase in sound level as a doubling of loudness, and a 10-dB decrease in sound level as a halving of loudness. The term ''sound pressure level'' implies a decibel measure and a reference pressure that is used as the denominator of the ratio. Throughout this document, NMFS uses 1 μPa (denoted re: 1μPa) as a standard reference pressure unless noted otherwise.

It is important to note that decibel values underwater and decibel values in air are not the same (different reference pressures and densities/sound speeds between media) and should not be directly compared. Because of the different densities of air and water and the different decibel standards (*i.e.,* reference pressures) in air and water, a sound with the same level in air and in water would be approximately 62 dB lower in air. Thus, a sound that measures 160 dB (re 1 μPa) underwater would have the same approximate effective level as a sound that is 98 dB (re 20 μPa) in air.

Sound frequency is measured in cycles per second, or Hertz (abbreviated Hz), and is analogous to musical pitch; high-pitched sounds contain high frequencies and low-pitched sounds contain low frequencies. Natural sounds in the ocean span a huge range of frequencies: from earthquake noise at 5 Hz to harbor porpoise clicks at 150,000 Hz (150 kHz). These sounds are so low or so high in pitch that humans cannot even hear them; acousticians call these infrasonic (typically below 20 Hz) and ultrasonic (typically above 20,000 Hz) sounds, respectively. A single sound may be made up of many different frequencies together. Sounds made up of only a small range of frequencies are called ''narrowband'', and sounds with a broad range of frequencies are called ''broadband''; explosives are an example of a broadband sound source and active tactical sonars are an example of a narrowband sound source.

When considering the influence of various kinds of sound on the marine environment, it is necessary to understand that different kinds of marine life are sensitive to different frequencies of sound. Current data indicate that not all marine mammal species have equal hearing capabilities (Richardson *et al.,* 1995; Southall *et al.,* 1997; Wartzok and Ketten, 1999; Au and Hastings, 2008).

Southall *et al.* (2007) designated ''functional hearing groups'' for marine mammals based on available behavioral data; audiograms derived from auditory evoked potentials; anatomical modeling; and other data. Southall *et al.* (2007) also estimated the lower and upper frequencies of functional hearing for each group. However, animals are less sensitive to sounds at the outer edges of their functional hearing range and are more sensitive to a range of frequencies within the middle of their functional hearing range. Note that no direct measurements of hearing ability have been successfully completed for low-frequency cetaceans. 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 (13 species of mysticetes): Functional hearing estimates occur between approximately 7 Hz and 30 kilohertz (kHz) (extended from 22 kHz based on data indicating that some mysticetes can hear above 22 kHz; Watkins, 1986; Ketten, 1998; Houser *et al.,* 2001; Au *et al.,* 2006; Lucifredi and Stein, 2007; Ketten *et al.,* 2007; Parks *et al.,* 2007a; Ketten and Mountain, 2009; Tubelli *et al.,* 2012);
- Mid-frequency cetaceans (larger toothed whales, beaked whales, and most delphinids): Functional hearing is estimated to occur between approximately 150 Hz and 160 kHz, with best hearing from 10 to less than 100 kHz (Johnson, 1967; White, 1977; Richardson *et al.,* 1995; Szymanski *et al.,* 1999; Kastelein *et al.,* 2003; Finneran *et al.,* 2005a, 2009; Nachtigall *et al.,* 2005, 2008; Yuen *et al.,* 2005;

Popov *et al.,* 2007; Au and Hastings, 2008; Houser *et al.,* 2008; Pacini *et al.,* 2010, 2011; Schlundt *et al.,* 2011);

• High-frequency cetaceans (porpoises, river dolphins, and members of the genera *Kogia* and *Cephalorhynchus*; including two members of the genus *Lagenorhynchus,* including the hourglass dolphin, on the basis of recent echolocation data and genetic data [May-Collado and Agnarsson, 2006; Kyhn *et al.,* 2009, 2010; Tougaard *et al.,* 2010]): Functional hearing is estimated to occur between approximately 200 Hz and 180 kHz (Popov and Supin, 1990a,b; Kastelein *et al.,* 2002; Popov *et al.,* 2005); and

• Pinnipeds in water; Phocidae (true seals): Functional hearing is estimated to occur between approximately 75 Hz to 100 kHz, with best hearing between 1–50 kHz (Møhl, 1968; Terhune and Ronald, 1971, 1972; Richardson *et al.,* 1995; Kastak and Schusterman, 1999; Reichmuth, 2008; Kastelein *et al.,* 2009);

• Pinnipeds in water; Otariidae (eared seals): Functional hearing is estimated to occur between 100 Hz and 40 kHz for Otariidae, with best hearing between 2–48 kHz (Schusterman *et al.,* 1972; Moore and Schusterman, 1987; Babushina *et al.,* 1991; Richardson *et al.,* 1995; Kastak and Schusterman, 1998; Kastelein *et al.,* 2005a; Mulsow and Reichmuth, 2007; Mulsow *et al.,* 2011a, b).

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 *et al.,* 2013).

Concurrent with the development of NOAA's Ocean Noise Strategy and draft ''Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammals,'' NMFS is currently considering additional modifications to some of the functional hearing ranges proposed by Southall *et al.* (2007). As more data from more species and/or individuals become available, these estimated hearing ranges may require additional modifications.

When sound travels (propagates) from its source, its loudness decreases as the distance traveled by the sound increases. Thus, the loudness of a sound at its source is higher than the loudness of that same sound a kilometer away. Acousticians often refer to the loudness of a sound at its source (typically referenced to one meter from the source) as the source level and the loudness of sound elsewhere as the received level (*i.e.,* typically the receiver). For example, a humpback whale 3 km from a device that has a source level of 230 dB may only be exposed to sound that is 160 dB loud, depending on how the sound travels through water (*e.g.,* spherical spreading [3 dB reduction with doubling of distance] was used in this example). As a result, it is important to understand the difference between source levels and received levels when discussing the loudness of sound in the ocean or its impacts on the marine environment.

As sound travels from a source, its propagation in water is influenced by various physical characteristics, including water temperature, depth, salinity, and surface and bottom properties that cause refraction, reflection, absorption, and scattering of sound waves. Oceans are not homogeneous and the contribution of each of these individual factors is extremely complex and interrelated. The physical characteristics that determine the sound's speed through the water will change with depth, season, geographic location, and with time of day (as a result, in actual active sonar operations, crews will measure oceanic conditions, such as sea water temperature and depth, to calibrate models that determine the path the sonar signal will take as it travels through the ocean and how strong the sound signal will be at a given range along a particular transmission path). As sound travels through the ocean, the intensity associated with the wavefront diminishes, or attenuates. This decrease in intensity is referred to as propagation loss, also commonly called transmission loss.

Metrics Used in This Document

This section includes a brief explanation of the two sound measurements (sound pressure level (SPL) and sound exposure level (SEL)) frequently used to describe sound levels in the discussions of acoustic effects in this document.

Sound pressure level (SPL)—Sound pressure is the sound force per unit area, and is usually measured in micropascals (μPa), where 1 Pa is the pressure resulting from a force of one newton exerted over an area of one square meter. SPL is expressed as the ratio of a measured sound pressure and a reference level.

SPL (in dB) = 20 log (pressure/reference pressure)

The commonly used reference pressure level in underwater acoustics is 1 μPa, and the units for SPLs are dB re: 1 μPa. SPL is an instantaneous pressure measurement and can be expressed as the peak, the peak-peak, or the root mean square (rms). Root mean square pressure, which is the square root of the arithmetic average of the squared instantaneous pressure values, is typically used in discussions of the effects of sounds on vertebrates and all references to SPL in this document refer to the root mean square. SPL does not take the duration of exposure into account. SPL is the applicable metric used in the risk continuum, which is used to estimate behavioral harassment takes (see Level B Harassment Risk Function (Behavioral Harassment) Section).

Sound exposure level (SEL)—SEL is an energy metric that integrates the squared instantaneous sound pressure over a stated time interval. The units for SEL are dB re: 1 μPa^2-s. Below is a simplified formula for SEL.

SEL = SPL + 10 log (duration in seconds)

As applied to active sonar, the SEL includes both the SPL of a sonar ping and the total duration. Longer duration pings and/or pings with higher SPLs will have a higher SEL. If an animal is exposed to multiple pings, the SEL in each individual ping is summed to calculate the cumulative SEL. The cumulative SEL depends on the SPL, duration, and number of pings received. The thresholds that NMFS uses to indicate at what received level the onset of temporary threshold shift (TTS) and permanent threshold shift (PTS) in hearing are likely to occur are expressed as cumulative SEL.

Potential Effects of Specified Activities on Marine Mammals

The Navy has requested authorization for the take of marine mammals that may occur incidental to training and testing activities in the Study Area. The Navy has analyzed potential impacts to marine mammals from impulsive and non-impulsive sound sources and vessel strike.

Other potential impacts to marine mammals from training activities in the Study Area were analyzed in the Navy's January 2014 NWTT DEIS/OEIS, in consultation with NMFS as a cooperating agency, and determined to be unlikely to result in marine mammal harassment. Therefore, the Navy has not requested authorization for take of marine mammals that might occur incidental to other components of their proposed activities. In this document, NMFS analyzes the potential effects on marine mammals from exposure to non-impulsive sound sources (sonar and other active acoustic sources), impulsive sound sources (underwater detonations), and vessel strikes.

For the purpose of MMPA authorizations, NMFS' effects assessments serve four primary purposes: (1) To prescribe the permissible methods of taking (*i.e.,* Level B harassment (behavioral harassment), Level A harassment (injury), or mortality, including an identification of the number and types of take that could occur by harassment or mortality) and to prescribe other means of effecting the least practicable adverse impact on such species or stock and its habitat (*i.e.,* mitigation); (2) to determine whether the specified activity would have a negligible impact on the affected species or stocks of marine mammals (based on the likelihood that the activity would adversely affect the species or stock through effects on annual rates of recruitment or survival); (3) to determine whether the specified activity would have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses; and (4) to prescribe requirements pertaining to monitoring and reporting.

More specifically, for activities involving non-impulsive or impulsive sources, NMFS' analysis will identify the probability of lethal responses, physical trauma, sensory impairment (permanent and temporary threshold shifts and acoustic masking), physiological responses (particular stress responses), behavioral disturbance (that rises to the level of harassment), and social responses (effects to social relationships) that would be classified as a take and whether such take would have a negligible impact on such species or stocks. This section focuses qualitatively on the different ways that non-impulsive and impulsive sources may affect marine mammals (some of which NMFS would not classify as harassment). Then, in the Estimated Take of Marine Mammals section, the potential effects to marine mammals from non-impulsive and impulsive sources will be related to the MMPA definitions of Level A and Level B harassment, along with the potential effects from vessel strikes, and we will attempt to quantify those effects.

Non-Impulsive Sources

Direct Physiological Effects

Based on the literature, there are two basic ways that non-impulsive sources might directly result in physical trauma or damage: Noise-induced loss of hearing sensitivity (more commonly-called ''threshold shift'') and acoustically mediated bubble growth. Separately, an animal's behavioral reaction to an acoustic exposure could lead to physiological effects that might ultimately lead to injury or death, which is discussed later in the Stranding section.

Threshold Shift (noise-induced loss of hearing)—When animals exhibit reduced hearing sensitivity (*i.e.,* sounds must be louder for an animal to detect them) following exposure to an intense sound or sound for long duration, it is referred to as a noise-induced threshold shift (TS). An animal can experience temporary threshold shift (TTS) or permanent threshold shift (PTS). TTS can last from minutes or hours to days (*i.e.,* there is complete recovery), can occur in specific frequency ranges (*i.e.,* an animal might only have a temporary loss of hearing sensitivity between the frequencies of 1 and 10 kHz), and can be of varying amounts (for example, an animal's hearing sensitivity might be reduced initially by only 6 dB or reduced by 30 dB). PTS is permanent, but some recovery is possible. PTS can also occur in a specific frequency range and amount as mentioned above for TTS.

The following physiological mechanisms are thought to play a role in inducing auditory TS: Effects to sensory hair cells in the inner ear that reduce their sensitivity, modification of the chemical environment within the sensory cells, residual muscular activity in the middle ear, displacement of certain inner ear membranes, increased blood flow, and post-stimulatory reduction in both efferent and sensory neural output (Southall *et al.,* 2007). The amplitude, duration, frequency, temporal pattern, and energy distribution of sound exposure all can affect the amount of associated TS and the frequency range in which it occurs. As amplitude and duration of sound exposure increase, so, generally, does the amount of TS, along with the recovery time. For intermittent sounds, less TS could occur than compared to a continuous exposure with the same energy (some recovery could occur between intermittent exposures depending on the duty cycle between sounds) (Kryter *et al.,* 1966; Ward, 1997). For example, one short but loud (higher SPL) sound exposure may induce the same impairment as one longer but softer 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, prolonged exposure to sounds 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). Although in the case of mid- and high-frequency active sonar (MFAS/HFAS), animals are not expected to be exposed to levels high enough or durations long enough to result in PTS.

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

Although the published body of scientific literature contains numerous theoretical studies and discussion papers on hearing impairments that can occur with exposure to a loud sound, only a few studies provide empirical information on the levels at which noise-induced loss in hearing sensitivity occurs in nonhuman animals. For marine mammals, published data are limited to the captive bottlenose dolphin, beluga, harbor porpoise, and Yangtze finless porpoise (Finneran *et al.,* 2000, 2002b, 2003, 2005a, 2007, 2010a, 2010b; Finneran and Schlundt, 2010; Lucke *et al.,* 2009; Mooney *et al.,* 2009a, 2009b; Popov *et al.,* 2011a, 2011b; Kastelein *et al.,* 2012a; Schlundt *et al.,* 2000; Nachtigall *et al.,* 2003, 2004). For pinnipeds in water, data are limited to measurements of TTS in harbor seals, an elephant seal, and California sea lions (Kastak *et al.,* 1999, 2005; Kastelein *et al.,* 2012b).

Marine mammal hearing plays a critical role in communication with conspecifics, and 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 occurs 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 time when communication is critical for successful mother/calf interactions could have more serious impacts. Also, depending on the degree and frequency range, the effects of PTS on an animal could range in severity, although it is considered generally more serious 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 one can infer that strategies exist for coping with this condition to some degree, though likely not without cost.

Acoustically Mediated Bubble Growth—One theoretical cause of injury to marine mammals is rectified diffusion (Crum and Mao, 1996), the process of increasing the size of a bubble by exposing it to a sound field. This process could be facilitated if the environment in which the ensonified bubbles exist is supersaturated with gas. Repetitive diving by marine mammals can cause the blood and some tissues to accumulate gas to a greater degree than is supported by the surrounding environmental pressure (Ridgway and Howard, 1979). The deeper and longer dives of some marine mammals (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 of sonar pings or explosion sounds 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. 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). Crum and Mao (1996) hypothesized that received levels would have to exceed 190 dB in order for there to be the possibility of significant bubble growth due to supersaturation of gases in the blood (*i.e.,* rectified diffusion). More recent work conducted by Crum *et al.* (2005) demonstrated the possibility of rectified diffusion for short duration signals, but at 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). Although it has been argued that traumas from some recent beaked whale strandings are consistent with gas emboli and bubble-induced tissue separations (Jepson *et al.,* 2003), there is no conclusive evidence of this. However, Jepson *et al.* (2003, 2005) and Fernandez *et al.* (2004, 2005, 2012) concluded that in vivo bubble formation, which may be exacerbated by deep, long-duration, repetitive dives may explain why beaked whales appear to be particularly vulnerable to sonar exposures. Further investigation is needed to further assess the potential validity of these hypotheses. More information regarding hypotheses that attempt to explain how behavioral responses to non-impulsive sources can lead to strandings is included in the Stranding and Mortality section.

Acoustic Masking

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

The extent of the masking interference depends on the spectral, temporal, and spatial relationships between the signals an animal is trying to receive and the masking noise, in addition to other factors. In humans, significant masking of tonal signals occurs as a result of exposure to noise in a narrow band of similar frequencies. As the sound level increases, 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.

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

The echolocation calls of toothed whales are subject to masking by high frequency sound. Human data indicate low-frequency sound can mask high-frequency sounds (*i.e.,* upward masking). Studies on captive odontocetes by Au *et al.* (1974, 1985, 1993) indicate that some species may use various processes to reduce masking effects (*e.g.,* adjustments in echolocation call intensity or frequency as a function of background noise conditions). There is also evidence that the directional hearing abilities of odontocetes are useful in reducing masking at the high-frequencies these cetaceans use to echolocate, but not at the low-to-moderate frequencies they use to communicate (Zaitseva *et al.,* 1980). A recent 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.

As mentioned previously, the functional hearing ranges of mysticetes, odontocetes, and pinnipeds underwater all encompass the frequencies of the sonar sources used in the Navy's MFAS/HFAS training 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. For hull-mounted sonar, which accounts for the largest takes of marine mammals (because of the source strength and number of hours it's conducted), the pulse length and low duty cycle of the MFAS/HFAS signal makes it less likely that masking would occur as a result.

Impaired Communication

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

Many animals will combine several of these strategies to compensate for high levels of background noise. Anthropogenic sounds 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 remain unknown, like most other trade-offs animals must make, some of these strategies probably come at a cost (Patricelli *et al.,* 2006). For example, vocalizing more loudly in noisy environments may have energetic costs that decrease the net benefits of vocal adjustment and alter a bird's energy budget (Brumm, 2004; Wood and Yezerinac, 2006). Shifting songs and calls to higher frequencies may also impose energetic costs (Lambrechts, 1996).

Stress Responses

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

In the case of many stressors, an animal's first and 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; the system that has received the most study has been the hypothalmus-pituitary-adrenal system (also known as the HPA axis in mammals or the hypothalamus-pituitary-interrenal axis in fish and some reptiles). Unlike stress responses associated with the autonomic nervous system, virtually all neuro-endocrine functions that are affected by stress—including immune competence, reproduction, metabolism, and behavior—are regulated by pituitary hormones. Stress-induced changes in the secretion of pituitary hormones have been implicated in failed reproduction (Moberg, 1987; Rivier, 1995), altered metabolism (Elasser *et al.,* 2000), reduced immune competence (Blecha, 2000), and behavioral disturbance. Increases in the circulation of glucocorticosteroids (cortisol, corticosterone, and aldosterone in marine mammals; see Romano *et al.,* 2004) have been equated with stress for many years.

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

Relationships between these physiological mechanisms, animal behavior, and the costs of stress responses have also been documented fairly well through controlled experiments; because this physiology exists in every vertebrate that has been studied, it is not surprising that stress responses and their costs have been documented in both laboratory and free-living animals (for examples see, Holberton *et al.,* 1996; Hood *et al.,* 1998; Jessop *et al.,* 2003; Krausman *et al.,* 2004; Lankford *et al.,* 2005; Reneerkens *et al.,* 2002; Thompson and Hamer, 2000). Information has also been collected on the physiological responses of marine mammals to exposure to anthropogenic sounds (Fair and Becker, 2000; Romano *et al.,* 2002; Wright *et al.,* 2008). 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. 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. The Office of Naval Research hosted a workshop (Effects of Stress on Marine Mammals Exposed to Sound) in 2009 that focused on this very topic (ONR, 2009).

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

Hearing is one of the primary senses marine mammals use to gather information about their environment and to communicate with conspecifics. Although empirical information on the relationship between sensory impairment (TTS, PTS, and acoustic masking) on marine mammals remains limited, it seems reasonable to assume that reducing an animal's ability to gather information about its environment and to communicate with other members of its species would be stressful for animals that use hearing as their primary sensory mechanism. Therefore, we assume that acoustic exposures sufficient to trigger onset PTS or TTS would be accompanied by physiological stress responses because terrestrial animals exhibit those responses under similar conditions (NRC, 2003). More importantly, marine mammals might experience stress responses at received levels lower than those necessary to trigger onset TTS. Based on empirical studies of the time required to recover from stress responses (Moberg, 2000), we also assume that stress responses are likely to persist beyond the time interval required for animals to recover from TTS and might result in pathological and pre-pathological states that would be as significant as behavioral responses to TTS.

Behavioral Disturbance

Behavioral responses to sound are highly variable and context-specific. Many different variables can influence an animal's perception of and response to (nature and magnitude) an acoustic event. An animal's prior experience with a sound or sound source effects whether it is less likely (habituation) or more likely (sensitization) to respond to certain sounds in the future (animals can also be innately pre-disposed to respond to certain sounds in certain ways) (Southall *et al.,* 2007). Related to the sound itself, the perceived nearness of the sound, bearing of the sound (approaching vs. retreating), similarity of a sound to biologically relevant sounds in the animal's environment (*i.e.,* calls of predators, prey, or conspecifics), and familiarity of the sound may affect the way an animal responds to the sound (Southall *et al.,* 2007). Individuals (of different age, gender, reproductive status, etc.) among most populations will have variable hearing capabilities, and differing behavioral sensitivities to sounds that will be affected by prior conditioning, experience, and current activities of those individuals. Often, specific acoustic features of the sound and contextual variables (*i.e.,* proximity, duration, or recurrence of the sound or the current behavior that the marine mammal is engaged in or its prior experience), as well as entirely separate factors such as the physical presence of a nearby vessel, may be more relevant to the animal's response than the received level alone.

Exposure of marine mammals to sound sources can result in no response or responses including, but not limited to: 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 and others in 1995. A more recent review (Nowacek *et al.,* 2007) addresses studies conducted since 1995 and focuses on observations where the received sound level of the exposed marine mammal(s) was known or could be estimated. The following sub-sections provide examples of behavioral responses that provide an idea of the variability in behavioral responses that would be expected given the differential sensitivities of marine mammal species to sound and the wide range of potential acoustic sources to which a marine mammal may be exposed. Estimates of the types of behavioral responses that could occur for a given sound exposure should be determined from the literature that is available for each species, or extrapolated from closely related species when no information exists.

Flight Response—A flight response is a dramatic change in normal movement to a directed and rapid movement away from the perceived location of a sound source. Relatively little information on flight responses of marine mammals to anthropogenic signals exist, although observations of flight responses to the presence of predators have occurred (Connor and Heithaus, 1996). Flight responses have been speculated as being a component of marine mammal strandings associated with sonar activities (Evans and England, 2001).

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.

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

Nowacek *et al.* (2004) reported disruptions of dive behaviors in foraging North Atlantic right whales when exposed to an alerting stimulus, an action, they noted, that could lead to an increased likelihood of ship strike. However, the whales did not respond to playbacks of either right whale social sounds or vessel noise, highlighting the importance of the sound characteristics in producing a behavioral reaction. Conversely, Indo-Pacific humpback dolphins have been observed to dive for longer periods of time in areas where vessels were present and/or approaching (Ng and Leung, 2003). In both of these studies, the influence of the sound exposure cannot be decoupled from the physical presence of a surface vessel, thus complicating interpretations of the relative contribution of each stimulus to the response. Indeed, the presence of surface vessels, their approach, and speed of approach, seemed to be significant factors in the response of the Indo-Pacific humpback dolphins (Ng and Leung, 2003). Low frequency signals of the Acoustic Thermometry of Ocean Climate (ATOC) sound source were not found to affect dive times of humpback whales in Hawaiian waters (Frankel and Clark, 2000) or to overtly affect elephant seal dives (Costa *et al.,* 2003). They did, however, produce subtle effects that varied in direction and degree among the individual seals, illustrating the equivocal nature of behavioral effects and consequent difficulty in defining and predicting them.

Due to past incidents of beaked whale strandings associated with sonar operations, feedback paths are provided between avoidance and diving and indirect tissue effects. This feedback accounts for the hypothesis that variations in diving behavior and/or avoidance responses can possibly result in nitrogen tissue supersaturation and nitrogen off-gassing, possibly to the point of deleterious vascular bubble formation (Jepson *et al.,* 2003). Although hypothetical, discussions surrounding this potential process are controversial.

Foraging—Disruption of feeding behavior can be difficult to correlate with anthropogenic sound exposure, so it is usually inferred by observed displacement from known foraging areas, the appearance of secondary indicators (*e.g.,* bubble nets or sediment plumes), or changes in dive behavior. Noise from seismic surveys was not found to impact the feeding behavior in western grey whales off the coast of Russia (Yazvenko *et al.,* 2007) and sperm whales engaged in foraging dives did not abandon dives when exposed to distant signatures of seismic airguns (Madsen *et al.,* 2006). However, Miller *et al.* (2009) reported buzz rates (a proxy for feeding) 19 percent lower during exposure to distant signatures of seismic airguns. 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 sound pressure levels 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 simulated mid-frequency sonar in the Southern California Bight were less likely to produce low frequency calls usually associated with feeding behavior (Melcón *et al.,* 2012). It is not known whether the lower rates of calling actually indicated a reduction in feeding behavior or social contact since the study used data from remotely deployed, passive acoustic monitoring buoys. In contrast, blue whales increased their likelihood of calling when ship noise was present, and decreased their likelihood of calling in the presence of explosive noise, although this result was not statistically significant (Melcón *et al.,* 2012). Additionally, the likelihood of an animal calling decreased with the increased received level of mid-frequency sonar, beginning at a SPL of approximately 110–120 dB re 1 μPa (Melcón *et al.,* 2012). Preliminary results from the 2010–2011 field season of an ongoing behavioral response study in Southern California waters indicated that, in some cases and at low received levels, tagged blue whales responded to mid-frequency sonar but that those responses were mild and there was a quick return to their baseline activity (Southall *et al.,* 2011). A determination of whether foraging disruptions incur fitness consequences will require information on or estimates of the energetic requirements of the individuals and the relationship between prey availability, foraging effort and success, and the life history stage of the animal. Goldbogen *et al.,* (2013) monitored behavioral responses of tagged blue whales located in feeding areas when exposed simulated MFA sonar. Responses varied depending on behavioral context, with deep feeding whales being more significantly affected (*i.e.,* generalized avoidance; cessation of feeding; increased swimming speeds; or directed travel away from the source) compared to surface feeding individuals that typically showed no change in behavior. Non-feeding whales also seemed to be affected by exposure. The authors indicate that disruption of feeding and displacement could impact individual fitness and health.

Breathing—Variations in respiration naturally vary with different behaviors and variations in respiration rate as a function of acoustic exposure can be expected to co-occur with other behavioral reactions, such as a flight response or an alteration in diving. However, respiration rates in and of themselves may be representative of annoyance or an acute stress response. Mean exhalation rates of gray whales at rest and while diving were found to be unaffected by seismic surveys conducted adjacent to the whale feeding grounds (Gailey *et al.,* 2007). Studies with captive harbor porpoises showed increased respiration rates upon introduction of acoustic alarms

(Kastelein *et al.,* 2001; Kastelein *et al.,* 2006a) and emissions for underwater data transmission (Kastelein *et al.,* 2005). However, exposure of the same acoustic alarm to a striped dolphin under the same conditions did not elicit a response (Kastelein *et al.,* 2006a), again highlighting the importance in understanding species differences in the tolerance of underwater noise when determining the potential for impacts resulting from anthropogenic sound exposure (Southall *et al.,* 2007; Henderson *et al.,* 2014).

Social Relationships—Social interactions between mammals can be affected by noise via the disruption of communication signals or by the displacement of individuals. Disruption of social relationships therefore depends on the disruption of other behaviors (*e.g.,* caused avoidance, masking, etc.) and no specific overview is provided here. However, social disruptions must be considered in context of the relationships that are affected. Long-term disruptions of mother/calf pairs or mating displays have the potential to affect the growth and survival or reproductive effort/success of individuals, respectively.

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

Avoidance—Avoidance is the displacement of an individual from an area as a result of the presence of a sound. Richardson *et al.,* (1995) noted that avoidance reactions are the most obvious manifestations of disturbance in marine mammals. It 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. Longer term displacement is possible, however, which can lead to changes in abundance or distribution patterns of the species in the affected region if they do not become acclimated to the presence of the sound (Blackwell *et al.,* 2004; Bejder *et al.,* 2006; Teilmann *et al.,* 2006). Acute avoidance responses have been observed in captive porpoises and pinnipeds exposed to a number of different sound sources (Kastelein *et al.,* 2001; Finneran *et al.,* 2003; Kastelein *et al.,* 2006a; Kastelein *et al.,* 2006b). Short-term avoidance of seismic surveys, low frequency emissions, and acoustic deterrents have also been noted in wild populations of odontocetes (Bowles *et al.,* 1994; Goold, 1996; 1998; Stone *et al.,* 2000; Morton and Symonds, 2002) and to some extent in mysticetes (Gailey *et al.,* 2007), while longer term or repetitive/chronic displacement for some dolphin groups and for manatees has been suggested to be due to the presence of chronic vessel noise (Haviland-Howell *et al.,* 2007; Miksis-Olds *et al.,* 2007).

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 (which both contained mid- and low-frequency components) 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, ceased feeding during the approach of the sonar and moved rapidly away from the source. When exposed to Source B, Kvadsheim and his co-workers reported that a tagged killer whale seemed to try to avoid further exposure to the sound field by the following behaviors: Immediately swimming away (horizontally) from the source of the sound; engaging in a series of erratic and frequently deep dives that seemed to take it below the sound field; or swimming away while engaged in a series of erratic and frequently deep dives. Although the sample sizes in this study are too small to support statistical analysis, the behavioral responses of the orcas were consistent with the results of other studies.

In 2007, the first in a series of behavioral response studies, a collaboration by the Navy, NMFS, and other scientists showed one beaked whale (*Mesoplodon densirostris*) 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 mid-frequency signals in the 130–140 dB (rms) received level range. After a few more minutes of the playback, when the received level reached a maximum of 140–150 dB, the whale ascended on the slow side of normal ascent rates with a longer than normal ascent, at which point the exposure was terminated. The results are from a single experiment and a greater sample size is needed before robust and definitive conclusions can be drawn.

Tyack *et al.* (2011) also indicates that Blainville's beaked whales appear to be sensitive to noise at levels well below expected TTS (~160 dB re1μPa). This sensitivity is manifest by an adaptive movement away from a sound source. This response was observed irrespective of whether the signal transmitted was within the band width of 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. The response to such stimuli appears to involve maximizing the distance from the sound source.

Stimpert *et al.* (2014) tagged a Baird's beaked whale, which was subsequently exposed to simulated mid-frequency sonar. Changes in the animal's dive behavior and locomotion were observed when received level reached 127 dB re1μPa.

Results from a 2007–2008 study conducted near the Bahamas showed a change in diving behavior of an adult Blainville's beaked whale to playback of mid-frequency source and predator sounds (Boyd *et al.,* 2008; Southall *et al.* 2009; Tyack *et al.,* 2011). 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 mid-frequency active sonar during the 2010 and 2011 field seasons of the southern California behavioral response study. The 2011 whale was also incidentally exposed to mid-frequency active sonar from a distant naval exercise. Received levels from the mid-frequency active sonar signals from the controlled and incidental exposures were calculated as 84–144 and 78–106 dB re 1 μPa root mean square (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. 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. 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 2 hours after mid-frequency 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 mid-frequency sonar playback was observed on one occasion (Miller *et al.,* 2011). 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).

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; Tyack *et al.,* 2011). In the Bahamas, Blainville's beaked whales located on the 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.

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.

There are few empirical studies of avoidance responses of free-living cetaceans to MFAS. Much more information is available on the avoidance responses of free-living cetaceans to other acoustic sources, such as seismic airguns and low-frequency tactical sonar, than MFAS.

Behavioral Responses

Southall *et al.* (2007) reports the results of the efforts of a panel of experts in acoustic research from behavioral, physiological, and physical disciplines that convened and 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 were not included in the quantitative analysis for the criteria recommendations. 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. MFAS/HFAS sonar is considered a non-pulse sound. 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 (incorporated by reference and summarized in the three paragraphs below).

The studies that address responses of low-frequency cetaceans to non-pulse sounds include data gathered in the field and related to several types of sound sources (of varying similarity to MFAS/HFAS) including: Vessel noise, drilling and machinery playback, low-frequency M-sequences (sine wave with multiple phase reversals) playback, tactical low-frequency active sonar playback, drill ships, Acoustic Thermometry of Ocean Climate (ATOC) source, and non-pulse playbacks. These studies generally indicate no (or very limited) responses to received levels in the 90 to 120 dB re: 1 µPa range and an increasing likelihood of avoidance and other behavioral effects in the 120 to 160 dB 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, while in other cases these responses were not seen in the 120 to 150 dB 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), at least for initial exposures. All recorded exposures above 140 dB 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 is no data to indicate whether other high frequency cetaceans are as sensitive to anthropogenic sound as harbor porpoises are.

The studies that address the responses of pinnipeds in water to non-pulse sounds include data gathered both in the field and the laboratory and related to several different sound sources (of varying similarity to MFAS/HFAS) 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 generally do not result in strong behavioral responses in pinnipeds in water, but no data exist at higher received levels.

Potential Effects of Behavioral Disturbance

The different ways that marine mammals respond to sound are sometimes indicators of the ultimate effect that exposure to a given stimulus will have on the well-being (survival, reproduction, etc.) of an animal. There is limited marine mammal data quantitatively 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.

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

Vigilance is normally an adaptive behavior that helps animals determine the presence or absence of predators, assess their distance from conspecifics, or to attend cues from prey (Bednekoff and Lima, 1998; Treves, 2000). Despite those benefits, however, vigilance has a cost of time; when animals focus their attention on specific environmental cues, they are not attending to other activities such as foraging. These costs have been documented best in foraging animals, where vigilance has been shown to substantially reduce feeding rates (Saino, 1994; Beauchamp and Livoreil, 1997; Fritz *et al.,* 2002). Animals will spend more time being vigilant, which may translate to less time foraging or resting, when disturbance stimuli approach them more directly, remain at closer distances, have a greater group size (for example, multiple surface vessels), or when they co-occur with times that an animal perceives increased risk (for example, 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. For example, bighorn sheep and Dall's sheep dedicated more time being vigilant, and less time resting or foraging, when aircraft made direct approaches over them (Frid, 2001; Stockwell *et al.,* 1991).

Several authors have established that long-term and intense disturbance stimuli can cause population declines by reducing the body condition of individuals that have been disturbed, followed by reduced reproductive success, reduced survival, or both (Daan *et al.,* 1996; Madsen, 1994; White, 1983). For example, Madsen (1994) reported that pink-footed geese 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 disturbed by all-terrain vehicles (Yarmoloy *et al.,* 1988), caribou disturbed by seismic exploration blasts (Bradshaw *et al.,* 1998), caribou disturbed by low-elevation military jet-fights (Luick *et al.,* 1996), and caribou disturbed by low-elevation jet flights (Harrington and Veitch, 1992). Similarly, a study of elk that were disturbed experimentally by pedestrians concluded that the ratio of young to mothers was inversely related to disturbance rate (Phillips and Alldredge, 2000).

The primary mechanism by which increased vigilance and disturbance appear to affect the fitness of individual animals is by disrupting an animal's time budget and, as a result, reducing the time they might spend foraging and resting (which increases an animal's activity rate and energy demand). For example, a study of grizzly bears reported that bears disturbed by hikers reduced their energy intake by an average of 12 kcal/minute (50.2 x 10^3kJ/minute), and spent energy fleeing or acting aggressively toward hikers (White *et al.,* 1999). Alternately, Ridgway *et al.* (2006) reported that increased vigilance in bottlenose dolphins exposed to sound over a 5-day period did not cause any sleep deprivation or stress effects such as changes in cortisol or epinephrine levels.

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

On a related note, many animals perform vital functions, such as feeding, resting, traveling, and socializing, on a diel cycle (24-hour cycle). Substantive behavioral reactions to noise exposure (such as disruption of critical life functions, displacement, or avoidance of important habitat) are more likely to be significant if they last more than one diel cycle or recur on subsequent days (Southall *et al.,* 2007). Consequently, a behavioral response lasting less than 1 day and not recurring on subsequent days is not considered particularly 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 that exercise for multiple days or, further, exposed in a manner resulting in a sustained multiple day substantive behavioral responses.

In order to understand how the effects of activities may or may not impact stocks and populations 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 changes. 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 (below). As depicted, behavioral and physiological changes can either have direct (acute) effects on vital rates, such as when changes in habitat use or increased stress levels raise the probability of mother-calf separation or predation, or 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 (New *et al.,* 2014).

In addition to outlining this general framework and compiling the relevant literature that supports it, New *et al.* (2014) have chosen four example species for which extensive long-term monitoring data exist (southern elephant seals, North Atlantic right whales, Ziphidae beaked whales, and bottlenose dolphins) and developed state-space energetic models that can be used to effectively forecast longer-term, population-level impacts from behavioral changes. While these are very specific models with very specific data requirements that cannot yet be applied broadly to project-specific risk assessments, they are a critical first step.

Stranding and Mortality

When a live or dead marine mammal swims or floats onto shore and becomes ''beached'' or incapable of returning to sea, the event is termed a ''stranding'' (Geraci *et al.,* 1999; Perrin and Geraci, 2002; Geraci and Lounsbury, 2005; NMFS, 2007). The legal definition for a stranding within the U.S. 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 unable to return to the water; (ii) on a beach or shore of the United States and, although able to return to the water, is in need of apparent medical attention; or (iii) in the waters under the jurisdiction of the United States (including any navigable waters), but is unable to return to its natural habitat under its own power or without assistance.'' (16 U.S.C. 1421h).

Marine mammals are known to strand for a variety of reasons, such as infectious agents, biotoxicosis, starvation, fishery interaction, ship strike, unusual oceanographic or weather events, sound exposure, or combinations of these stressors sustained concurrently or in series. However, the cause or causes of most strandings are unknown (Geraci *et al.,* 1976; Eaton, 1979, Odell *et al.,* 1980; Best, 1982). Numerous studies suggest that the physiology, behavior, habitat relationships, age, or condition of cetaceans may cause them to strand or might pre-dispose them to strand when exposed to another phenomenon. These suggestions are consistent with the conclusions of numerous other studies that have demonstrated that combinations of dissimilar stressors commonly combine to kill an animal or dramatically reduce its fitness, even though one exposure without the other does not produce the same result (Chroussos, 2000; Creel, 2005; DeVries *et al.,* 2003; Fair and Becker, 2000; Foley *et al.,* 2001; Moberg, 2000; Relyea, 2005a; 2005b, Romero, 2004; Sih *et al.,* 2004). For reference, between 2001 and 2009, there was an annual average of 1,400 cetacean strandings and 4,300 pinniped strandings along the coasts of the continental U.S. and Alaska (NMFS, 2011).

Several sources have published lists of mass stranding events of cetaceans in an attempt to identify relationships between those stranding events and military sonar (Hildebrand, 2004; IWC, 2005; Taylor *et al.,* 2004). For example, based on a review of stranding records between 1960 and 1995, the International Whaling Commission (2005) identified ten mass stranding events of Cuvier's beaked whales had been reported and one mass stranding of four Baird's beaked whale. The IWC concluded that, out of eight stranding events reported from the mid-1980s to the summer of 2003, seven had been coincident with the use of tactical mid-frequency sonar, one of those seven had been associated with the use of tactical low-frequency sonar, and the remaining stranding event had been associated with the use of seismic airguns.

Most of the stranding events reviewed by the International Whaling Commission 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.

Between 1960 and 2006, 48 strandings (68 percent) involved beaked whales, three (4 percent) involved dolphins, and 14 (20 percent) involved whale species. Cuvier's beaked whales were involved in the greatest number of these events (48 or 68 percent), followed by sperm whales (seven or 10 percent), and Blainville's and Gervais' beaked whales (four each or 6 percent). Naval activities (not just activities conducted by the U.S. Navy) that might have involved active sonar are reported to have coincided with nine or 10 (13 to 14 percent) of those stranding events. Between the mid-1980s and 2003 (the period reported by the International Whaling Commission), NMFS identified reports of 44 mass cetacean stranding events of which at least seven were coincident with naval exercises that were using MFAS.

Strandings Associated With Impulse Sound

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 5 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 Ocean Beach, California (3 days later and approximately 11.8 mi. [19 km] from Silver Strand where the training event occurred), 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 impulse 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 these and other training and testing events are presented in the Mitigation section.

Strandings Associated With MFAS

Over the past 16 years, there have been five stranding events coincident with military mid-frequency 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). 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 stranding. A number of other stranding events coincident with the operation of mid-frequency sonar, including the death of beaked whales or other species (minke whales, dwarf sperm whales, pilot whales), have been reported; however, the majority have not been investigated to the degree necessary to determine the cause of the stranding and only one of these stranding events, the Bahamas (2000), was associated with exercises conducted by the U.S. Navy. Most recently, the Independent Scientific Review Panel investigating potential contributing factors to a 2008 mass stranding of melon-headed whales in Antsohihy, Madagascar released its final report suggesting that the stranding was likely initially triggered by an industry seismic survey. This report suggests that the operation of a commercial high-powered 12 kHz multi-beam echosounder during an industry seismic survey was a plausible and likely initial trigger that caused a large group of melon-headed whales to leave their typical habitat and then ultimately strand as a result of secondary factors such as malnourishment and dehydration. The report indicates that the risk of this particular convergence of factors and ultimate outcome is likely very low, but recommends that the potential be considered in environmental planning. 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 a suite of mitigation intended to more broadly minimize impacts to marine mammals, the Navy and NMFS have a detailed Stranding Response Plan that outlines reporting, communication, and response protocols intended both to minimize the impacts of, and enhance the analysis of, any potential stranding in areas where the Navy operates.

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

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

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

Madeira, Spain (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 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 nm (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 4 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, six 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; Fernández *et al.,* 2012).

Hanalei Bay (2004)—On July 3 and 4, 2004, approximately 150 to 200 melon-headed whales occupied the shallow waters of the Hanalei Bay, Kaua'i, 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 9 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. Since that time there have been two ''out of habitat'' or ''near mass strandings'' of melon-headed whales in the Philippines (Aragones *et al.,* 2010). Pictures of one of these events depict grouping behavior like that displayed at Hanalei Bay in July 2004. No naval sonar activity was noted it the area, although it was suspected by the authors, based on personal communication with a government fisheries representative, that dynamite blasting in the area may have occurred within the days prior to one of the events (Aragones *et al.,* 2010). Although melon-headed whales entering embayments may be infrequent and rare, there is precedent for this type of occurrence on other occasions in the absence of naval activity.

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

Association Between Mass Stranding Events and Exposure to MFAS

Several authors have noted similarities between some of these stranding incidents: They occurred in islands or archipelagoes with deep water nearby, several appeared to have been associated with acoustic waveguides like surface ducting, and the sound fields created by ships transmitting MFAS (Cox *et al.,* 2006, D'Spain *et al.,* 2006). Although Cuvier's beaked whales have been the most common species involved in these stranding events (81 percent of the total number of stranded animals), other beaked whales (including *Mesoplodon europeaus, M. densirostris,* and *Hyperoodon ampullatus*) comprise 14 percent of the total. Other species (*Stenella coeruleoalba, Kogia breviceps* and *Balaenoptera acutorostrata*) have stranded, but in much lower numbers and less consistently than beaked whales.

Based on the evidence available, however, NMFS cannot determine whether (a) Cuvier's beaked whale is more prone to injury from high-intensity sound than other species; (b) their behavioral responses to sound makes them more likely to strand; or (c) they are more likely to be exposed to MFAS than other cetaceans (for reasons that remain unknown). Because the association between active sonar exposures and marine mammals mass stranding events is not consistent—some marine mammals strand without being exposed to sonar and some sonar transmissions are not associated with marine mammal stranding events despite their co-occurrence—other risk factors or a grouping of risk factors probably contribute to these stranding events.

Behaviorally Mediated Responses to MFAS That May Lead to Stranding

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

Although causal relationships between beaked whale stranding events and active sonar remain unknown, several authors have hypothesized that stranding events involving these species in the Bahamas and Canary Islands may have been triggered when the whales changed their dive behavior in a startled response to exposure to active sonar or to further avoid exposure (Cox *et al.,* 2006, Rommel *et al.,* 2006). These authors proposed three mechanisms by which the behavioral responses of beaked whales upon being exposed to active sonar might result in a stranding event. These include the following: Gas bubble formation caused by excessively fast surfacing; remaining at the surface too long when tissues are supersaturated with nitrogen; or diving prematurely when extended time at the surface is necessary to eliminate excess nitrogen. More specifically, beaked whales that occur in deep waters that are in close proximity to shallow waters (for example, the ''canyon areas'' that are cited in the Bahamas stranding event; see D'Spain and D'Amico, 2006), may respond to active sonar by swimming into shallow waters to avoid further exposures and strand if they were not able to swim back to deeper waters. Second, beaked whales exposed to active sonar might alter their dive behavior. Changes in their dive behavior might cause them to remain at the surface or at depth for extended periods of time which could lead to hypoxia directly by increasing their oxygen demands or indirectly by increasing their energy expenditures (to remain at depth) and increase their oxygen demands as a result. If beaked whales are at depth when they detect a ping from an active sonar transmission and change their dive profile, this could lead to the formation of significant gas bubbles, which could damage multiple organs or interfere with normal physiological function (Cox *et al.,* 2006; Rommel *et al.,* 2006; Zimmer and Tyack, 2007). Baird *et al.* (2005) found that slow ascent rates from deep dives and long periods of time spent within 50 m of the surface were typical for both Cuvier's and Blainville's beaked whales, the two species involved in mass strandings related to naval sonar. These two behavioral mechanisms may be necessary to purge excessive dissolved nitrogen concentrated in their tissues during their frequent long dives (Baird *et al.,* 2005). Baird *et al.* (2005) further suggests that abnormally rapid ascents or premature dives in response to high-intensity sonar could indirectly result in physical harm to the beaked whales, through the mechanisms described above (gas bubble formation or non-elimination of excess nitrogen).

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

Zimmer and Tyack (2007) modeled nitrogen tension and bubble growth in several tissue compartments for several hypothetical dive profiles and concluded that repetitive shallow dives (defined as a dive where depth does not exceed the depth of alveolar collapse, approximately 72 m for *Ziphius*), perhaps as a consequence of an extended avoidance reaction to sonar sound, could pose a risk for decompression sickness and that this risk should increase with the duration of the response. Their models also suggested that unrealistically rapid ascent 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 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). The probability of flight responses should also increase as received levels of active sonar increase (and the ship is, therefore, closer) and as ship speeds increase (that is, as approach speeds increase). For example, the probability of flight responses in Dall's sheep (*Ovis dalli dalli*) (Frid 2001a, b), ringed seals (*Phoca hispida*) (Born *et al.,* 1999), Pacific brant (*Branta bernic nigricans*) and Canada geese (*B. Canadensis*) increased as a helicopter or fixed-wing aircraft approached groups of these animals more directly (Ward *et al.,* 1999). Bald eagles (*Haliaeetus leucocephalus*) perched on trees alongside a river were also more likely to flee from a paddle raft when their perches were closer to the river or were closer to the ground (Steidl and Anthony, 1996).

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

Impulsive 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). In addition, gas-containing organs including the nasal sacs, larynx, pharynx, trachea, and lungs may be damaged by compression/expansion caused by the oscillations of the blast gas bubble (Reidenberg and Laitman, 2003). 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 susceptible 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). Sound-related trauma can be lethal or sublethal. 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).

There have been fewer studies addressing the behavioral effects of explosives on marine mammals compared to MFAS/HFAS. However, though the nature of the sound waves emitted from an explosion are different (in shape and rise time) from MFAS/HFAS, NMFS still anticipates the same sorts of behavioral responses to result from repeated explosive detonations (a smaller range of likely less severe responses (*i.e.*, not rising to the level of MMPA harassment)) would be expected to occur as a result of exposure to a single explosive detonation that was not powerful enough or close enough to the animal to cause TTS or injury.

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 5–8 km from a seismic array during observational studies and controlled exposure experiments in western Australia (McCauley, 1998; 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.

Seismic pulses at average received levels of 131 dB re 1 micropascal squared second (μPa^2-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). These studies demonstrate that even low levels of noise received far from the noise source can induce behavioral responses.

Madsen *et al.* (2006) and Miller *et al.* (2009) tagged and monitored eight sperm whales in the Gulf of Mexico exposed to seismic airgun surveys. Sound sources were from approximately 2 to 7 nm away from the whales and based on multipath propagation received levels were as high as 162 dB SPL re 1 μPa with energy content greatest between 0.3 and 3.0 kHz (Madsen, 2006). The whales showed no horizontal avoidance, although the whale that was approached most closely had an extended resting period and did not resume foraging until the airguns had ceased firing (Miller *et al.*, 2009). The remaining whales continued to execute foraging dives throughout exposure; however, swimming movements during foraging dives were 6 percent lower during exposure than control periods, suggesting subtle effects of noise on foraging behavior (Miller *et al.*, 2009). Captive bottlenose dolphins sometimes vocalized after an exposure to impulse sound from a seismic watergun (Finneran *et al.*, 2010a).

A review of behavioral reactions by pinnipeds to impulse noise can be found in Richardson *et al.* (1995) and Southall *et al.* (2007). Blackwell *et al.* (2004) observed that ringed seals exhibited little or no reaction to pipe-driving noise with mean underwater levels of 157 dB re 1 μPa rms and in air levels of 112 dB re 20 μPa, suggesting that the seals had habituated to the noise. In contrast, captive California sea lions avoided sounds from an impulse source at levels of 165–170 dB re 1 μPa (Finneran *et al.*, 2003b). Experimentally, Götz and Janik (2011) tested underwater, startle responses to a startling sound (sound with a rapid rise time and a 93 dB sensation level [the level above the animal's threshold at that frequency]) and a non-startling sound (sound with the same level, but with a slower rise time) in wild-captured gray seals. The animals exposed to the startling treatment avoided a known food source, whereas animals exposed to the non-startling treatment did not react or habituated during the exposure period. The results of this study highlight the importance of the characteristics of the acoustic signal in an animal's response of habituation.

Vessels

Commercial and Navy ship strikes of cetaceans can cause major wounds, which may lead to the death of the animal. An animal at the surface could be struck directly by a vessel, a surfacing animal could hit the bottom of a vessel, or an animal just below the surface could be cut by a vessel's propeller. The severity of injuries typically depends on the size and speed of the vessel (Knowlton and Kraus, 2001; Laist *et al.*, 2001; Vanderlaan and Taggart, 2007). The most vulnerable marine mammals are those that spend extended periods of time at the surface in order to restore oxygen levels within their tissues after deep dives (*e.g.*, the sperm whale). In addition, some baleen whales, such as the North Atlantic right whale, seem generally unresponsive to vessel sound, making them more susceptible to vessel collisions (Nowacek *et al.*, 2004). These species are primarily large, slow moving whales. Smaller marine mammals (*e.g.*, bottlenose dolphin) move quickly through the water column and are often seen riding the bow wave of large ships. Marine mammal responses to vessels may include avoidance and changes in dive pattern (NRC, 2003).

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

Jensen and Silber (2003) detailed 292 records of known or probable ship strikes of all large whale species from 1975 to 2002. Of these, vessel speed at the time of collision was reported for 58 cases. Of these cases, 39 (or 67 percent) resulted in serious injury or death (19 of those resulted in serious injury as determined by blood in the water, propeller gashes or severed tailstock, and fractured skull, jaw, vertebrae, hemorrhaging, massive bruising or other injuries noted during necropsy and 20 resulted in death). Operating speeds of vessels that struck various species of large whales ranged from 2 to 51 knots. The majority (79 percent) of these strikes occurred at speeds of 13 knots or greater. The average speed that resulted in serious injury or death was 18.6 knots. 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 knots, and exceeded 90 percent at 17 knots. 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).

The Jensen and Silber (2003) report notes that the database represents a minimum number of collisions, because the vast majority probably goes undetected or unreported. In contrast, Navy vessels are likely to detect any strike that does occur, and they are required to report all ship strikes involving marine mammals. Overall, the percentages of Navy traffic relative to overall large shipping traffic are very small (on the order of 2 percent).

There are no records of any Navy vessel strikes to marine mammals during training or testing activities in the NWTT Study Area. There has been only one whale strike in the Pacific Northwest by the Navy since such records have been kept (June 1994–present). In August 2012, a San Diego homeported DDG (destroyer) at-sea about 35 nm west of Coos Bay, Oregon struck a whale (believed to be a minke) while transiting to San Diego from Seattle. There have been Navy strikes of large whales in areas outside the Study Area, such as Hawaii and Southern California. However, these areas differ significantly from the Study Area given that both Hawaii and Southern

California have a much higher number of Navy vessel activities.

Other efforts have been undertaken to investigate the impact from vessels (both whale-watching and general vessel traffic noise) and demonstrated impacts do occur (Bain, 2002; Erbe, 2002; Lusseau, 2009; Williams *et al.*, 2006, 2009, 2011b, 2013, 2014a, 2014b; Noren *et al.*, 2009; Read *et al.*, 2014; Rolland *et al.*, 2012; Pirotta *et al.*, 2015). This body of research for the most part has investigated impacts associated with the presence of chronic stressors, which differ significantly from generally intermittent Navy training and testing activities. For example, in an analysis of energy costs to killer whales, Williams *et al.* (2009) suggested that whale-watching in the Johnstone Strait resulted in lost feeding opportunities due to vessel disturbance, which could carry higher costs than other measures of behavioral change might suggest. Ayres *et al.* (2012) recently reported on research in the Salish Sea 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.

Marine Mammal Habitat

The Navy's proposed training and testing activities could potentially affect marine mammal habitat through the introduction of sound into the water column, impacts to the prey species of marine mammals, bottom disturbance, or changes in water quality. Each of these components was considered in the January 2014 NWTT DEIS/OEIS and was determined by the Navy to have no effect on marine mammal habitat. Based on the information below and the supporting information included in the January 2014 NWTT DEIS/OEIS, NMFS has preliminarily determined that the proposed training and testing activities would not have adverse or long-term impacts on marine mammal habitat.

Critical Habitat

The southern resident killer whale (in the inshore area) is the only ESA-listed marine mammal species with designated critical habitat located in the Study Area. The majority of the Navy's proposed training and testing activities would, however, not occur in the southern resident killer whale's designated critical habitat (NMFS, 2006). For all substressors that would occur within the critical habitat, those training and testing activities are not expected to impact the identified primary constituent elements of that habitat and therefore would have no effect on that critical habitat. Effects to designated critical habitat will be fully analyzed in the Navy's and NMFS' internal ESA Section 7 consultations for NWTT.

Expected Effects on Habitat

Unless the sound source or explosive detonation is stationary and/or continuous over a long duration in one area, the effects of the introduction of sound into the environment are generally considered to have a less severe impact on marine mammal habitat than the physical alteration of the habitat. Acoustic exposures are not expected to result in long-term physical alteration of the water column or bottom topography, as the occurrences are of limited duration and are intermittent in time. Surface vessels associated with the activities are present in limited duration and are intermittent as they move relatively rapidly through any given area. Most of the high-explosive military expended materials would detonate at or near the water surface. Only bottom-laid explosives are likely to affect bottom substrate; habitat used for underwater detonations and seafloor device placement would primarily be soft-bottom sediment. Once on the seafloor, military expended material would likely be colonized by benthic organisms because the materials would serve as anchor points in the shifting bottom substrates, similar to a reef. The surface area of bottom substrate affected would make up a very small percentage of the total training area available in the NWTT Study Area.

Effects on Marine Mammal Prey

Invertebrates—Marine invertebrate distribution in the NWTT Study Area is influenced by habitat, ocean currents, and water quality factors such as temperature, salinity, and nutrient content (Levinton, 2009). The distribution of invertebrates is also influenced by their distance from the equator (latitude); in general, the number of marine invertebrate species increases toward the equator (Macpherson, 2002). The higher number of species (diversity) and abundance of marine invertebrates in coastal habitats, compared with the open ocean, is a result of more nutrient availability from terrestrial environments and the variety of habitats and substrates found in coastal waters (Levinton, 2009).

Marine invertebrates in the Study Area inhabit coastal waters and benthic habitats, including salt marshes, kelp forests, soft sediments, canyons, and the continental shelf. Salt marsh invertebrates include oysters, crabs, and worms that are important prey for birds and small mammals. Mudflats provide habitat for substantial amounts of crustaceans, bivalves, and worms. The sandy intertidal area is dominated by species that are highly mobile and can burrow. One of the most abundant invertebrates found in the near shore areas of the Study Area on soft sediments are geoduck clams (*Panopea generosa*).

All marine invertebrate taxonomic groups are represented in the NWTT Study Area. Major invertebrate phyla (taxonomic range)—those with greater than 1,000 species and the general zones they inhabit in the Study Area are described in Chapter 3 of the January 2014 NWTT DEIS/OEIS.

Very little is known about sound detection and use of sound by aquatic invertebrates (Budelmann 2010; Montgomery *et al.*, 2006; Popper *et al.*, 2001). Organisms may detect sound by sensing either the particle motion or pressure component of sound, or both. Aquatic invertebrates probably do not detect pressure since many are generally the same density as water and few, if any, have air cavities that would function like the fish swim bladder in responding to pressure (Budelmann, 2010; Popper *et al.*, 2001). Many marine invertebrates, however, have ciliated ''hair'' cells that may be sensitive to water movements, such as those caused by currents or water particle motion very close to a sound source (Budelmann, 2010; Mackie and Singla, 2003). These cilia may allow invertebrates to sense nearby prey or predators or help with local navigation. Marine invertebrates may produce and use sound in territorial behavior, to deter predators, to find a mate, and to pursue courtship (Popper *et al.*, 2001).

Both behavioral and auditory brainstem response studies suggest that crustaceans may sense sounds up to three kilohertz (kHz), but best sensitivity is likely below 200 Hz (Lovell *et al.*, 2005; Lovell *et al.*, 2006; Goodall *et al.*, 1990). Most cephalopods (*e.g.*, octopus and squid) likely sense low-frequency sound below 1,000 Hz, with best sensitivities at lower frequencies (Budelmann, 2010; Mooney *et al.*, 2010; Packard *et al.*, 1990). A few cephalopods may sense higher frequencies up to 1,500 Hz (Hu *et al.*, 2009). Squid did not respond to toothed whale ultrasonic echolocation clicks at sound pressure levels ranging from 199 to 226 dB re 1 μPa peak-to-peak, likely because these clicks were outside of squid hearing range (Wilson *et al.*, 2007). However, squid exhibited alarm responses when exposed to broadband sound from an approaching seismic airgun with received levels exceeding 145 to 150 dB re 1 µPa root mean square (McCauley *et al.*, 2000b).

Little information is available on the potential impacts on marine invertebrates of exposure to sonar, explosions, and other sound-producing activities. It is expected that most marine invertebrates would not sense mid- or high-frequency sounds, distant sounds, or aircraft noise transmitted through the air-water interface. Most marine invertebrates would not be close enough to intense sound sources, such as some sonars, to potentially experience impacts to sensory structures. Any marine invertebrate capable of sensing sound may alter its behavior if exposed to non-impulsive sound, although it is unknown if responses to non-impulsive sounds occur. Continuous noise, such as from vessels, may contribute to masking of relevant environmental sounds, such as reef noise. Because the distance over which most marine invertebrates are expected to detect any sounds is limited and vessels would be in transit, any sound exposures with the potential to cause masking or behavioral responses would be brief and long-term impacts are not expected. Although non-impulsive underwater sounds produced during training and testing activities may briefly impact individuals, intermittent exposures to non-impulsive sounds are not expected to impact survival, growth, recruitment, or reproduction of widespread marine invertebrate populations.

Most detonations would occur greater than 3 nm from shore. As water depth increases away from shore, benthic invertebrates would be less likely to be impacted by detonations at or near the surface. In addition, detonations near the surface would release a portion of their explosive energy into the air, reducing the explosive impacts in the water. Some marine invertebrates may be sensitive to the low-frequency component of impulsive sound, and they may exhibit startle reactions or temporary changes in swim speed in response to an impulsive exposure. Because exposures are brief, limited in number, and spread over a large area, no long-term impacts due to startle reactions or short-term behavioral changes are expected. Although individual marine invertebrates may be injured or killed during an explosion or pile driving, no long-term impacts on the survival, growth, recruitment, or reproduction of marine invertebrate populations are expected.

Fish—Fish are not distributed uniformly throughout the NWTT Study Area, but are closely associated with a variety of habitats. Some species range across thousands of square miles while others have small home ranges and restricted distributions (Helfman *et al.*, 2009). The movements of some open-ocean species may never overlap with coastal fishes that spend their lives within several hundred feet (a few hundred meters) of the shore. Even within a single fish species, the distribution and specific habitats in which individuals occur may be influenced by its developmental stage, size, sex, reproductive condition, and other factors.

The distribution and abundance of fishes depends greatly on the physical and biological factors of the marine ecosystem, such as salinity, temperature, dissolved oxygen, population dynamics, predator and prey interaction oscillations, seasonal movements, reproduction and life cycles, and recruitment success (Helfman *et al.*, 1997). A single factor is rarely responsible for the distribution of fish species; more often, a combination of factors is accountable. For example, open ocean species optimize their growth, reproduction, and survival by tracking gradients of temperature, oxygen, or salinity (Helfman *et al.*, 1997). Another major component in understanding species distribution is the location of highly productive regions, such as frontal zones. These areas concentrate various prey species and their predators, such as tuna, and provide visual cues for the location of target species for commercial fisheries (NMFS, 2001).

There are 17 major taxonomic groups of marine fishes within the NWTT Study Area. Detailed information on taxa presence, distribution, and characteristics are provided in Chapter 3 of the January 2014 NWTT DEIS/OEIS.

All fish have two sensory systems to detect sound in the water: The inner ear, which functions very much like the inner ear in other vertebrates, and the lateral line, which consists of a series of receptors along the fish's body (Popper, 2008). The inner ear generally detects relatively higher-frequency sounds, while the lateral line detects water motion at low frequencies (below a few hundred Hz) (Hastings and Popper, 2005a). Although hearing capability data only exist for fewer than 100 of the 32,000 fish species, current data suggest that most species of fish detect sounds from 50 to 1,000 Hz, with few fish hearing sounds above 4 kHz (Popper, 2008). It is believed that most fish have their best hearing sensitivity from 100 to 400 Hz (Popper, 2003b). Additionally, some clupeids (shad in the subfamily Alosinae) possess ultrasonic hearing (*i.e.*, able to detect sounds above 100,000 Hz) (Astrup, 1999). Permanent hearing loss, or permanent threshold shift has not been documented in fish. The sensory hair cells of the inner ear in fish can regenerate after they are damaged, unlike in mammals where sensory hair cells loss is permanent (Lombarte *et al.*, 1993; Smith *et al.*, 2006). As a consequence, 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 (*e.g.*, Smith *et al.*, 2006).

Potential direct injuries from non-impulsive sound sources, such as sonar, are unlikely because of the relatively lower peak pressures and slower rise times than potentially injurious sources such as explosives. Non-impulsive sources also lack the strong shock waves associated with an explosion. Therefore, direct injury is not likely to occur from exposure to non-impulsive sources such as sonar, vessel noise, or subsonic aircraft noise. Only a few fish species are able to detect high-frequency sonar and could have behavioral reactions or experience auditory masking during these activities. These effects are expected to be transient and long-term consequences for the population are not expected. MFAS is unlikely to impact fish species because most species are unable to detect sounds in this frequency range and vessels operating MFAS would be transiting an area (not stationary). While a large number of fish species may be able to detect low-frequency sonar and other active acoustic sources, low-frequency active usage is rare and mostly conducted in deeper waters. Overall effects to fish from would be localized and infrequent.

Physical effects from pressure waves generated by underwater sounds (*e.g.* underwater explosions) could potentially affect fish within proximity of training or testing activities. In particular, the rapid oscillation between high- and low-pressure peaks has the potential to burst the swim bladders and other gas-containing organs of fish (Keevin and Hemen, 1997). Sublethal effects, such as changes in behavior of fish, have been observed in several occasions as a result of noise produced by explosives (National Research Council of the National Academies, 2003; Wright, 1982). If an individual fish were repeatedly exposed to sounds from underwater explosions that caused alterations in natural behavioral patterns or physiological stress, these impacts could lead to long-term consequences for the individual such as reduced survival, growth, or reproductive capacity. However, the time scale of individual explosions is very limited, and training exercises involving explosions are dispersed in space and time. Consequently, repeated exposure of individual fish to sounds from underwater explosions is not likely and most acoustic effects are expected to be short-term and localized. Long-term consequences for populations would not be expected. A limited number of fish may be killed in the immediate proximity of pile driving locations and additional fish may be injured. Short-term effects such as masking, stress, behavioral change, and hearing threshold shifts are also expected during pile driving operations. However, given the relatively small area that would be affected, and the abundance and distribution of the species concerned, no population-level effects are expected. The abundances of various fish and invertebrates near the detonation point of an explosion or around a pile driving location could be altered for a few hours before animals from surrounding areas repopulate the area; however these populations would be replenished as waters near the sound source are mixed with adjacent waters.

Marine Mammal Avoidance

Marine mammals may be temporarily displaced from areas where Navy training and testing is occurring, but the area should be utilized again after the activities have ceased. Avoidance of an area can help the animal avoid further acoustic effects by avoiding or reducing further exposure. The intermittent or short duration of many activities should prevent animals from being exposed to stressors on a continuous basis. In areas of repeated and frequent acoustic disturbance, some animals may habituate or learn to tolerate the new baseline or fluctuations in noise level. While some animals may not return to an area, or may begin using an area differently due to training and testing activities, most animals are expected to return to their usual locations and behavior.

Other Expected Effects

Other sources that may affect marine mammal habitat were considered in the January 2014 NWTT DEIS/OEIS and potentially include the introduction of fuel, debris, ordnance, and chemical residues into the water column. The majority of high-order explosions would occur at or above the surface of the ocean, and would have no impacts on sediments and minimal impacts on water quality. While disturbance or strike from an item falling through the water column is possible, it is unlikely because (1) objects sink slowly, (2) most projectiles are fired at targets (and hit those targets), and (3) animals are generally widely dispersed throughout the water column and over the NWTT Study Area. Chemical, physical, or biological changes in sediment or water quality would not be detectable. In the event of an ordnance failure, the energetic materials it contained would remain mostly intact. The explosive materials in failed ordnance items and metal components from training and testing would leach slowly and would quickly disperse in the water column. Chemicals from other explosives would not be introduced into the water column in large amounts and all torpedoes would be recovered following training and testing activities, reducing the potential for chemical concentrations to reach levels that can affect sediment quality, water quality, or benthic habitats.

Proposed Mitigation

In order to issue an incidental take authorization under section 101(a)(5)(A) of the MMPA, NMFS must set forth the ''permissible methods of taking pursuant to such activity, and other means of effecting the least practicable adverse impact on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance.'' NMFS' duty under this ''least practicable adverse impact'' standard is to prescribe mitigation reasonably designed to minimize, to the extent practicable, any adverse population-level impacts, as well as habitat impacts. While population-level impacts can be minimized by reducing impacts on individual marine mammals, not all takes translate to population-level impacts. NMFS' primary objective under the ''least practicable adverse impact'' standard is to design mitigation targeting those impacts on individual marine mammals that are most likely to lead to adverse population-level effects.

The NDAA of 2004 amended the MMPA as it relates to military-readiness activities and the ITA process such that ''least practicable adverse impact'' shall include consideration of personnel safety, practicality of implementation, and impact on the effectiveness of the ''military readiness activity.'' The training and testing activities described in the LOA application are considered military readiness activities.

NMFS reviewed the proposed activities and the proposed mitigation measures as described in the LOA application to determine if they would result in the least practicable adverse effect on marine mammals, which includes a careful balancing of the likely benefit of any particular measure to the marine mammals with the likely effect of that measure on personnel safety, practicality of implementation, and impact on the effectiveness of the ''military-readiness activity.'' Included below are the mitigation measures the Navy proposed in their LOA application. NMFS worked with the Navy to develop these proposed measures, and they are informed by years of experience and monitoring. In addition, the adaptive management process (see Adaptive management) and annual meetings between NMFS and the Navy 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 measures should be refined or modified.

The Navy's proposed mitigation measures are modifications to the proposed activities that are implemented for the sole purpose of reducing a specific potential environmental impact on a particular resource. These do not include standard operating procedures, which are established for reasons other than environmental benefit. Most of the following proposed mitigation measures are currently, or were previously, implemented as a result of past environmental compliance documents. The Navy's overall approach to assessing potential mitigation measures is based on two principles: (1) Mitigation measures will be effective at reducing potential impacts on the resource, and (2) from a military perspective, the mitigation measures are practicable, executable, and safety and readiness will not be impacted.

Lookouts

The use of Lookouts is a critical component of Navy procedural measures and implementation of mitigation zones. Navy Lookouts are highly qualified and experienced observers of the marine environment. Their duties require that they report all objects sighted in the water to the Officer of the Deck (OOD) (*e.g.*, trash, a periscope, marine mammals, sea turtles) and all disturbances (*e.g.*, surface disturbance, discoloration) that may be indicative of a threat to the vessel and its crew. There are personnel standing watch on station at all times (day and night) when a ship or surfaced submarine is moving through the water.

The Navy would have two types of Lookouts for the purposes of conducting visual observations: (1) Those positioned on surface ships, and (2) those positioned ashore, in aircraft or on boats. Lookouts positioned on surface ships would be dedicated solely to diligent observation of the air and surface of the water. They would have multiple observation objectives, which include but are not limited to detecting the presence of biological resources and recreational or fishing boats, observing mitigation zones, and monitoring for vessel and personnel safety concerns.

Due to manning and space restrictions on aircraft, small boats, and some Navy ships, Lookouts for these platforms may be supplemented by the aircraft crew or pilot, boat crew, range site personnel, or shore-side personnel. Lookouts positioned in minimally manned platforms may be responsible for tasks in addition to observing the air or surface of the water (*e.g.*, navigation of a helicopter or small boat). However, all Lookouts will (considering personnel safety, practicality of implementation, and impact on the effectiveness of the activity) comply with the observation objectives described above for Lookouts positioned on ships.

The procedural measures described below primarily consist of having Lookouts during specific training and testing activities.

All personnel standing watch on the bridge, Commanding Officers, Executive Officers, maritime patrol aircraft aircrews, anti-submarine warfare helicopter crews, civilian equivalents, and Lookouts will successfully complete the United States Navy Marine Species Awareness Training prior to standing watch or serving as a Lookout. Additional details on the Navy's Marine Species Awareness Training can be found in the NWTT Draft EIS/OEIS.

The Navy proposes to use one or more Lookouts during the training and testing activities provided in Table 10. Additional details on Lookout procedures and implementation are provided in Chapter 11 of the LOA application (*http://www.nmfs.noaa.gov/pr/permits/incidental/military.htm*).

TABLE 10—LOOKOUT MITIGATION MEASURES FOR TRAINING AND TESTING ACTIVITIES WITHIN THE NWTT STUDY AREA

Number of lookouts	Training and testing activities
1–2	Low-Frequency and Non-Hull Mounted Mid-Frequency Active Sonar.
1	High-Frequency and Hull Mounted Mid-Frequency Active Sonar.
1	Improved Extended Echo Ranging Sonobuoys (testing only).
1	Explosive Signal Underwater Sound Buoys Using >0.5–2.5 Pound Net Explosive Weight.
2	Mine Countermeasures and Neutralization Activities Using Positive Control Firing Devices (training only).
1–2	Gunnery Exercises Using Surface Target (training only).
1	Missile Exercises Using Surface Target (training only).
1 (minimum)	Bombing Exercises—Explosive (training only).
1	Torpedo—Explosive (testing only).[1]
1	Weapons Firing Noise During Gunnery Exercises (training only).
1 (minimum)	Vessel Movement.
1	Towed In-Water Strike.
1	Gunnery Exercises—Non-Explosive (training only).
1	Bombing Exercises—Non-Explosive (training only).

[1] For explosive torpedo tests from aircraft, the Navy will have one Lookout positioned in an aircraft; for explosive torpedoes tested from a surface ship, the Navy is proposing to use the Lookout procedures currently implemented for hull-mounted mid-frequency active sonar activities.

Mitigation Zones

The Navy proposes to use mitigation zones to reduce the potential impacts to marine mammals from training and testing activities. Mitigation zones are measured as the radius from a source and represent a distance that the Navy would monitor. Mitigation zones are applied to acoustic stressors (*i.e.*, non-impulsive and impulsive sound) and physical strike and disturbance (*e.g.*, vessel movement and bombing exercises). In each instance, visual detections of marine mammals would be communicated immediately to a watch station for information dissemination and appropriate action. Acoustic detections would be communicated to Lookouts posted in aircraft and on surface vessels.

Most of the current mitigation zones for activities that involve the use of impulsive and non-impulsive sources were originally designed to reduce the potential for onset of TTS. The Navy updated their acoustic propagation modeling to incorporate new hearing threshold metrics (*i.e.*, upper and lower frequency limits), new marine mammal density data, and factors such as an animal's likely presence at various depths. An explanation of the acoustic propagation modeling process can be found in previous authorizations for the Atlantic Fleet Training and Testing Study Area; the Hawaii-Southern California Training and Testing Study Area; and the Determination of Acoustic Effects on Marine Mammals and Sea Turtles for the Northwest Training and Testing EIS/OEIS technical report (Marine Species Modeling Team, 2013).

As a result of the updates to the acoustic propagation modeling, in some cases the ranges to onset of TTS effects are much larger than previous model outputs. Due to the ineffectiveness and unacceptable operational impacts associated with mitigating these large areas, the Navy is unable to mitigate for onset of TTS for every activity. For the NWTT analysis, the Navy developed each recommended mitigation zone to avoid or reduce the potential for onset of the lowest level of injury, PTS, out to the predicted maximum range. In some cases where the ranges to effects are smaller than previous models estimated, the mitigation zones were adjusted accordingly to provide consistency across the measures. Mitigating to the predicted maximum range to PTS consequently also mitigates to the predicted maximum range to onset mortality (1 percent mortality), onset slight lung injury, and onset slight gastrointestinal tract injury, since the maximum range to effects for these criteria are shorter than for PTS. Furthermore, in most cases, the predicted maximum range to PTS also consequently covers the predicted average range to TTS. Table 11 summarizes the predicted average range to TTS, average range to PTS, maximum range to PTS, and recommended mitigation zone for each activity category, based on the Navy's acoustic propagation modeling results. The predicted ranges are based on local environmental conditions and are unique to the NWTT Study Area.

The Navy's proposed mitigation zones are based on the longest range for all the marine mammal and sea turtle functional hearing groups. Most mitigation zones were driven by the high-frequency cetacean or sea turtle functional hearing group. Therefore, the mitigation zones are more conservative for the remaining functional hearing groups (low-frequency and mid-frequency cetaceans, and pinnipeds), and likely cover a larger portion of the potential range to onset of TTS. Additional information on the estimated range to effects for each acoustic stressor is detailed in Chapter 11 of the LOA application (*http://www.nmfs.noaa.gov/pr/permits/incidental/military.htm*).

TABLE 11—PREDICTED RANGES TO TTS, PTS, AND RECOMMENDED MITIGATION ZONES FOR EACH ACTIVITY CATEGORY

Activity category	Bin (representative source) [1]	Predicted average range to TTS	Predicted average range to PTS	Predicted maximum range to PTS	Recommended mitigation zone
Non-Impulsive Sound					
Low-Frequency and Hull-Mounted Mid-Frequency Active Sonar.[2]	SQS–53 ASW hull-mounted sonar (MF1).	4,251 yd. (3,887 m).	281 yd. (257 m)	<292 yd. (<267 m).	Training: 1,000 yd. (920 m) and 500 yd. (460 m) power downs and 200 yd. (180 m) shutdown for cetaceans, 100 yd. (90 m) mitigation zone for pinnipeds. Testing: 1,000 yd. (920 m) and 500 yd. (460 m) power downs for sources that can be powered down and 200 yd. (180 m) shutdown for cetaceans, 100 yd. (90 m) for pinnipeds (excludes haulouts).
High-Frequency and Non-Hull-Mounted Mid-Frequency Active Sonar.[2]	AQS–22 ASW dipping sonar (MF4).	226 yd. (207 m)	<55 yd. (<50 m)	<55 yd. (<50 m)	Training: 200 yd. (180 m). Testing: 200 yd. (180 m) for cetaceans, 100 yd. (90 m) for pinnipeds (excludes haulouts).
Explosive and Impulsive Sound					
Improved Extended Echo Ranging Sonobuoys.	Explosive sonobuoy (E4).	237 yd. (217 m)	133 yd. (122 m)	235 yd. (215 m)	Training: n/a Testing: 600 yd. (550 m) for marine mammals, sea turtles, and concentrations of floating vegetation.
Signal Underwater Sound (SUS) buoys using >0.5–2.5 lb. NEW.	Explosive sonobuoy (E3).	178 yd. (163 m)	92 yd. (84 m)	214 yd. (196 m)	Training: 350 yd. (320 m) for marine mammals, sea turtles, and concentrations of floating vegetation. Testing: 350 yd. (320 m) for marine mammals, sea turtles, and concentrations of floating vegetation.
Mine Countermeasure and Neutralization Activities (positive control).	>0.5 to 2.5 lb NEW (E3).	495 yd. (453 m)	145 yd. (133 m)	373 yd. (341 m)	Training: 400 yd. (336 m). Testing: n/a.
Gunnery Exercises—Small- and Medium-Caliber (Surface Target).	25 mm projectile (E1)	72 yd. (66 m)	48 yd. (44 m)	73 yd. (67 m)	Training: 200 yd. (180 m). Testing: n/a.
Gunnery Exercises—Large-Caliber (Surface Target).	5 in. projectiles (E5 at the surface).[3]	210 yd. (192 m)	110 yd. (101 m)	177 yd. (162 m)	Training: 600 yd. (550 m). Testing: 600 yd. (550 m).
Missile Exercises up to 500 lb. NEW (Surface Target).	Harpoon missile (E10).	1,164 yd. (1,065 m).	502 yd. (459 m)	955 yd. (873 m)	Training: 2,000 yd. (1.8 km). Testing: n/a.
Bombing Exercises	MK–84 2,000 lb. bomb (E12).	1,374 yd. (1,256 m).	591 yd. (540 m)	1,368 yd. (1,251 m).	Training: 2,500 yd. (2.3 km). Testing: n/a.
Lightweight Torpedo (Explosive) Testing.	MK–46 torpedo (E8)	497 yd. (454 m)	245 yd. (224 m)	465 yd. (425 m)	Training: n/a. Testing: 2,100 yd. (1.9 km).
Heavyweight Torpedo (Explosive) Testing.	MK–48 torpedo (E11)	1,012 yd. (926 m).	472 yd. (432 m)	885 yd. (809 m)	Training: n/a. Testing: 2,100 yd. (1.9 km).

[1] This table does not provide an inclusive list of source bins; bins presented here represent the source bin with the largest range to effects within the given activity category.
[2] High-frequency and non-hull-mounted mid-frequency active sonar category includes unmanned underwater vehicle and torpedo testing activities.
[3] The representative source Bin E5 has different range to effects depending on the depth of activity occurrence (at the surface or at various depths).
Notes: ASW = anti-submarine warfare, in. = inch, km = kilometer, m = meter, mm = millimeter, n/a = Not Applicable, NEW = net explosive weight, PTS = permanent threshold shift, TTS = temporary threshold shift, yd. = yard.

Low-Frequency and Hull-Mounted Mid-Frequency Active Sonar Training

There are no low-frequency active sonar training activities proposed in the Study Area. The Navy is proposing to (1) continue implementing the current measures for mid-frequency active sonar, (2) clarify the conditions needed to recommence an activity after a sighting, and (3) implement mitigation measures for pinnipeds and for pierside sonar testing in the vicinity of hauled out pinnipeds.

Activities that involve the use of hull-mounted mid-frequency active sonar (including pierside) will use Lookouts for visual observation from a ship immediately before and during the activity. Mitigation zones for these activities involve powering down the sonar by 6 dB when a marine mammal is sighted within 1,000 yd. (920 m) of the sonar dome, and by an additional 4 dB when sighted within 500 yd. (460 m) from the source, for a total reduction of 10 dB. Active transmissions will cease if a marine mammal is sighted within 200 yd. (180 m). Active transmission will recommence if any one of the following conditions is met: (1) The animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, (3) the mitigation zone has been clear from any additional sightings for a period of 30 minutes, (4) the ship has transited more than 2,000 yd. (1.8 km) beyond the location of the last sighting, or (5) the Lookout concludes that dolphins are deliberately closing in on the ship to ride the ship's bow wave (and there are no other marine mammal sightings within the mitigation zone). Active transmission may resume when dolphins are bow riding because they are out of the main transmission axis of the active sonar while in the shallow-wave area of the ship bow.

For pinnipeds, the Navy proposes a 100 yd. (90 m) mitigation zone for activities that involve the use of hull-mounted mid-frequency active sonar. The pinniped mitigation zone does not apply for pierside testing in the vicinity of pinnipeds hauled out on man-made structures and vessels. Within Puget Sound there are several locations where pinnipeds use Navy structures (*e.g.,* submarines, security barriers) for haulouts in spite of the degree of activity surrounding these sites. Given that animals continue to choose these areas for their resting behavior, it would appear there are no long-term effects or consequences to those animals as a result of ongoing and routine Navy activities.

Testing

There are no current hull-mounted mid-frequency active sonar testing activities in the Study Area, and no mitigation procedures. However, the Navy's Proposed Action includes newly assessed hull-mounted mid-frequency active sonar testing activities. For testing activities, the recommended measures are provided below.

Activities that involve the use of low-frequency active sonar (including pierside) will use Lookouts for visual observation immediately before and during the event. If a marine mammal is sighted within 200 yd. (180 m) of the sound source, active transmissions will cease. Active transmission will recommence if any one of the following conditions is met: (1) The animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, (3) the mitigation zone has been clear from any additional sightings for a period of 30 minutes, or (4) the sound source has transited more than 2,000 yd. (1.8 km) beyond the location of the last sighting.

Activities that involve the use of hull-mounted mid-frequency active sonar (including pierside and shore-based testing) will follow the mitigation measures described above for Low-Frequency and Hull-Mounted Mid-Frequency Active Sonar Training.

For pinnipeds, the Navy proposes a 100 yd. mitigation zone. The pinniped mitigation zone does not apply for pierside testing in the vicinity of pinnipeds hauled out on man-made structures and vessels.

High-Frequency and Non-Hull-Mounted Mid-Frequency Active Sonar Training

Non-hull-mounted mid-frequency active sonar training activities include the use of aircraft deployed sonobuoys and helicopter dipping sonar. The Navy is proposing to: (1) Continue implementing the current mitigation measures for activities currently being executed, such as dipping sonar activities; (2) extend the implementation of its current mitigation to all other activities in this category; and (3) clarify the conditions needed to recommence an activity after a sighting.

Mitigation will include visual observation from a vessel or aircraft (with the exception of platforms operating at high altitudes) immediately before and during active transmission within a mitigation zone of 200 yd. (180 m) from the active sonar source. For activities involving helicopter deployed dipping sonar, visual observation will commence 10 minutes before the first deployment of active dipping sonar. Helicopter dipping and sonobuoy deployment will not begin if concentrations of floating vegetation (kelp paddies), are observed in the mitigation zone. If the source can be turned off during the activity, active transmission will cease if a marine mammal is sighted within the mitigation zone. Active transmission will recommence if any one of the following conditions is met: (1) The animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, (3) the mitigation zone has been clear from any additional sightings for a period of 10 minutes for an aircraft-deployed source, (4) the mitigation zone has been clear from any additional sightings for a period of 30 minutes for a vessel-deployed source, (5) the vessel or aircraft has repositioned itself more than 400 yd. (370 m) away from the location of the last sighting, or (6) the vessel concludes that dolphins are deliberately closing in to ride the vessel's bow wave (and there are no other marine mammal sightings within the mitigation zone).

Testing

Mitigation measures for high-frequency active sonar sources currently exist only for testing activities conducted in the Inland Waters of Puget Sound and in the Western Behm Canal, Alaska. These activities include the use of unmanned vehicles, non-explosive torpedoes, and similar systems. Currently, the mitigation measures for testing activities using high frequency and non-hull-mounted mid-frequency sources are the same as those currently in place for testing activities with low frequency sources.

For the proposed action, the Navy is proposing that testing activities with high frequency and non-hull-mounted mid-frequency sources employ the proposed mitigation measures described above for training.

For pinnipeds, the Navy proposes a 100 yd. (90 m) mitigation zone during testing. The pinniped mitigation zone does not apply for pierside or shore-based testing in the vicinity of pinnipeds hauled out on man-made structures and vessels. Within Puget Sound there are several locations where pinnipeds use Navy structures (*e.g.,* submarines, security barriers) for haulouts in spite of the degree of activity surrounding these sites. Given that animals continue to choose these areas for their resting behavior, it would appear there are no long-term effects or consequences to those animals as a result of ongoing and routine Navy activities.

Improved Extended Echo Ranging Sonobuoys

Training

The Navy's proposed action does not include Improved Extended Echo Ranging sonobuoy training activities.

Testing

The Navy is proposing to (1) modify the mitigation measures currently implemented for this activity by reducing the marine mammal mitigation zone from 1,000 yd. (920 m) to 600 yd. (550 m), (2) clarify the conditions needed to recommence an activity after a sighting, and (3) adopt the marine mammal mitigation zone size for floating vegetation for ease of implementation. The recommended measures are provided below.

Mitigation will include pre-testing aerial observation and passive acoustic monitoring, which will begin 30 minutes before the first source/receiver pair detonation and continue throughout the duration of the test. The pre-testing aerial observation will include the time it takes to deploy the sonobuoy pattern (deployment is conducted by aircraft dropping sonobuoys in the water). Improved Extended Echo Ranging sonobuoys will not be deployed if concentrations of floating vegetation (kelp paddies) are observed in the mitigation zone around the intended deployment location. Explosive detonations will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Detonations will recommence if any one of the following conditions is met: (1) The animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, or (3) the mitigation zone has been clear from any additional sightings for a period of 30 minutes.

Passive acoustic monitoring would be conducted with Navy assets, such as sonobuoys, already participating in the activity. These assets would only detect vocalizing marine mammals within the frequency bands monitored by Navy personnel. Passive acoustic detections would provide only limited range and bearing to detected animals, and therefore cannot provide locations of these animals. Passive acoustic detections would be reported to Lookouts posted in aircraft and on vessels in order to increase vigilance of their visual surveillance.

Explosive Signal Underwater Sound Buoys Using >0.5–2.5 Pound Net Explosive Weight

Training

The Navy is proposing to add the following recommended measures. Mitigation will include pre-exercise aerial monitoring during deployment within a mitigation zone of 350 yd. (320 m) around an explosive SUS buoy. Explosive SUS buoys will not be deployed if concentrations of floating vegetation (kelp paddies) are observed in the mitigation zone (around the intended deployment location). SUS deployment will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Deployment will recommence if any one of the following conditions is met: (1) The animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, or (3) the mitigation zone has been clear from any additional sightings for a period of 10 minutes.

Passive acoustic monitoring will also be conducted with Navy assets, such as sonobuoys, already participating in the activity. These assets would only detect vocalizing marine mammals within the frequency bands monitored by Navy personnel. Passive acoustic detections would not provide range or bearing to detected animals, and therefore cannot provide locations of these animals. Passive acoustic detections would be reported to Lookouts posted in aircraft in order to increase vigilance of their visual surveillance.

Testing

The Navy's proposed mitigation measures for testing activities are consistent with Navy training mitigation measures described above.

Mine Countermeasures and Neutralization Activities Using Positive Control Firing Devices

Training

Mine countermeasure and neutralization activities in the Study Area involve the use of diver-placed charges that typically occur close to shore. When these activities are conducted using a positive control firing device, the detonation is controlled by the personnel conducting the activity and is not authorized until the area is clear at the time of detonation.

Currently, the Navy employs the following mitigation zone procedures during mine countermeasure and neutralization activities using positive control firing devices:

- Mitigation Zone—The exclusion zone for marine mammals shall extend in a 700 yd. (640 m) arc radius around the detonation site for charges >0.5–2.5 lb. NEW.
- Pre-Exercise Surveys—For Demolition and Mine Countermeasures Operations, pre-exercise surveys shall be conducted within 30 minutes prior to the commencement of the scheduled explosive event. The survey may be conducted from the surface, by divers, or from the air, and personnel shall be alert to the presence of any marine mammal. Should such an animal be present within the survey area, the explosive event shall not be started until the animal voluntarily leaves the area. The Navy will ensure the mitigation zone is clear of marine mammals for a full 30 minutes prior to initiating the explosive event. Personnel will record any marine mammal observations during the exercise as well as measures taken if species are detected within the exclusion zone.
- Post-Exercise Surveys—Surveys within the same radius shall also be conducted within 30 minutes after the completion of the explosive event.

For activities involving positive control diver-placed charges, the Navy is proposing to (1) modify the currently implemented mitigation measures for this activity involving >0.5–2.5 lb. NEW detonation by changing the mitigation zone from 700 yd. (640 m) to 400 yd. (366 m), (2) clarify the conditions needed to recommence an activity after a sighting, and (3) add a requirement to observe for floating vegetation. The recommended measures for activities involving positive control diver-placed activities are provided below.

The Navy is proposing to use the 400 yd. (366 m) mitigation zones for marine mammals described above during activities involving positive control diver-placed charges involving >0.5–2.5 lb. NEW. Visual observation will be conducted by two small boats, each with a minimum of one surveyor.

Explosive detonations will cease if a marine mammal is sighted in the water portion of the mitigation zone (*i.e.,* not on shore). Detonations will recommence if any one of the following conditions is met: (1) The animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, or (3) the mitigation zone has been clear from any additional sightings for a period of 30 minutes.

Testing

The Navy's proposed action does not include mine countermeasure and neutralization testing activities.

Gunnery Exercises—Small and Medium-Caliber Using a Surface Target

Training

The Navy is proposing to (1) continue implementing the current mitigation measures for this activity, (2) clarify the conditions needed to recommence an activity after a sighting, and (3) add a requirement to visually observe for kelp paddies.

Mitigation will include visual observation from a vessel or aircraft immediately before and during the exercise within a mitigation zone of 200 yd. (180 m) around the intended impact location. Vessels will observe the mitigation zone from the firing position. When aircraft are firing, the aircrew will maintain visual watch of the mitigation zone during the activity. The exercise will not commence if concentrations of floating vegetation (kelp paddies) are observed in the mitigation zone. Firing will cease if a marine mammal is sighted within the mitigation zone. Firing will recommence if any one of the following conditions is met: (1) The animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, (3) the mitigation zone has been clear from any additional sightings for a period of 10 minutes for a firing aircraft, (4) the mitigation zone has been clear from any additional sightings for a period of 30 minutes for a firing ship, or (5) the intended target location has been repositioned more than 400 yd. (370 m) away from the location of the last sighting.

Testing

The Navy's proposed action does not include gunnery testing activities.

Gunnery Exercises—Large-Caliber Explosive Rounds Using a Surface Target

Training

There are currently no existing mitigation measures unique to large-caliber explosive gunnery exercises in the Study Area. The Navy is proposing to adopt mitigation measures in place at other Navy training ranges outside of the Study Area.

For all explosive and non-explosive large-caliber gunnery exercises conducted from a ship, mitigation will include visual observation immediately before and during the exercise within a mitigation zone of 70 yd. (46 m) within 30 degrees on either side of the gun target line on the firing side. The exercise will not commence if concentrations of floating vegetation (kelp paddies) are observed in the mitigation zone. Firing will cease if a marine mammal is sighted within the mitigation zone. Firing will recommence if any one of the following conditions is met: (1) The animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, (3) the mitigation zone has been clear from any additional sightings for a period of 30 minutes, or (4) the vessel has repositioned itself more than 140 yd. (128 m) away from the location of the last sighting.

Testing

The Navy is proposing to (1) implement new mitigation zone measures for this activity, (2) describe conditions needed to recommence an activity after a sighting, and (3) implement a requirement to visually observe for kelp paddies. The recommended measures are provided below.

Mitigation will include visual observation from a ship immediately before and during the exercise within a mitigation zone of 600 yd. (550 m) around the intended impact location. Ships will observe the mitigation zone from the firing position. The exercise will not commence if concentrations of floating vegetation (kelp paddies) are observed in the mitigation zone. Firing will cease if a marine mammal is sighted within the mitigation zone. Firing will recommence if any one of the following conditions is met: (1) The animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, or (3) the mitigation zone has been clear from any additional sightings for a period of 30 minutes.

Missile Exercises up to 250 Pound Net Explosive Weight Using a Surface Target

Training

Currently, the Navy employs a mitigation zone of 1,800 yd. (1.6 km) for all missile exercises. Because the Navy is not proposing to use missiles with less than a 251 lb. NEW warhead in the Study Area, separate mitigation procedures for this exercise have not been developed. Should the need arise to conduct training using missiles in this category, the Navy proposes that mitigation procedures be followed as described below for the larger category of missiles (Missile Exercises 251–500 Pound Net Explosive Weight [Surface Target]).

Testing

The Navy's proposed action does not include missile testing activities.

Missile Exercises 251–500 Pound Net Explosive Weight (Surface Target)

Training

Current mitigation measures apply to all missile exercises, regardless of the warhead size. The Navy proposes to add a mitigation zone that applies only to missiles with a NEW of 251–500 lb. The recommended measures are provided below.

When aircraft are involved in the missile firing, mitigation will include visual observation by the aircrew prior to commencement of the activity within a mitigation zone of 2,000 yd. (1.8 km) around the intended impact location. The exercise will not commence if concentrations of floating vegetation (kelp paddies) are observed in the mitigation zone. Firing will cease if a marine mammal is sighted within the mitigation zone. Firing will recommence if any one of the following conditions is met: (1) The animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, or (3) the mitigation zone has been clear from any additional sightings for a period of 10 minutes or 30 minutes (depending on aircraft type).

Testing

The Navy's proposed action does not include missile testing activities.

Bombing Exercises

Training

Currently, the Navy employs the following mitigation zone procedures during bombing exercises:

- Ordnance shall not be targeted to impact within 1,000 yd. (920 m) of known or observed floating kelp or marine mammals.
- A 1,000 yd. (920 m) radius mitigation zone shall be established around the intended target.
- The exercise will be conducted only if marine mammals are not visible within the mitigation zone.

The Navy is proposing to (1) maintain the existing mitigation zone to be used for non-explosive bombing activities, (2) revise the mitigation zone procedures to account for predicted ranges to impacts to marine species when high explosive bombs are used, (3) clarify the conditions needed to recommence an activity after a sighting, and (4) add a requirement to visually observe for kelp paddies.

Mitigation will include visual observation from the aircraft immediately before the exercise and during target approach within a mitigation zone of 2,500 yd. (2.3 km) around the intended impact location for explosive bombs and 1,000 yd. (920 m) for non-explosive bombs. The exercise will not commence if concentrations of floating vegetation (kelp paddies) are observed in the mitigation zone. Bombing will cease if a marine mammal is sighted within the mitigation zone. Bombing will recommence if any one of the following conditions is met: (1) The animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, or (3) the mitigation zone has been clear from any additional sightings for a period of 10 minutes.

Testing

The Navy's proposed action does not include bomb testing activities.

Torpedo (Explosive) Testing

Training

The Navy does not include training with explosive torpedoes in the proposed action.

Testing

The Navy is proposing to (1) establish mitigation measures for this activity that include a mitigation zone of 2,100 yd. (1.9 km), (2) establish the conditions needed to recommence an activity after a sighting, and (3) establish a requirement to visually observe for kelp paddies. The recommended measures are provided below.

Mitigation will include visual observation by aircraft (with the exception of platforms operating at high altitudes) immediately before, during, and after the event within a mitigation zone of 2,100 yd. (1.9 km) around the intended impact location. The event will not commence if concentrations of floating vegetation (kelp paddies) are observed in the mitigation zone. Firing will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Firing will recommence if any one of the following conditions is met: (1) The animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, or (3) the mitigation zone has been clear from any additional sightings for a period of 10 minutes or 30 minutes (depending on aircraft type).

In addition to visual observation, passive acoustic monitoring will be conducted with Navy assets, such as passive ships sonar systems or sonobuoys, already participating in the activity. Passive acoustic observation would be accomplished through the use of remote acoustic sensors or expendable sonobuoys, or via passive acoustic sensors on submarines when they participate in the proposed action. These assets would only detect vocalizing marine mammals within the frequency bands monitored by Navy personnel. Passive acoustic detections would not provide range or bearing to detected animals, and therefore cannot provide locations of these animals. Passive acoustic detections would be reported to the Lookout posted in the aircraft in order to increase vigilance of the visual surveillance; and to the person in control of the activity for their consideration in determining when the mitigation zone is determined free of visible marine mammals.

Weapons Firing Noise During Gunnery Exercises—Large-Caliber

Training

The Navy and U.S. Coast Guard are proposing to adopt measures currently used during Navy gunnery exercises in other ranges outside of the Study Area. For all explosive and non-explosive large-caliber gunnery exercises conducted from a ship, mitigation will include visual observation immediately before and during the exercise within a mitigation zone of 70 yd. (46 m) within 30 degrees on either side of the gun target line on the firing side. The exercise will not commence if concentrations of floating vegetation (kelp paddies) are observed in the mitigation zone. Firing will cease if a marine mammal is sighted within the mitigation zone. Firing will recommence if any one of the following conditions is met: (1) The animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, (3) the mitigation zone has been clear from any additional sightings for a period of 30 minutes, or (4) the vessel has repositioned itself more than 140 yd. (128 m) away from the location of the last sighting.

Testing

The Navy's proposed action does not include gun testing activities.

Vessels

Training

The Navy's current measures to mitigate potential impacts to marine mammals from vessel and in-water device strikes during training activities are provided below:

- Naval vessels shall maneuver to keep at least 500 yd. (460 m) away from any observed whale in the vessel's path and avoid approaching whales head-on. These requirements do not apply if a vessel's safety is threatened, such as when change of course will create an imminent and serious threat to a person, vessel, or aircraft, and to the extent vessels are restricted in their ability to maneuver. Restricted maneuverability includes, but is not limited to, situations when vessels are engaged in dredging, submerged activities, launching and recovering aircraft or landing craft, minesweeping activities, replenishment while underway and towing activities that severely restrict a vessel's ability to deviate course.
- Vessels will take reasonable steps to alert other vessels in the vicinity of the whale. Given rapid swimming speeds and maneuverability of many dolphin species, naval vessels would maintain normal course and speed on sighting dolphins unless some condition indicated a need for the vessel to maneuver.

The Navy is proposing to continue to use the 500 yd. (460 m) mitigation zone currently established for whales, and to implement a 200 yd. (180 m) mitigation zone for all other marine mammals. Vessels will avoid approaching marine mammals head on and will maneuver to maintain a mitigation zone of 500 yd. (460 m) around observed whales and 200 yd. (180 m) around all other marine mammals (except bow-riding dolphins), providing it is safe to do so.

Testing

The Navy's current measures to mitigate potential impacts to marine mammals from vessel and in-water device strikes during testing activities are provided below:

- Range activities shall be conducted in such a way as to ensure marine mammals are not harassed or harmed by human-caused events.
- Visual surveillance shall be accomplished just prior to all in-water exercises. This surveillance shall ensure that no marine mammals are visible within the boundaries of the area within which the test unit is expected to be operating. Surveillance shall include, as a minimum, monitoring from all participating surface craft and, where available, adjacent shore sites.
- The Navy shall postpone activities until cetaceans (whales, dolphins, and porpoises) leave the activity area. When cetaceans have been sighted in an area, all range participants increase vigilance and take reasonable and practicable actions to avoid collisions and activities that may result in close interaction of naval assets and marine mammals. Actions may include changing speed or

direction and are dictated by environmental and other conditions (*e.g.,* safety, weather).

- Range craft shall not approach within 100 yd. (90 m) of marine mammals and shall be followed to the extent practicable considering human and vessel safety priorities. All Navy vessels and aircraft, including helicopters, are expected to comply with this directive. This includes marine mammals ''hauled-out'' on islands, rocks, and other areas such as buoys.

The Navy is proposing to incorporate the training mitigation measures described above during testing activities involving surface ships, and for all other testing activities to continue using the mitigation measures currently implemented, revised to exclude pinnipeds during test body retrieval and to include the exception for bow-riding dolphins as described above under Training. During test body retrieval, the activity cannot be relocated away from marine mammals active in the area, or significantly delayed without risking loss of the test body, so the activity must proceed even if pinnipeds are present in the immediate vicinity. However, the retrieval vessel is a range craft and risks to marine mammals are very low.

Towed In-Water Devices

Training

The Navy is proposing to adopt measures currently used in other ranges outside of the Study Area during activities involving towed in-water devices. The Navy will ensure that towed in-water devices being towed from manned platforms avoid coming within a mitigation zone of 250 yd. (230 m) around any observed marine mammal, providing it is safe to do so.

Testing

The Navy's proposed mitigation measures for testing activities from manned platforms are consistent with Navy training mitigation measures described above. During testing in which in-water devices are towed by unmanned platforms, a manned escort vessel will be included and one Lookout will be employed.

Non-Explosive Gunnery Exercises—Small, Medium, and Large-Caliber Using a Surface Target

Training

Currently, the Navy employs the same mitigation measures for non-explosive gunnery exercises as described above for explosive Gunnery Exercises—Small-, Medium-, and Large-Caliber Using a Surface Target.

The Navy is proposing to (1) continue using the mitigation measures currently implemented for this activity, and (2) clarify the conditions needed to recommence an activity after a sighting. The recommended measures are provided below.

Mitigation will include visual observation from a vessel or aircraft immediately before and during the exercise within a mitigation zone of 200 yd. (180 m) around the intended impact location. The exercise will not commence if concentrations of floating vegetation (kelp paddies) are observed in the mitigation zone. Firing will cease if a marine mammal is sighted within the mitigation zone. Firing will recommence if any one of the following conditions is met: (1) The animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, (3) the mitigation zone has been clear from any additional sightings for a period of 10 minutes for a firing aircraft, (4) the mitigation zone has been clear from any additional sightings for a period of 30 minutes for a firing ship, or (5) the intended target location has been repositioned more than 400 yd. (370 m) away from the location of the last sighting.

Testing

The Navy's proposed action does not include gunnery testing activities.

Non-Explosive Bombing Exercises

Training

The Navy is proposing to continue using the mitigation measures currently implemented for this activity. The recommended measure includes clarification of a post-sighting activity recommencement criterion.

Mitigation will include visual observation from the aircraft immediately before the exercise and during target approach within a mitigation zone of 1,000 yd. (920 m) around the intended impact location. The exercise will not commence if concentrations of floating vegetation (kelp paddies) are observed in the mitigation zone. Bombing will cease if a marine mammal is sighted within the mitigation zone. Bombing will recommence if any one of the following conditions is met: (1) The animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, or (3) the mitigation zone has been clear from any additional sightings for a period of 10 minutes.

Testing

The Navy's proposed action does not include bomb testing activities.

Consideration of Time/Area Limitations

Already incorporated into the Navy's and NMFS' analysis of affects to marine mammals, has been consideration of emergent science regarding locations where cetaceans are known to engage in specific activities (*e.g.,* feeding, breeding/calving, or migration) at certain times of the year that are important to individual animals as well as populations of marine mammals (see discussion in Van Parijs, 2015). As explained in that paper, each such location has been designated a Biologically Important Area (BIA). It is important to note that the BIAs were not meant to define exclusionary zones, nor were they meant to be locations that serve as sanctuaries from human activity, or areas analogous to marine protected areas (see Ferguson *et al.* (2015a) regarding the envisioned purpose for the BIA designations). The delineation of BIAs does not have direct or immediate regulatory consequences. The intention was that the BIAs would serve as resource management tools and their boundaries be dynamic and considered along with any new information as well as, ''existing density estimates, range-wide distribution data, information on population trends and life history parameters, known threats to the population, and other relevant information'' (Van Parijs, 2015).

The Navy and NMFS have supported and will continue to support the Cetacean and Sound Mapping project, including providing representation on the Cetacean Density and Distribution Mapping Working Group (CetMap) developing the BIAs. The final products, including U.S. West Coast BIAs, from this mapping effort were completed and published in March 2015 (Aquatic Mammals, 2015; Calambokidis *et al.,* 2015; Ferguson *et al.,* 2015a, 2015b; Van Parijs, 2015). 131 BIAs for 24 marine mammal species, stocks, or populations in seven regions within U.S. waters were identified (Ferguson *et al.,* 2015a). BIAs in the West Coast of the continental U.S. with the potential to overlap portions of the Study Area include the following feeding and migration areas: Northern Puget Sound Feeding Area for gray whales; Northbound Migration Phase A for gray whales; Northbound Migration Phase B for gray whales; Potential Presence Migration Area for gray whales; Northern Washington Feeding Area for humpback whales; Stonewall and Heceta Bank Feeding Area for humpback whales; Cape Blanco and Orford Reef Feeding Area for gray whale; and Point St. George Feeding Area for gray whales (Calambokidis *et al.,* 2015).

NMFS Office of Protected Resources routinely considers available information about marine mammal habitat use to inform discussions with applicants regarding potential spatio-temporal limitations on their activities that might help effect the least practicable adverse impact on species or stocks and their habitat. BIAs are useful tools for planning and impact assessments and are being provided to the public via this Web site: *www.cetsound.noaa.gov.* While these BIAs are useful tools for analysts, any decisions regarding protective measures based on these areas must go through the normal MMPA evaluation process (or any other statutory process that the BIAs are used to inform)—the designation of a BIA does not pre-suppose any specific management decision associated with those areas, nor does it have direct or immediate regulatory consequences.

During the April 2014 annual adaptive management meeting in Washington, DC, NMFS and the Navy discussed the BIAs that might overlap with portions of the NWTT Study Area, what Navy activities take place in these areas (in the context of what their effects on marine mammals might be or whether additional mitigation is necessary), and what measures could be implemented to reduce impacts in these areas (in the context of their potential to reduce marine mammal impacts and their practicability). Upon request by NMFS the Navy preparing a draft assessment of these BIAs, including the degree of spatial overlap as well as an assessment of potential impacts or lack of impacts for each BIA. The Navy preliminarily determined that the degree of overlap between Navy activities within the Study Area and regional BIAs is relatively small (10 percent) geographically. Further, a review of the BIAs for humpback whales and gray whales against areas where most acoustic activities are conducted in the Study Area (especially those that involve ASW hull-mounted sonar, sonobuoys, and use of explosive munitions) identified that there is no spatial overlap. The Navy preliminarily concluded that any potential impacts from training and testing activities on a given area are infrequent, spatially and temporally variable, and biologically insignificant since the activities are unlikely to significantly affect the marine mammal activities for which the BIAs were designated. The Navy also concluded that additional mitigations other than those already described in the January 2014 NWTT DEIS/OEIS and LOA application would not be further protective nor offer addition protection to marine mammals beyond what is already proposed. NMFS is currently reviewing the Navy's draft assessment, the outcome of which will be discussed in the final rule.

As we learn more about marine mammal density, distribution, and habitat use (and the BIAs are updated), NMFS and the Navy will continue to reevaluate appropriate time-area measures through the Adaptive Management process outlined in these regulations.

Stranding Response Plan

NMFS and the Navy developed a Stranding Response Plan for the NWTRC in 2010 and the NUWC Keyport Range Complex in 2011 as part of the incidental take authorization process for those complexes. The Stranding Response Plan is specifically intended to outline the applicable requirements in the event that a marine mammal stranding is reported in the complexes during a major training exercise. NMFS considers all plausible causes within the course of a stranding investigation and this plan in no way presumes that any strandings in a Navy range complex are related to, or caused by, Navy training and testing activities, absent a determination made during investigation. The plan is designed to address mitigation, monitoring, and compliance. The Navy is currently working with NMFS to refine this plan for the NWTT Study Area. The current Stranding Response Plans for the NWTRC and NUWC Keyport Range Complex are available for review here: *http://www.nmfs.noaa.gov/pr/permits/incidental/military.htm.*

Mitigation Conclusions

NMFS has carefully evaluated the Navy's proposed mitigation measures—many of which were developed with NMFS' input during the first phase of Navy Training and Testing authorizations—and considered a range of other measures in the context of ensuring that NMFS prescribes the means of effecting the least practicable adverse impact on the affected marine mammal species and stocks and their habitat. Our evaluation of potential measures included consideration of the following factors in relation to one another: The manner in which, and the degree to which, the successful implementation of the mitigation measures is expected to reduce the likelihood and/or magnitude of adverse impacts to marine mammal species and stocks and their habitat; the proven or likely efficacy of the measures; and the practicability of the suite of measures for applicant implementation, including consideration of personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity.

Any mitigation measure(s) prescribed by NMFS should be able to accomplish, have a reasonable likelihood of accomplishing (based on current science), or contribute to accomplishing one or more of the general goals listed below:

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

b. Reduce the number of marine mammals (total number or number at biologically important time or location) exposed to received levels of MFAS/HFAS, underwater detonations, or other activities expected to result in the take of marine mammals (this goal may contribute to a, above, or to reducing harassment takes only).

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

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

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

f. For monitoring directly related to mitigation—increase the probability of detecting marine mammals, thus allowing for more effective implementation of the mitigation (shut-down zone, etc.).

Based on our evaluation of the Navy's proposed measures, as well as other measures considered by NMFS, NMFS has determined preliminarily that the Navy's proposed mitigation measures (especially when the adaptive management component is taken into consideration (see Adaptive Management, below)) are adequate means of effecting the least practicable adverse impacts on marine mammals species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, while also considering personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity.

The proposed rule comment period provides the public an opportunity to submit recommendations, views, and/or concerns regarding this action and the proposed mitigation measures. While NMFS has determined preliminarily that the Navy's proposed mitigation measures would effect the least practicable adverse impact on the affected species or stocks and their habitat, NMFS will consider all public comments to help inform our final decision. Consequently, the proposed mitigation measures may be refined, modified, removed, or added to prior to the issuance of the final rule based on public comments received, and where appropriate, further analysis of any additional mitigation measures.

Monitoring

Section 101(a)(5)(A) of the MMPA states that in order to issue an ITA for an activity, NMFS must set forth ''requirements pertaining to the monitoring and reporting of such taking.'' The MMPA implementing regulations at 50 CFR 216.104 (a)(13) indicate that requests for LOAs must include the suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species and of the level of taking or impacts on populations of marine mammals that are expected to be present.

Integrated Comprehensive Monitoring Program (ICMP)

The Navy's ICMP is intended to coordinate 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. Although the ICMP does not specify actual monitoring field work or projects, it does establish top-level goals that have been developed in coordination with NMFS. As the ICMP is implemented, detailed and specific studies will be developed which support the Navy's 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.,* tonal and impulsive sound), 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) associated with specific adverse effects, 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 authorized entity complies with the ITA and Incidental Take Statement;
- An increase in the probability of detecting marine mammals (through improved technology or methods), both specifically within the safety zone (thus allowing for more effective implementation of the mitigation) and in general, to better achieve the above goals; and
- A reduction in the adverse impact of activities to the least practicable level, as defined in the MMPA.

Monitoring would address the ICMP top-level goals through a collection of specific regional and ocean basin studies based on scientific objectives. Quantitative metrics of monitoring effort (*e.g.,* 20 days of aerial surveys) would not be a specific requirement. The adaptive management process and reporting requirements would serve as the basis for evaluating performance and compliance, primarily considering the quality of the work and results produced, as well as peer review and publications, and public dissemination of information, reports, and data. Details of the ICMP are available online (*http://www.navymarinespeciesmonitoring.us/*).

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 top-level goals, a conceptual framework incorporating a progression of knowledge, and in consultation with a Scientific Advisory Group and other regional experts. The Strategic Planning Process for Marine Species Monitoring would be used to set intermediate scientific objectives, identify potential species of interest at a regional scale, and evaluate and select specific monitoring projects to fund or continue supporting for a given fiscal year. This process would also address 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 Monitoring in the NWTT Study Area

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

1. The Navy has shown significant initiative in developing its marine species monitoring program and made considerable progress toward reaching goals and objectives of the ICMP.

2. Observation data from watchstanders aboard navy vessels is generally useful to indicate the presence or absence of marine mammals within the mitigation zones (and sometimes beyond) and to document the implementation of mitigation measures, but does not provide useful species-specific information or behavioral data.

3. Data gathered by experienced marine mammal observers can provide very valuable information at a level of detail not possible with watchstanders.

4. Though it is by no means conclusive, it is worth noting that no instances of obvious behavioral disturbance have been observed by Navy watchstanders or experienced marine mammal observers conducting visual monitoring.

5. Visual surveys generally provide suitable data for addressing questions of distribution and abundance of marine mammals, but are much less effective at providing information on movements and behavior, with a few notable exceptions where sightings are most frequent.

6. Passive acoustics and animal tagging have significant potential for applications addressing animal movements and behavioral response to Navy training activities, but require a longer time horizon and heavy investment in analysis to produce relevant results.

This following section includes a summary of Navy-funded compliance monitoring in the NWTRC since 2010 and in the NUWC Keyport Range Complex since 2011. Additional Navy-funded monitoring outside of and in addition to the Navy's commitments to NMFS is provided later in the section. The monitoring years are shown in Table 12.

TABLE 12—NAVY MONITORING YEARS IN THE STUDY AREA

Navy monitoring years in the study area range complex	Year 1	Year 2	Year 3
Northwest Training Range Complex.	12 November 2010–01 May 2011	02 May 2011–01 May 2012	02 May 2012–01 May 2013.
Keport Range Complex	12 April 2011–08 November 2011	09 November 2011–08 November 2012.	09 November 2012–08 November 2013.

Northwest Training Range Complex

Passive Acoustic Monitoring

As part of previous monitoring within the Pacific Northwest, the Navy funded deployment of two passive acoustic devices along the central coast of Washington State from 2011 to 2013. Results from this effort are summarized in the Navy's annual NWTRC monitoring reports for 2011, 2012, and 2013 (U.S. Department of the Navy, 2011; Širović *et al.,* 2012a and 2012b in U.S. Department of the Navy, 2012a; Kerosky *et al.,* 2013 in U.S. Department of the Navy, 2013). Total passive acoustic data recorded over the 3 years totals over 17,417 hours and includes signals from four baleen whale species (blue whale, fin whale, gray whale, and humpback whale) and seven odontocetes (Risso's dolphin, Pacific white-sided dolphin, killer whale, sperm whale, Stejneger's beaked whale, Baird's beaked whale, and Cuvier's beaked whale) (Kerosky *et al.* 2013 in U.S. Department of the Navy, 2013). Kerosky *et al.* (2013) found that seasonal patterns of all four baleen whale species were similar within the monitoring sites in NWTRC, with most calls detected between winter and early spring. Of the odontocetes recorded, sperm whales were generally detected most consistently while other non-beaked odontocetes occurred more sporadically. Stejneger's beaked whales were the most consistently recorded beaked whale, with all their detections occurring between December and June. Previous research-funded results from these same locations from 2004 to 2010 is available in Oleson *et al.* (2009) and Oleson and Hildebrand (2012).

Satellite Tagging

The Navy purchased 10 satellite tracking tags in Year 1, suitable for deployment by a suite of marine species within the offshore waters of the NWTRC. The tags used were the Andrews-style LIMPET (Low Impact Minimally Percutaneous External Transmitter), in either the location-only Spot5 configuration or the location/dive data Mk10–A configuration (Wildlife Computers, Redmond, Washington) (Schorr *et al.,* 2012). Tags were programmed to species-specific, transmission schedule-based surfacing behavior and transmission data from previous deployments. Tags transmit animal movement data via the Argos satellite system. The commercial Argos system consists of data acquisition and relay equipment attached to NOAA low-orbiting weather satellites and ground-based receivers and data processing systems.

The Navy purchased these satellite tracking tags as part of the NWTRC monitoring from 2010 to 2013. The tags were deployed opportunistically during field efforts associated with a 3-year collaborative field project addressing marine mammal distribution and habitat use off Oregon and Washington (Schorr *et al.,* 2012). The species of interest were endangered cetaceans such as blue whales, fin whales, humpback whales, and sperm whales, but also included high-priority cetaceans such as beaked whales, in the event they were encountered in favorable tagging conditions. Other species of interest for tagging included seasonal resident gray whales and transient or offshore killer whales.

Annual results from this effort are summarized in the Navy's NWTRC Monitoring Reports for 2011, 2012, and 2013 (U.S. Department of the Navy, 2011a, 2012a, and 2013d) and collectively in Schorr *et al.* (2012). During this reporting period (2010–2013), a collective total of 21 tags were deployed on four different species off the Washington coast (3 gray whales, 5 humpback whales, 11 fin whales, and 2 offshore killer whales). A total of approximately 348 days of animal movement data was obtained (Schorr *et al.,* 2013; U.S. Department of the Navy, 2013d). Transmissions confirmed that gray whales were not migrating; rather, they stayed very close to shore and in a very localized area consistent with feeding. Movement data for the tagged humpback whales suggest individuals spent time both on and off the shelf edge, including some of the underwater canyons off northern Washington. Movements obtained from tagged fin whales suggest these whales are most commonly using waters associated with the outer shelf edge. Overall, 75 percent of the fin whale locations received were within the NWTRC. Three fin whales with transmission durations greater than 21 days remained in the NWTRC for the entire duration of tag transmission. According to Schorr *et al.* (2013), localized movements for periods of this duration suggest that at least some fin whales are not simply migrating through the area, but are utilizing habitat within the NWTRC for extended periods of time, even during seasons generally associated with migration and use of lower latitude breeding areas for other baleen whales. While in the NWTRC, tagged killer whales primarily spent their time on the continental shelf, or well offshore of the shelf edge.

In 2012, the Navy funded a multi-year satellite tracking study of Pacific Coast Feeding Group gray whales (U.S. Department of the Navy, 2013d). Tags were attached to 11 gray whales near Crescent City, California, in fall 2012 (Mate, 2013). Good track histories were received from nine of the 11 tags which confirmed an exclusive near shore (< 15 km) distribution and movement along the California, Oregon, and Washington coast. Additional tag deployments on gray whales have occurred since the Mate (2013) report. These will be described in the NWTRC Year 4 Annual Monitoring Report in 2014.

Satellite tagging efforts are also funded for 2014–2018 along the U.S. west coast and include fin and blue whales. Longer term tags (up to 1 year) will allow for an assessment of animal occurrence, movement patterns, and residence time at areas within and outside of Navy at-sea ranges, including the NWTRC.

Explosive Ordnance/Underwater Detonation Monitoring

The Navy has conducted two annual underwater detonation training events in the NWTRC at the Floral Point site in Hood Canal. In 2012, the event was monitored by marine mammal and seabird observers, and acoustic measurements were also recorded. The observers were positioned aboard small Navy craft that followed a closely spaced transect pattern in nearshore waters. In 2013, a similar monitoring effort occurred, but two beach observers were added to the monitoring team in order to provide a training opportunity. The beach observers are not required under the permits. The entire area to be monitored can be seen via the small craft vessels and as a result of the tightly spaced transect observation pattern. Pre-event and post-event surveys were also conducted. Harbor seals were the only marine mammal species seen either before or after the training event, and no marine mammals were in the exclusion zone during the detonations.

Keyport Range Complex

Annual monitoring surveys were undertaken in 2011, 2012, and 2013 in the DBRC portion of the Keyport Range Complex. These surveys included both visual and passive acoustic monitoring during concurrent mid-frequency active sonar and high-frequency active sonar tests. In addition to Navy Lookouts, Navy marine mammal observers were positioned aboard range vessels and at a high elevation observation point on land to monitor the events. A pre-event and post-event survey was also conducted. Species seen included harbor seals, California sea lions, and harbor porpoise. In total over all years, there were 262 sightings representing 420 individuals seen during the visual surveys, which may include repeat sightings of the same individuals. No marine mammals were detected using the bottom-moored passive acoustic monitoring array in any year. Discussion and results from these efforts are summarized in the Navy's Keyport Range Complex Annual Monitoring Reports for 2011, 2012, and 2013 (U.S. Department of the Navy, 2012c, 2012d, and 2013e).

Other Regional Navy-Funded Monitoring Efforts

Additional marine mammal studies are being funded or conducted by the Navy outside of and in addition to the Navy's commitments to NMFS for the NWTRC and the NUWC Keyport Range Complex. A variety of field survey methodologies are being utilized in order to better determine marine mammal presence, seasonality, abundance, distribution, habitat use, and density in these areas. The following studies either have been conducted or are underway during the 2010–2014 period:

- Naval Base Pinniped Haulout Surveys (2010–2014): Biologists located at NAVBASE Kitsap, Bangor, Bremerton, the Manchester Fuel Depot, and Naval Station Everett have been conducting year-round counts of sea lions hauled out on site-specific structures such as the floating security fences, submarines, or other opportunistic haulouts such as the large floating dock near Manchester. These counts are typically conducted weekly and involve identifying the sea lions to species and documenting branded animals. This information has shown seasonal use of the haulouts at each site, as well as trends in the number of animals by species using the haulouts at each site. In the case of Bangor, there are no haulout areas used by adult harbor seals, despite the adults being seen daily in the water, year-round. The only exception to this would be during pupping season when one wave screen (floating dock) is used temporarily by adult females to give birth. In late fall 2013, there were sightings of individual harbor seal pups using opportunistic manmade structures as temporary haulouts. These sightings include one harbor seal pup using a partially submerged ladder rung as a haulout and place to nurse; another pup resting on a floating oil boom; a third pup resting on a large piece of chain hanging in the water; a fourth pup managing to get aboard a submarine and haul out next to the California sea lions; and a fifth, older juvenile resting on the outer pontoon of the floating security fence. Harbor seals have not been seen hauled out at Bremerton or at the floating dock near Manchester. Harbor seals do haul out on the log rafts near Naval Station Everett.
- Marine Mammal Surveys in Hood Canal and Dabob Bay (2011–2012): The Navy conducted an opportunistic marine mammal vessel-based line transect density survey in Hood Canal and Dabob Bay during September and October 2011 and again in October 2012. In Hood Canal, the surveys followed a double saw-tooth pattern to achieve uniform coverage of the entire NAVBASE Kitsap, Bangor waterfront. Transects generally covered the area from Hazel Point on the south end of the Toandos Peninsula to Thorndyke Bay. Surveys in the adjacent Dabob Bay followed a slightly different pattern and generally followed more closely to the shoreline while completing a circular route through the Bay. These surveys had a dual purpose of collecting marine mammal and marbled murrelet (bird species) data, and near-shore surveys tended to yield more marbled murrelet sightings. During surveys, the survey vessels traveled at a speed of approximately five knots when transiting along the transect lines. Two observers recorded sightings of marine mammals both in the water and hauled out. Marine mammal sightings data included species identification, Global Positioning System animal locations relative to vessel position, and detailed behavioral notes. Data from the line

transect surveys can be used to improve estimates of marine mammal density in Hood Canal and Dabob Bay.

• Aerial Surveys of Pinniped Haulout Sites in Pacific Northwest Inland Waters (2013–2014): Navy-funded aerial surveys of pinniped haulout sites in the inland waters of Washington State were initiated in March 2013 (Jeffries, 2013b) and continued until March 2014 (1-year study design). The objectives of this effort were to provide estimates of seasonal abundance, identify seasonal distribution patterns, and collect data to determine seal and sea lion densities. Aerial surveys being conducted under this effort represent the first pinniped assessments to be done in the region over all four seasons, and will therefore provide much-needed information about seasonal variation of harbor seal, northern elephant seal, California sea lion, and Steller sea lion distribution and abundance in the inland waters of Washington. In addition, this effort will update the Atlas of Seal and Seal Lion Haulout Sites in Washington (inland waters region) (Jeffries *et al.,* 2000). Finally, in a collaborative effort, the NMFS Northwest Region provided additional funding to support summer-only aerial surveys of the U.S. waters of the Strait of Juan de Fuca (Cape Flattery to Port Angeles), as well as the San Juan Islands. This collaborative approach between the Navy and NMFS will allow NMFS to update the SAR for the Pacific harbor seal (Washington Inland Waters stock). The current SAR is derived from population estimates from 1999, and abundance information from current surveys will provide NMFS with required data to revise this outdated stock assessment.

• Aerial Surveys of Marine Mammals in Pacific Northwest Inland Waters (2013–2014): Navy-funded aerial line-transect density surveys in the inland waters of Washington State were initiated in August 2013 (Smultea and Bacon, 2013). Surveys are planned to continue quarterly (every season) through 2014. These surveys were designed in cooperation with NMFS in order to estimate density and abundance of species with sufficient sightings, document distribution and habitat use, and describe behaviors seen. Smultea and Bacon (2013) reported a total of 779 sightings composed of an estimated 1,716 individual marine mammals representing four species: Harbor seal, harbor porpoise, California sea lion, and Risso's dolphins. Eighty-seven percent of sightings were of harbor seals, while harbor porpoise were the second-most frequent sighting (9 percent), followed by California sea lions; a pair of Risso's dolphins were seen twice.

• Tagging and Behavioral Monitoring of Sea Lions in the Pacific Northwest in Proximity to Navy Facilities (2013–2015): In an Interagency Agreement between the Navy and the NMFS Alaska Fisheries Science Center, the Navy has funded a sea lion satellite tagging study beginning in 2013 through 2015. Tagging is anticipated to occur in early 2014 with monitoring and data analysis extending into 2015. There are significant scientific data gaps in identifying the location of local foraging areas and percentage of time hauled out for pinniped species near Puget Sound Navy facilities. Data collected from this project will directly tie into Navy's future Phase III marine mammal density modeling for training and testing activities at-sea, and within Puget Sound. In particular, integration of improved haulout percentages will lower over-predictive modeled takes which currently, due to lack of regional data, assume all pinniped species are always in-water for purposes of model assessment of takes. Numbers of animals observed hauled out can be corrected into a population estimate by applying an estimate of the proportion of satellite-tagged-animals that are hauled out at the time of the census. Satellite-linked dive recorders can be used to assess location of foraging activity and describe the diving behavior, as well as record when the animal is hauled out.

Proposed Monitoring for the NWTT Study Area

Based on NMFS-Navy meetings in June and October 2011, future Navy compliance monitoring, including pending NWTT monitoring, will address ICMP top-level goals through a series of regional and ocean basin study questions with a prioritization and funding focus on species of interest as identified for each range complex. The ICMP will also address relative investments to different range complexes based on goals across all range complexes, and monitoring will leverage multiple techniques for data acquisition and analysis whenever possible.

Within the NWTT area, the Navy's initial recommendation for species of interest includes blue whale, fin whale, humpback whale, Southern Resident killer whale (offshore portion of their annual movements), and beaked whales. Navy monitoring for NWTT under this LOA authorization and concurrently in other areas of the Pacific Ocean will therefore be structured to address region-specific species-specific study questions that will be outlined in the final NWTT Monitoring Project Table in consultation with NMFS.

As an early start to NWTT monitoring, in July 2014 the Navy provided funding ($209,000) to NMFS' Northwest Fisheries Science Center to jointly participate in a new NWTT-specific study: Modeling the distribution of southern resident killer whales in the Pacific Northwest. The goal of this new study is to provide a more scientific understanding of endangered southern resident killer whale winter distribution off the Pacific Northwest coast. While the end project will work to develop a Bayesian space-state model for predicting the offshore winter occurrence, the project will actually consist of analysis of existing NMFS data (passive acoustic detections, satellite tag tracks) as well as new data collection from fall 2014 through spring 2015. Details of the study can be found at: *http://www.navymarinespeciesmonitoring.us/regions/pacific/current-projects/.* The eight main tasks the study supports include:

• Identification and classification of marine mammal detections from acoustic recorders.

• Acquisition and field deployment of satellite-linked transmitters (n=4) to track and determine southern resident killer whales movements.

• Deployment of autonomous underwater acoustic recorders in and adjacent to the coastal and shelf/slope waters of Washington State. Navy funding will allow 10 additional recorders to be purchased and deployed along with four NMFS recorders for a total of 14 deployed recorders.

• Estimation of the probability of Southern Resident killer whale detection on acoustic recorders.

• Development of the state-space occurrence models.

• Development of predicative maps of the seasonal annual occurrence of southern resident killer whales.

• Development a cost efficient strategy for the deployment of acoustic recorders in and adjacent to Pacific Northwest Navy ranges.

• Reporting.

Ongoing Navy Research

The U.S. Navy is one of the world's leading organizations in assessing the effects of human activities the marine environment, including marine mammals. From 2004 through 2013, the Navy has funded over $240M specifically for marine mammal research. Navy scientists work cooperatively with other government researchers and scientists, universities, industry, and non-governmental conservation organizations in collecting, evaluating, and modeling information on marine resources. They also develop approaches to ensure that these resources are minimally impacted by existing and future Navy operations. It is imperative that the Navy's Research and Development efforts related to marine mammals are conducted in an open, transparent manner with validated study needs and requirements. The goal of the Navy's R&D program is to enable collection and publication of scientifically valid research as well as development of techniques and tools for Navy, academic, and commercial use. Historically, R&D programs are funded and developed by the Navy's Chief of Naval Operations Energy and Environmental Readiness and Office of Naval Research (ONR), Code 322 Marine Mammals and Biological Oceanography Program. Primary focus of these programs since the 1990s is on understanding the effects of sound on marine mammals, including physiological, behavioral and ecological effects.

ONR's current Marine Mammals and Biology Program thrusts include, but are not limited to: (1) Monitoring and detection research; (2) integrated ecosystem research including sensor and tag development; (3) effects of sound on marine life (such as hearing, behavioral response studies, physiology [diving and stress], and PCAD); and (4) models and databases for environmental compliance.

To manage some of the Navy's marine mammal research programmatic elements, OPNAV N45 developed in 2011 a new Living Marine Resources (LMR) Research and Development Program (*http://www.lmr.navy.mil/*). The goal of the LMR Research and Development Program is to identify and fill knowledge gaps and to demonstrate, validate, and integrate new processes and technologies to minimize potential effects to marine mammals and other marine resources. Key elements of the LMR program include:

- Providing science-based information to support Navy environmental effects assessments for research, development, acquisition, testing, and evaluation as well as Fleet at-sea training, exercises, maintenance, and support activities.
- Improving knowledge of the status and trends of marine species of concern and the ecosystems of which they are a part.
- Developing the scientific basis for the criteria and thresholds to measure the effects of Navy-generated sound.
- Improving understanding of underwater sound and sound field characterization unique to assessing the biological consequences resulting from underwater sound (as opposed to tactical applications of underwater sound or propagation loss modeling for military communications or tactical applications).
- Developing technologies and methods to monitor and, where possible, mitigate biologically significant consequences to living marine resources resulting from naval activities, emphasizing those consequences that are most likely to be biologically significant.

Navy Research and Development

Navy Funded—Both the LMR and ONR Research and Development (R&D) programs periodically fund projects within the NWTT Study Area. Some data and results from these R&D projects are summarized in the Navy's annual range complex monitoring reports, and available on NMFS' Web site (*http://www.nmfs.noaa.gov/pr/permits/incidental/military.htm*) and the Fleet's new marine species monitoring Web site (*http://www.navymarinespeciesmonitoring.us/regions/pacific/current-projects/*). In addition, the Navy's Range Complex monitoring during training and testing activities is coordinated with the Research and Development monitoring in a given region to leverage research objectives, assets, and studies where possible under the ICMP.

The integration between the Navy's new LMR research and development program and related range complex monitoring will continue and improve during the applicable period of the rulemaking with results presented in NWTT annual monitoring reports.

Other National Department of Defense Funded Initiatives—Strategic Environmental Research and Development Program (SERDP) and Environmental Security Technology Certification Program (ESTCP) are the DoD's environmental research programs, harnessing the latest science and technology to improve environmental performance, reduce costs, and enhance and sustain mission capabilities. The Programs respond to environmental technology requirements that are common to all of the military Services, complementing the Services' research programs. SERDP and ESTCP promote partnerships and collaboration among academia, industry, the military Services, and other Federal agencies. They are independent programs managed from a joint office to coordinate the full spectrum of efforts, from basic and applied research to field demonstration and validation.

Adaptive Management

The final regulations governing the take of marine mammals incidental to Navy training and testing activities in the NWTT Study Area would contain an adaptive management component carried over from previous authorizations. Although better than 5 years ago, our understanding of the effects of Navy training and testing activities (*e.g.,* MFAS/HFAS, underwater detonations) on marine mammals is still relatively limited, and yet the science in this field is evolving fairly quickly. These circumstances make the inclusion of an adaptive management component both valuable and necessary within the context of 5-year regulations for activities that have been associated with marine mammal mortality in certain circumstances and locations.

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

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

Proposed Reporting

In order to issue an ITA for an activity, section 101(a)(5)(A) of the MMPA states that NMFS must set forth ''requirements pertaining to the monitoring and reporting of such taking.'' Effective reporting is critical both to compliance as well as ensuring that the most value is obtained from the required monitoring. Some of the reporting requirements are still in development and the final rulemaking may contain additional details not contained here. Additionally, proposed reporting requirements may be modified, removed, or added based on information or comments received during the public comment period. Reports from individual monitoring events, results of analyses, publications, and periodic progress reports for specific monitoring projects would be posted to the Navy's Marine Species Monitoring web portal: *http://www.navymarinespeciesmonitoring.us.* Currently, there are several different reporting requirements pursuant to these proposed regulations:

General Notification of Injured or Dead Marine Mammals

Navy personnel would ensure that NMFS (the appropriate Regional Stranding Coordinator) is notified immediately (or as soon as clearance procedures allow) if an injured or dead marine mammal is found during or shortly after, and in the vicinity of, any Navy training exercise utilizing MFAS, HFAS, or underwater explosive detonations. The Navy would provide NMFS with species identification or a description of the animal(s), the condition of the animal(s) (including carcass condition if the animal is dead), location, time of first discovery, observed behaviors (if alive), and photographs or video (if available).

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

Annual Monitoring Plan Reports

The Navy shall submit an annual report of the NWTT Monitoring Plan describing the implementation and results of the NWTT Monitoring Plan from the previous calendar year. Data collection methods will be standardized across range complexes and study areas to allow for comparison in different geographic locations. Although additional information will be gathered, the protected species observers collecting marine mammal data pursuant to the NWTT Monitoring Plan shall, at a minimum, provide the same marine mammal observation data required in § 218.145. The report shall be submitted either 90 days after the calendar year, or 90 days after the conclusion of the monitoring year to be determined by the Adaptive Management process.

The NWTT Monitoring Plan Report may be provided to NMFS within a larger report that includes the required Monitoring Plan reports from multiple range complexes and study areas (the multi-Range Complex Annual Monitoring Report). Such a report would describe progress of knowledge made with respect to monitoring plan study questions across all Navy ranges associated with the ICMP. Similar study questions shall be treated together so that progress on each topic shall be summarized across all Navy ranges. The report need not include analyses and content that does not provide direct assessment of cumulative progress on the monitoring plan study questions.

Annual Exercise and Testing Reports

The Navy shall submit preliminary reports detailing the status of authorized sound sources within 21 days after the anniversary of the date of issuance of the LOA. The Navy shall submit detailed reports 3 months after the anniversary of the date of issuance of the LOA. The detailed annual reports shall describe the level of training and testing conducted during the reporting period, and a summary of sound sources used (total annual 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; total annual expended/detonated rounds [missiles, bombs, etc.] for each explosive bin; and improved Extended Echo-Ranging System (IEER)/sonobuoy summary, including total number of IEER events conducted in the Study Area, total expended/detonated rounds (buoys), and total number of self-scuttled IEER rounds. The analysis in the detailed reports will be based on the accumulation of data from the current year's report and data collected from previous reports.

5-Year Close-Out Exercise and Testing Report

This report will be included as part of the 2020 annual exercise or testing report. This report will provide the annual totals for each sound source bin with a comparison to the annual allowance and the 5-year total for each sound source bin with a comparison to the 5-year allowance. Additionally, if there were any changes to the sound source allowance, this report will include a discussion of why the change was made and include the analysis to support how the change did or did not result in a change in the SEIS and final rule determinations. The report will be submitted 3 months after the expiration of the rule. NMFS will submit comments on the draft close-out report, if any, within 3 months of receipt. The report will be considered final after the Navy has addressed NMFS' comments, or 3 months after the submittal of the draft if NMFS does not provide comments.

Estimated Take of Marine Mammals

In the potential effects section, NMFS' analysis identified the lethal responses, physical trauma, sensory impairment (PTS, TTS, and acoustic masking), physiological responses (particular stress responses), and behavioral responses that could potentially result from exposure to MFAS/HFAS or underwater explosive detonations. In this section, the potential effects to marine mammals from MFAS/HFAS and underwater detonation of explosives will be related to the MMPA regulatory definitions of Level A and Level B harassment and attempt to quantify the effects that might occur from the proposed training and testing activities in the Study Area.

As mentioned previously, behavioral responses are context-dependent, complex, and influenced to varying degrees by a number of factors other than just received level. For example, an animal may respond differently to a sound emanating from a ship that is moving towards the animal than it would to an identical received level coming from a vessel that is moving away, or to a ship traveling at a different speed or at a different distance from the animal. At greater distances, though, the nature of vessel movements could also potentially not have any effect on the animal's response to the sound. In any case, a full description of the suite of factors that elicited a behavioral response would require a mention of the vicinity, speed and movement of the vessel, or other factors. So, while sound sources and the received levels are the primary focus of the analysis and those that are laid out quantitatively in the regulatory text, it is with the understanding that other factors related to the training are sometimes contributing to the behavioral responses of marine mammals, although they cannot be quantified.

Definition of Harassment

As mentioned previously, with respect to military readiness activities, section 3(18)(B) of the MMPA defines ''harassment'' as: ''(i) any act that injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild [Level A

Harassment]; or (ii) any act that disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns, including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering, to a point where such behavioral patterns are abandoned or significantly altered [Level B Harassment].'' It is important to note that, as Level B harassment is interpreted here and quantified by the behavioral thresholds described below, the fact that a single behavioral pattern (of unspecified duration) is abandoned or significantly altered and classified as a Level B take does not mean, necessarily, that the fitness of the harassed individual is affected either at all or significantly, or that, for example, a preferred habitat area is abandoned. Further analysis of context and duration of likely exposures and effects is necessary to determine the impacts of the estimated effects on individuals and how those may translate to population level impacts, and is included in the Analysis and Negligible Impact Determination.

Level B Harassment

Of the potential effects that were described earlier in this document, the following are the types of effects that fall into the Level B harassment category:

Behavioral Harassment—Behavioral disturbance that rises to the level described in the definition above, when resulting from exposures to non-impulsive or impulsive sound, is considered Level B harassment. Some of the lower level physiological stress responses discussed earlier would also likely co-occur with the predicted harassments, although these responses are more difficult to detect and fewer data exist relating these responses to specific received levels of sound. When Level B harassment is predicted based on estimated behavioral responses, those takes may have a stress-related physiological component as well.

As the statutory definition is currently applied, a wide range of behavioral reactions may qualify as Level B harassment under the MMPA, including but not limited to avoidance of the sound source, temporary changes in vocalizations or dive patters, temporary avoidance of an area, or temporary disruption of feeding, migrating, or reproductive behaviors. The estimates calculated by the Navy using the acoustic thresholds do not differentiate between the different types of potential behavioral reactions. Nor do the estimates provide information regarding the potential fitness or other biological consequences of the reactions on the affected individuals. We therefore consider the available scientific evidence to determine the likely nature of the modeled behavioral responses and the potential fitness consequences for affected individuals

Temporary Threshold Shift (TTS)—As discussed previously, TTS can affect how an animal behaves in response to the environment, including conspecifics, predators, and prey. The following physiological mechanisms are thought to play a role in inducing auditory fatigue: Effects to sensory hair cells in the inner ear that reduce their sensitivity, modification of the chemical environment within the sensory cells; residual muscular activity in the middle ear, displacement of certain inner ear membranes; increased blood flow; and post-stimulatory reduction in both efferent and sensory neural output. Ward (1997) suggested that when these effects result in TTS rather than PTS, they are within the normal bounds of physiological variability and tolerance and do not represent a physical injury. Additionally, Southall *et al.* (2007) indicate that although PTS is a tissue injury, TTS is not because the reduced hearing sensitivity following exposure to intense sound results primarily from fatigue, not loss, of cochlear hair cells and supporting structures and is reversible. Accordingly, NMFS classifies TTS (when resulting from exposure to sonar and other active acoustic sources and explosives and other impulsive sources) as Level B harassment, not Level A harassment (injury).

Level A Harassment

Of the potential effects that were described earlier, following are the types of effects that can fall into the Level A harassment category (unless they further rise to the level of serious injury or mortality):

Permanent Threshold Shift (PTS)—PTS (resulting either from exposure to MFAS/HFAS or explosive detonations) is irreversible and considered an injury. PTS results from exposure to intense sounds that cause a permanent loss of inner or outer cochlear hair cells or exceed the elastic limits of certain tissues and membranes in the middle and inner ears and result in changes in the chemical composition of the inner ear fluids.

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

Tissue Damage due to Behaviorally Mediated Bubble Growth—Several authors suggest mechanisms in which marine mammals could behaviorally respond to exposure to MFAS/HFAS by altering their dive patterns (unusually rapid ascent, unusually long series of surface dives, etc.) in a manner that might result in unusual bubble formation or growth ultimately resulting in tissue damage. In this scenario, the rate of ascent would need to be sufficiently rapid to compromise behavioral or physiological protections against nitrogen bubble formation.

There is considerable disagreement among scientists as to the likelihood of this phenomenon (Piantadosi and Thalmann, 2004; Evans and Miller, 2003). Although it has been argued that traumas from recent beaked whale strandings are consistent with gas emboli and bubble-induced tissue separations (Jepson *et al.,* 2003; Fernandez *et al.,* 2005; Fernández *et al.,* 2012), nitrogen bubble formation as the cause of the traumas has not been verified. If tissue damage does occur by this phenomenon, it would be considered an injury. Recent modeling by Kvadsheim *et al.* (2012) determined that while behavioral and physiological responses to sonar have the potential to result in bubble formation, the actual observed behavioral responses of cetaceans to sonar did not imply any significantly increased risk over what may otherwise occur normally in individual marine mammals.

Physical Disruption of Tissues Resulting from Explosive Shock Wave—Physical damage of tissues resulting from a shock wave (from an explosive detonation) is classified as an injury. Blast effects are greatest at the gas-liquid interface (Landsberg, 2000) and gas-containing organs, particularly the lungs and gastrointestinal tract, are especially susceptible (Goertner, 1982; Hill, 1978; Yelverton *et al.,* 1973). Nasal sacs, larynx, pharynx, trachea, and lungs may be damaged by compression/expansion caused by the oscillations of the blast gas bubble (Reidenberg and Laitman, 2003). Severe damage (from the shock wave) to the ears can include tympanic membrane rupture, fracture of the ossicles, damage to the cochlea, hemorrhage, and cerebrospinal fluid leakage into the middle ear.

Vessel or Ordnance Strike—Vessel strike or ordnance strike associated with the specified activities would be considered Level A harassment, serious injury, or mortality. Vessel or ordnance strike is not anticipated with the Navy activities in the Study Area.

Take Thresholds

For the purposes of an MMPA authorization, three types of take are identified: Level B harassment; Level A harassment; and mortality (or serious injury leading to mortality). The categories of marine mammal responses (physiological and behavioral) that fall into the two harassment categories were described in the previous section.

Because the physiological and behavioral responses of the majority of the marine mammals exposed to non-impulse and impulse sounds cannot be easily detected or measured, and because NMFS must authorize take prior to the impacts to marine mammals, a method is needed to estimate the number of individuals that will be taken, pursuant to the MMPA, based on the proposed action. To this end, NMFS developed acoustic thresholds that estimate at what received level (when exposed to non-impulse or impulse sounds) Level B harassment and Level A harassment of marine mammals would occur. The acoustic thresholds for non-impulse and impulse sounds are discussed below.

Level B Harassment Threshold (TTS)—Behavioral disturbance, acoustic masking, and TTS are all considered Level B harassment. Marine mammals would usually be behaviorally disturbed at lower received levels than those at which they would likely sustain TTS, so the levels at which behavioral disturbance are likely to occur is considered the onset of Level B harassment. The behavioral responses of marine mammals to sound are variable, context specific, and, therefore, difficult to quantify (see Risk Function section, below).

TTS is a physiological effect that has been studied and quantified in laboratory conditions. Because data exist to support an estimate of the received levels at which marine mammals will incur TTS, NMFS uses an acoustic criteria to estimate the number of marine mammals that might sustain TTS. TTS is a subset of Level B harassment (along with sub-TTS behavioral harassment) and the Navy is not specifically required to estimate those numbers; however, the more specifically the affected marine mammal responses can be estimated, the better the analysis.

Level A Harassment Threshold (PTS)—For acoustic effects, because the tissues of the ear appear to be the most susceptible to the physiological effects of sound, and because threshold shifts tend to occur at lower exposures than other more serious auditory effects, NMFS has determined that PTS is the best indicator for the smallest degree of injury that can be measured. Therefore, the acoustic exposure associated with onset-PTS is used to define the lower limit of Level A harassment.

PTS data do not currently exist for marine mammals and are unlikely to be obtained due to ethical concerns. However, PTS levels for these animals may be estimated using TTS data from marine mammals and relationships between TTS and PTS that have been determined through study of terrestrial mammals.

We note here that behaviorally mediated injuries (such as those that have been hypothesized as the cause of some beaked whale strandings) could potentially occur in response to received levels lower than those believed to directly result in tissue damage. As mentioned previously, data to support a quantitative estimate of these potential effects (for which the exact mechanism is not known and in which factors other than received level may play a significant role) do not exist. However, based on the number of years (more than 60) and number of hours of MFAS per year that the U.S. (and other countries) has operated compared to the reported (and verified) cases of associated marine mammal strandings, NMFS believes that the probability of these types of injuries is very low. Tables 13 and 14 provide a summary of non-impulsive and impulsive thresholds to TTS and PTS for marine mammals. A detailed explanation of how these thresholds were derived is provided in the NWTT DEIS/OEIS Criteria and Thresholds Technical Report (Finneran and Jenkins, 2012) and summarized in Chapter 6 of the LOA application (*http://www.nmfs.noaa.gov/pr/permits/incidental/military.htm*).

TABLE 13—ONSET TTS AND PTS THRESHOLDS FOR NON-IMPULSE SOUND

Group	Species	Onset TTS	Onset PTS
Low-Frequency Cetaceans	All mysticetes	178 dB re 1μPa2-sec(LF_{II}).	198 dB re 1μPa2-sec(LF_{II})
Mid-Frequency Cetaceans	Most delphinids, beaked whales, medium and large toothed whales.	178 dB re 1μPa2-sec(MF_{II}).	198 dB re 1μPa2-sec(MF_{II})
High-Frequency Cetaceans	Porpoises, Kogia spp.	152 dB re 1μPa2-sec(HF_{II}).	172 dB re 1μPa2-secSEL (HF_{II})
Phocidae In-water	Harbor, Hawaiian monk, elephant seals	183 dB re 1μPa2-sec(P_{WI}).	197 dB re 1μPa2-sec(P_{WI})
Otariidae & Obodenidae In-water Mustelidae In-water	Sea lions and fur seals Sea otters.	206 dB re 1μPa2-sec(O_{WI}).	220 dB re 1μPa2-sec(O_{WI})

$LF_{II,}$ $MF_{II,}$ HF_{II}: New compound Type II weighting functions; $P_{WI,}$ O_{WI}: Original Type I (Southall *et al.,* 2007) for pinniped and mustelid in water.

Table 14. Impulsive sound and explosive criteria and thresholds for predicting injury and mortality.

<table>
<tr><th>Group</th><th>Species</th><th>Onset TTS</th><th>Onset PTS</th><th>Onset Slight GI Tract Injury</th><th>Onset Slight Lung Injury</th><th>Onset Mortality</th></tr>
<tr><td>Low Frequency Cetaceans</td><td>All mysticetes</td><td>172 dB re 1 μPa^2-s SEL (Type II weighting) or 224 dB re 1 μPa Peak SPL (unweighted)</td><td>187 dB re 1 μPa^2-s SEL (Type II weighting) or 230 dB re 1 μPa Peak SPL (unweighted)</td><td rowspan="6">237 dB re 1 μPa (unweighted)</td><td rowspan="6">Note 1</td><td rowspan="6">Note 2</td></tr>
<tr><td>Mid-Frequency Cetaceans</td><td>Most delphinids, medium and large toothed whales</td><td>172 dB re 1 μPa^2-s SEL (Type II weighting) or 224 dB re 1 μPa Peak SPL (unweighted)</td><td>187 dB re 1 μPa^2-s SEL (Type II weighting) or 230 dB re 1 μPa Peak SPL (unweighted)</td></tr>
<tr><td>High Frequency Cetaceans</td><td>Porpoises and Kogia spp.</td><td>146 dB re 1 μPa^2-s SEL (Type II weighting) or 195 dB re 1 μPa Peak SPL (unweighted)</td><td>161 dB re 1 μPa^2-s SEL (Type II weighting) or 201 dB re 1 μPa Peak SPL (unweighted)</td></tr>
<tr><td>Phocidae</td><td>Northern elephant seal and harbor seal</td><td>177 dB re 1 μPa^2-s (Type I weighting) or 212 dB re 1 μPa Peak SPL (unweighted)</td><td>192 dB re 1 μPa^2-s (Type I weighting) or 218 dB re 1 μPa Peak SPL (unweighted)</td></tr>
<tr><td>Otariidae</td><td>Steller and California Sea Lion, Guadalupe and Northern fur seal</td><td rowspan="2">200 dB re 1 μPa^2-s (Type I weighting) or 212 dB re 1 μPa Peak SPL (unweighted)</td><td rowspan="2">215 dB re 1 μPa^2-s (Type I weighting) or 218 dB re 1 μPa Peak SPL (unweighted)</td></tr>
<tr><td>Mustelidae</td><td>Sea Otter</td></tr>
<tr><td colspan="3">Note 1 $= 39.1M^{1/3}\left(1+\frac{D_{Rm}}{10.081}\right)^{1/2} Pa-\sec$</td><td colspan="4">Note 2 $= 91.4M^{1/3}\left(1+\frac{D_{Rm}}{10.081}\right)^{1/2} Pa-\sec$</td></tr>
</table>

[1] Impulse calculated over a delivery time that is the lesser of the initial positive pressure duration or 20 percent of the natural period of the assumed-spherical lung adjusted for animal size and depth.

<E T='04'>Notes:</E> GI = gastrointestinal, M = mass of animals in kilograms, D_{Rm} = depth of receiver (animal) in meters, SEL = Sound Exposure Level, SPL = Sound Pressure Level (re 1 μPa), dB = decibels, re 1 μPa = referenced to one micropascal, dB re 1 μPa^2-s = decibels referenced to one micropascal squared second

Level B Harassment Risk Function (Behavioral Harassment)

As the statutory definition is currently applied, a wide range of behavioral reactions may qualify as Level B harassment under the MMPA, including but not limited to avoidance of the sound source, temporary changes in vocalizations or dive patters, temporary avoidance of an area, or temporary disruption of feeding, migrating, or reproductive behaviors. The estimates calculated by the Navy using the acoustic thresholds do not differentiate between the different types of potential behavioral reactions. Nor do the estimates provide information regarding the potential fitness or other biological consequences of the reactions on the affected individuals. We therefore consider the available scientific evidence to determine the likely nature of the modeled behavioral responses and the potential fitness consequences for affected individuals.

Behavioral Response Criteria for Non-Impulsive Sound from Sonar and other

Active Sources—In 2006, NMFS issued the first MMPA authorization to allow the take of marine mammals incidental to MFAS (to the Navy for RIMPAC). For that authorization, NMFS used 173 dB SEL as the criterion for the onset of behavioral harassment (Level B harassment). This type of single number criterion is referred to as a step function, in which (in this example) all animals estimated to be exposed to received levels above 173 db SEL would be predicted to be taken by Level B harassment and all animals exposed to less than 173 dB SEL would not be taken by Level B harassment. As mentioned previously, marine mammal behavioral responses to sound are highly variable and context specific (affected by differences in acoustic conditions; differences between species and populations; differences in gender, age, reproductive status, or social behavior; or the prior experience of the individuals), which means that there is support for alternate approaches for estimating behavioral harassment.

Unlike step functions, acoustic risk continuum functions (which are also called ''exposure-response functions'' or ''dose-response functions'' in other risk assessment contexts) allow for probability of a response that NMFS would classify as harassment to occur over a range of possible received levels (instead of one number) and assume that the probability of a response depends first on the ''dose'' (in this case, the received level of sound) and that the probability of a response increases as the ''dose'' increases. In January 2009, NMFS issued three final rules governing the incidental take of marine mammals (within Navy's Hawaii Range, Southern California Training and Testing Range, and Atlantic Fleet Active Sonar Training complexes) that used a risk continuum to estimate the percent of marine mammals exposed to various levels of MFAS that would respond in a manner NMFS considers harassment.

The Navy and NMFS have previously used acoustic risk functions to estimate the probable responses of marine mammals to acoustic exposures for other training and research programs. Examples of previous application include the Navy EISs on the Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) sonar (U.S. Department of the Navy, 2001c); the North Pacific Acoustic Laboratory experiments conducted off the Island of Kauai (Office of Naval Research, 2001), and the Supplemental EIS for SURTASS LFA sonar (U.S. Department of the Navy, 2007d). As discussed earlier, factors other than received level (such as distance from or bearing to the sound source, context of animal at time of exposure) can affect the way that marine mammals respond; however, data to support a quantitative analysis of those (and other factors) do not currently exist. It is also worth specifically noting that while context is very important in marine mammal response, given otherwise equivalent context, the severity of a marine mammal behavioral response is also expected to increase with received level (Houser and Moore, 2014). NMFS will continue to modify these criteria as new data become available and can be appropriately and effectively incorporated.

The particular acoustic risk functions developed by NMFS and the Navy (see Figures 1 and 2 of the LOA application) estimate the probability of behavioral responses to MFAS/HFAS (interpreted as the percentage of the exposed population) that NMFS would classify as harassment for the purposes of the MMPA given exposure to specific received levels of MFAS/HFAS. The mathematical function (below) underlying this curve is a cumulative probability distribution adapted from a solution in Feller (1968) and was also used in predicting risk for the Navy's SURTASS LFA MMPA authorization as well.

$$R = \frac{1-\left(\frac{L-B}{K}\right)^{-A}}{1-\left(\frac{L-B}{K}\right)^{-2A}}$$

Where: R = Risk (0 − 1.0)
L = Received level (dB re: 1 μPa)
B = Basement received level = 120 dB re: 1 μPa
K = Received level increment above B where 50-percent risk = 45 dB re: 1 μPa
A = Risk transition sharpness parameter = 10 (odontocetes and pinnipeds) or 8 (mysticetes)

Detailed information on the above equation and its parameters is available in the January 2014 NWTT DEIS/OEIS and previous Navy documents listed above.

The harbor porpoise and beaked whales have unique criteria based on specific data that show these animals to be especially sensitive to sound. Harbor porpoise and beaked whale non-impulsive behavioral criteria are used unweighted—without weighting the received level before comparing it to the threshold (see Finneran and Jenkins, 2012).

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 mid-frequency sonar use, even in areas where other species were more abundant (D'Amico *et al.,* 2009), but there were not sufficient data to support a separate treatment for beaked whales until recently. With the recent publication of results from Blainville's beaked whale monitoring and experimental exposure studies on the instrumented AUTEC range in the Bahamas (McCarthy *et al.* 2011; Tyack *et al.* 2011), there are now statistically strong data suggesting that beaked whales tend to avoid actual naval mid-frequency sonar in real anti-submarine training scenarios as well as playbacks of killer whale vocalizations, and other anthropogenic sounds. Tyack *et al.* (2011) report that, in reaction to sonar playbacks, most beaked whales stopped echolocating, made long slow ascent, and moved away from the sound. During an exercise using mid-frequency sonar, beaked whales avoided the sonar acoustic footprint at a distance where the received level was ''around 140 dB'' (SPL) and once the exercise ended, beaked whales re-inhabited the center of exercise area within 2–3 days (Tyack *et al.,* 2011). The Navy has therefore adopted an unweighted 140 dB re 1 μPa SPL threshold for significant behavioral effects for all beaked whales (family: Ziphiidae).

Since the development of the criterion, analysis of the data the 2010 and 2011 field seasons of the southern California Behavioral Responses Study have been published. The study, DeRuiter *et al.* (2013b), provides similar evidence of Cuvier's beaked whale sensitivities to sound based on two controlled exposures. Two whales, one in each season, were tagged and exposed to simulated mid-frequency active sonar at distances of 3.4–9.5 km. The 2011 whale was also incidentally exposed to mid-frequency active sonar from a distant naval exercise (approximately 118 km away). Received levels from the mid-frequency active sonar signals during 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. Because the sample size was limited (controlled exposures during a single dive in both 2010 and 2011) and baseline behavioral data was obtained from different stocks and geographic areas (*i.e.,* Hawaii and Mediterranean Sea), and the responses exhibited to controlled exposures were not exhibited by an animal exposed to some of the same received levels of real sonar exercises, the Navy relied on the studies at the AUTEC that analyzed beaked whale responses to actual naval exercises using mid-frequency active sonar to evaluate potential behavioral responses by beaked whales to proposed training and testing activities using sonar and other active acoustic sources.

The information currently available regarding harbor porpoises suggests a very low threshold level of response for both captive and wild animals. Threshold levels at which both captive (Kastelein *et al.,* 2000; Kastelein *et al.,* 2005; Kastelein *et al.,* 2006; Kastelein *et al.,* 2008) and wild harbor porpoises (Johnston, 2002) responded to sound (*e.g.,* acoustic harassment devices, acoustic deterrent devices, or other non-impulsive sound sources) are very low (*e.g.,* approximately 120 dB re 1 μPa). Therefore, a SPL of 120 dB re 1 μPa is used in this analysis as a threshold for predicting behavioral responses in harbor porpoises instead of the risk functions used for other species (*i.e.,* we assume for the purpose of estimating take that all harbor porpoises exposed to 120 dB or higher MFAS/HFAS will be taken by Level B behavioral harassment).

Behavioral Response Criteria for Impulsive Sound from Explosions—If more than one explosive event occurs within any given 24-hour period within a training or testing event, behavioral criteria are applied to predict the number of animals that may be taken by Level B harassment. For multiple explosive events the behavioral threshold used in this analysis is 5 dB less than the TTS onset threshold (in sound exposure level). This value is derived from observed onsets of behavioral response by test subjects (bottlenose dolphins) during non-impulse TTS testing (Schlundt *et al.* 2000). Some multiple explosive events, such as certain naval gunnery exercises, may be treated as a single impulsive event because a few explosions occur closely spaced within a very short period of time (a few seconds). For single impulses at received sound levels below hearing loss thresholds, the most likely behavioral response is a brief alerting or orienting response. Since no further sounds follow the initial brief impulses, Level B take in the form of behavioral harassment beyond that associated with potential TTS would not be expected to occur. This reasoning was applied to previous shock trials (63 FR 230; 66 FR 87; 73 FR 143) and is extended to these Phase II criteria. Behavioral thresholds for impulsive sources are summarized in Table 15 and further detailed in the LOA application.

Since impulse events can be quite short, it may be possible to accumulate multiple received impulses at sound pressure levels considerably above the energy-based criterion and still not be considered a behavioral take. The Navy treats all individual received impulses as if they were one second long for the purposes of calculating cumulative sound exposure level for multiple impulse events. For example, five air gun impulses, each 0.1 second long, received at a Type II weighted sound pressure level of 167 dB SPL would equal a 164 dB sound exposure level, and would not be predicted as leading to a significant behavioral response (take) in MF or HF cetaceans. However, if the five 0.1 second pulses are treated as a 5 second exposure, it would yield an adjusted SEL of approximately 169 dB, exceeding the behavioral threshold of 167 dB SEL. For impulses associated with explosions that have durations of a few microseconds, this assumption greatly overestimates effects based on sound exposure level metrics such as TTS and PTS and behavioral responses. Appropriate weighting values will be applied to the received impulse in one-third octave bands and the energy summed to produce a total weighted sound exposure level value. For impulsive behavioral criteria, the Navy's weighting functions (detailed in Chapter 6 of the LOA application) are applied to the received sound level before being compared to the threshold.

TABLE 15—BEHAVIORAL THRESHOLDS FOR IMPULSIVE SOUND

Hearing group	Impulsive behavioral threshold for > 2 pulses/24 hours	Onset TTS
Low-Frequency Cetaceans	167 dB SEL (LF_{II})	172 dB SEL (MF_{II}) or 224 dB Peak SPL.
Mid-Frequency Cetaceans	167 dB SEL (MF_{II})	
High-Frequency Cetaceans	141 dB SEL (HF_{II})	146 dB SEL (HF_{II}) or 195 dB Peak SPL.
Phocid Seals (in water)	172 dB SEL (P_{WI})	177 dB SEL (P_{WI}) or 212 dB Peak SPL.
Otariidae & Mustelidae (in water)	195 dB SEL (O_{WI})	200 dB SEL (O_{WI}) or 212 dB Peak SPL.

Notes: (1) $LF_{II,}$ $MF_{II,}$ HF_{II} are New compound Type II weighting functions; $P_{WI,}$ O_{WI} = Original Type I (Southall *et al.* 2007) for pinniped and mustelid in water (see Finneran and Jenkins 2012). (2) SEL = re 1 μPa^2-s; SPL = re 1 μPa, SEL = Sound Exposure Level, dB = decibel, SPL = Sound Pressure Level.

Marine Mammal Density Estimates

A quantitative analysis of impacts on a species requires data on the abundance and distribution of the species population in the potentially impacted area. The most appropriate unit of metric for this type of analysis is density, which is described as the number of animals present per unit area.

There is no single source of density data for every area, species, and season because of the fiscal costs, resources, and effort involved in NMFS providing enough survey coverage to sufficiently estimate density. Therefore, to characterize the marine species density for large areas such as the Study Area, the Navy needed to compile data from multiple sources. Each data source may use different methods to estimate density, of which, uncertainty in the estimate can be directly related to the method applied. To develop a database of marine species density estimates, the Navy, in consultation with NMFS experts, adopted a protocol to select the best available data sources (including habitat-based density models, line-transect analyses, and peer-reviewed published studies) based on species, area, and season (see the Navy's Pacific Marine Species Density Database Technical Report; U.S. Department of the Navy, 2014b). The resulting Geographic Information System (GIS) database includes one single spatial and seasonal density value for every marine mammal present within the Study Area.

The Navy Marine Species Density Database includes a compilation of the best available density data from several primary sources and published works including survey data from NMFS within the U.S. EEZ. NMFS is the primary agency responsible for estimating marine mammal and sea turtle density within the U.S. EEZ. NMFS publishes annual SARs for various regions of U.S. waters and covers all stocks of marine mammals within those waters. The majority of species that occur in the Study Area are covered by the Pacific Region Stock Assessment Report (Carretta *et al.,* 2014), with a few species (*e.g.,* Steller sea lions) covered by the Alaska Region Stock Assessment Report (Allen and Angliss, 2014). Other independent researchers often publish density data or research covering a particular marine mammal species, which is integrated into the NMFS SARs.

For most cetacean species, abundance is estimated using line-transect methods that employ a standard equation to derive densities based on sighting data collected from systematic ship or aerial surveys. More recently, habitat-based density models have been used effectively to model cetacean density as a function of environmental variables (*e.g.,* Redfern *et al.,* 2006; Barlow *et al.,* 2009; Becker *et al.,* 2010; Becker *et al.,* 2012a; Becker *et al.,* 2012b; Becker, 2012c; Forney *et al.,* 2012). Where the data supports habitat based density modeling, the Navy's database uses those density predictions. Habitat-based density models allow predictions of cetacean densities on a finer spatial scale than traditional line-transect analyses because cetacean densities are estimated as a continuous function of habitat variables (*e.g.,* sea surface temperature, water depth). Within most of the world's oceans, however there have not been enough systematic surveys to allow for line-transect density estimation or the development of habitat models. To get an approximation of the cetacean species distribution and abundance for unsurveyed areas, in some cases it is appropriate to extrapolate data from areas with similar oceanic conditions where extensive survey data exist. Habitat Suitability Indexes or Relative Environmental Suitability have also been used in data-limited areas to estimate occurrence based on existing observations about a given species' presence and relationships between basic environmental conditions (Kaschner *et al.,* 2006).

Methods used to estimate pinniped at-sea density are generally quite different than those described above for cetaceans. Pinniped abundance is generally estimated via shore counts of animals at known rookeries and haulout sites. For example, for species such as the California sea lion, population estimates are based on counts of pups at the breeding sites (Carretta *et al.,* 2014). However, this method is not appropriate for other species such as harbor seals, whose pups enter the water shortly after birth. Population estimates for these species are typically made by counting the number of seals ashore and applying correction factors based on the proportion of animals estimated to be in the water (Carretta *et al.,* 2014). Population estimates for pinniped species that occur in the Study Area are provided in the Pacific Region Stock Assessment Report (Carretta *et al.,* 2014). Translating these population estimates to in-water densities presents challenges because the percentage of seals or sea lions at sea compared to those on shore is species-specific and depends on gender, age class, time of year (molt and breeding/pupping seasons), foraging range, and for species such as harbor seal, time of day and tide level. These parameters were identified from the literature and used to establish correction factors which were then applied to estimate the proportion of pinnipeds that would be at sea within the Study Area for a given season.

Density estimates for each species in the Study Area, and the sources for these estimates, are provided in Chapter 6 of the LOA application and in the Navy's Pacific Marine Species Density Database Technical Report (U.S. Department of the Navy, 2014b).

Quantitative Modeling To Estimate Take for Impulsive and Non-Impulsive Sound

The Navy performed a quantitative analysis to estimate the number of marine mammals that could be affected by acoustic sources or explosives used during Navy training and testing activities. Inputs to the quantitative analysis include marine mammal density estimates; marine mammal depth occurrence distributions; oceanographic and environmental data; marine mammal hearing data; and criteria and thresholds for levels of potential effects. The quantitative analysis consists of computer modeled estimates and a post-model analysis to determine the number of potential harassments. The model calculates sound energy propagation from sonar, other active acoustic sources, and explosives during naval activities; the sound or impulse received by animat (virtual representation of an animal) dosimeters representing marine mammals distributed in the area around the modeled activity; and whether the sound or impulse received by a marine mammal exceeds the thresholds for effects. The model estimates are then further analyzed and adjusted to consider animal avoidance (*i.e.,* swimming away from sonar or other active sources and away from multiple explosions to avoid repeated high level sound exposures) and implementation of mitigation measures, resulting in final estimates of potential effects due to Navy training and testing.

Various computer models and mathematical equations can be used to predict how energy spreads from a sound source (*e.g.,* sonar or underwater detonation) to a receiver (*e.g.,* dolphin or sea turtle). Basic underwater sound models calculate the overlap of energy and marine life using assumptions that account for the many, variable, and often unknown factors that can influence the result. Assumptions in previous and current Navy models have intentionally erred on the side of overestimation when there are unknowns or when the addition of other variables was not likely to substantively change the final analysis. For example, because the ocean environment is extremely dynamic and information is often limited to a synthesis of data gathered over wide areas and requiring many years of research, known information tends to be an average of a seasonal or annual variation. El Niño Southern Oscillation events of the ocean-atmosphere system are an example of dynamic change where unusually warm or cold ocean temperatures are likely to redistribute marine life and alter the propagation of underwater sound energy. Previous Navy modeling therefore made some assumptions indicative of a maximum theoretical propagation for sound energy (such as a perfectly reflective ocean surface and a flat seafloor).

More complex computer models build upon basic modeling by factoring in additional variables in an effort to be more accurate by accounting for such things as variable bathymetry and an animal's likely presence at various depths.

The Navy has developed new software tools, up to date marine mammal density data, and other oceanographic data for the quantification of estimated acoustic impacts to marine mammal impacts from Navy activities. This new approach is the resulting evolution of the basic model previously used by the Navy and reflects a more complex modeling approach as described below. The new model, NAEMO, is the standard model now used by the Navy to estimate the potential acoustic effects of Navy training and testing activities on marine mammals. Although this more complex computer modeling approach accounts for various environmental factors affecting acoustic propagation, the current software tools do not consider the likelihood that a marine mammal would attempt to avoid repeated exposures to a sound or avoid an area of intense activity where a training or testing event may be focused. Additionally, the software tools do not consider the implementation of mitigation (*e.g.,* stopping sonar transmissions when a marine mammal is within a certain distance of a ship or mitigation zone clearance prior to detonations). In both of these situations, naval activities are modeled as though an activity would occur regardless of proximity to marine mammals and without any horizontal movement by the animal away from the sound source or human activities. Therefore, 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. This final, post-analysis step in the modeling process is meant to better quantify the predicted effects by accounting for likely animal avoidance behavior and implementation of standard Navy mitigations.

The incorporation of mitigation factors for the reduction of predicted effects used a conservative approach (erring on the side of overestimating the number of effects) since reductions as a result of implemented mitigation were only applied to those events having a very high likelihood of detecting marine mammals. It is important to note that there are additional protections offered by mitigation procedures which will further reduce effects to marine mammals, but these are not considered in the quantitative adjustment of the model predicted effects.

The steps of the quantitative analysis of acoustic effects, the values and assumptions that went into the Navy's model, and the resulting ranges to effects are detailed in Chapter 6 (Section 6.5) of the LOA application (*http://www.nmfs.noaa.gov/pr/permits/incidental/military.htm*). Details of the model's processes and the description and derivation of the inputs are presented in the Navy's Determination of Acoustic Effects technical Report (Marine Species Modeling Team, 2013). The post-model analysis, which considers the potential for avoidance and highly effective mitigation during the use of sonar and other active acoustic sources and explosives, is described in Section 6.5 of the LOA application. A detailed explanation of the post-model acoustic effect analysis quantification process is also provided in the technical report Post-Model Quantitative Analysis of Animal Avoidance Behavior and Mitigation Effectiveness for the Northwest Training and Testing (U.S. Department of the Navy, 2014c).

Analysis of Guadalupe Fur Seal Exposures

While there are past and current reports of Guadalupe fur seal strandings in the Pacific Northwest, NMFS does not have at-sea Guadalupe fur seal sightings from which to derive a density estimate. For the NWTT DEIS/OEIS, the Navy elected to take a subset of Northern fur seal modeled exposures as a surrogate for Guadalupe fur seals. Essentially, a fraction of the northern fur seal modeled exposures from the Navy's acoustic effects analysis were used for Guadalupe fur seals exposures based on a comparative ratio of expected occurrence offshore in the NWTT Study Area for northern fur seals and Guadalupe fur seals (based on NMFS stranding records). Northern fur seal at-sea densities described in the Navy's Pacific Marine Species Density Database Technical Report (U.S. Department of the Navy, 2014b) were derived as a single NWTT Study Area wide layer (0.106 animals/km^2 winter and spring, and 0.082 animals/km^2 summer and fall). The estimated (not modeled) results for Guadalupe fur seals were incorporated directly into the NWTT DEIS/OEIS (and original December 2013 NWTT LOA application).

This initial analysis, however, was done without consideration of the likely differences in biological at-sea distributions of both northern fur seals and Guadalupe fur seals. Northern fur seals have a documented highly pelagic distribution through the offshore waters of the Study Area where the majority of Navy training would occur (Davis *et al.,* 2008, NMFS 2007, Lee *et al.,* 2014, Pelland *et al.,* 2014, Sterling *et al.,* 2014). This was the justification for the NWTT Study Area wide single density values by season (U.S. Department of the Navy, 2014b). Within the Pacific Northwest, Guadalupe fur seals are more likely to be coastally distributed given their extralimital at-sea occurrence and associated stranding records (Lambourn *et al.,* 2012).

The Navy, therefore, has proposed to modify the Guadalupe fur seal take number in the NWTT Final EIS/OEIS and has revised the LOA application to account for species-specific biological differences in at-sea distributions within the NWTT Study Area. This would limit Guadalupe fur seal exposures as compared to the process described above, as well as more realistically reflect impacts from offshore Navy training and testing events. The first step in this reanalysis was an examination of the exact Navy events modeled in NAEMO that generated exposures for Northern fur seals. The Navy then analyzed the potential for co-occurrence of the activities resulting in exposures with the Guadalupe fur seal's distribution to determine if the currently predicted exposures should be modified. For training, the Navy asserted that TRACKEX events typically conducted >50 nm from shore in the NWTT Study Area would have limited to no co-occurrence with Guadalupe fur seals, and would not result in training related MMPA exposures. TRACKEX events account for 82 percent of exposures under the NWTT DEIS/OEIS preferred alternative (Table 16). The remaining 18 percent of exposures were from offshore submarine sonar maintenance and offshore surface ship sonar maintenance. While these events would also likely be further offshore, the Navy cannot totally exclude such events from at-sea co-occurring with the Guadalupe fur seal. For testing, the Navy asserts that countermeasure testing and littoral combat ship (LCS) mission package testing-ASW typically conducted >50 nm from shore in the NWTT Study Area would have limited to no co-occurrence with Guadalupe fur seals and would not result in testing MMPA exposures. Countermeasure testing and LCS mission package testing-ASW events account for 92 percent of exposures under the NWTT EIS/OEIS preferred alternative (Table 16). The remaining 8 percent of exposures were from various testing activities with the majority (5.6 percent) from ASW-guided missile destroyer (DDG)-attack submarine (SSN) testing which the Navy cannot totally exclude from at-sea co-occurrence with the Guadalupe fur seal.

Based on the results of this analysis, the Navy is modifying current NWTT EIS/OEIS take tables and has revised the LOA application to account for a percentage decrease in Guadalupe fur seal take requests. For this proposed rulemaking, the Guadalupe fur seal Level B behavioral take request for training has changed from "37" to "7" (Table 18) and for testing has changed from "27" to "3" (Table 21).

TABLE 16—PHASE II NAEMO MODELED EXPOSURES TO NORTHERN FUR SEAL IN RELATIONSHIP TO NAVY TRAINING EVENTS SIMILAR TO NWTRC PHASE I EVENTS AND FOR NWTT

NWTT events applicable to the NWTT LOA application	Dec 2013 Percentage of Northern fur seal modeled exposures	Dec 2013 Guadalupe fur seal take request	Proposed Aug 2014 Modification amount	Revised Navy recommended Guadalupe fur seal take request	Rational
Training Activities Deemed *to Not Have* High Probability Of Overlap With Guadalupe Fur Seals					
TRACKEX (Maritime patrol aircraft, submarine, surface ship).	82	37	−30	7	82% of exposures from TRACKEX, therefore 30 exposures (82% of 37) can be reduced.
Training Activities *That Could Have* Overlap With Guadalupe Fur Seals					
Submarine sonar maintenance	11				
Surface ship sonar maintenance	7				
Testing Activities Deemed *to Not Have* High Probability Of Overlap With Guadalupe Fur Seals					
NAVSEA countermeasure testing	81	27	−24	3	92% of exposures from countermeasure testing and LCS package testing-ASW, therefore 24 exposures (92% of 27) can be reduced.
NAVSEA LCS mission package testing—ASW.	11.				
Testing Activities *That Could Have* Overlap With Guadalupe Fur Seals					
NAVSEA ASW–DDG–SSN	6				
Various others	< 1				

Analysis of Harbor Seal Exposures

For harbor seals in the inland waters portion of the Study Area, there was a change to the Washington Inland Waters stock in 2014 subsequent to the presentation of the January 2014 NWTT DEIS/OEIS to the public. Based on DNA evidence, the single Inland Waters stock was broken up into three new stocks, designated the Hood Canal, the Washington Northern Inland Waters, and the Southern Puget Sound stocks (Carretta *et al.,* 2014). Evidence from tagging data (London *et al.,* 2012) suggests the Hood Canal stock generally does not forage beyond Hood Canal. The Navy has assumed that acoustic effects modeling for locations in Hood Canal and Dabob Bay can therefore be accurately assigned to the Hood Canal stock. For the Washington Northern Inland Waters stock and the Southern Puget Sound stock and because it is possible that these stocks overlap while foraging, modeled acoustic effects to harbor seals in the inland waters portion of the Study Area (excluding Hood Canal and Dabob Bay) were therefore assigned to the appropriate stock using a derived ratio based on the abundance estimates for the two stocks as reported in the 2013 Pacific Stock Assessment Report (Carretta *et al.* (2014); Washington Northern Inland Waters stock: n = 11,036; Southern Puget Sound stock: n = 1,568). The ratio of the Washington Northern Inland Waters stock (0.88) to that of the Southern Puget Sound stock (0.12) was then used to prorate the total modeled exposures in order to estimate acoustic exposures for each of these stocks in the inland waters portion of the Study Area.

As a result of the changes to the harbor seal abundance and haulout assumptions for the Hood Canal stock, for this proposed rulemaking the harbor seal Level B behavioral take request has increased by an additional 417 takes for training (Table 18) and an additional 52,970 takes (Table 21) for testing. The Level A take request has increased an additional 4 takes for training (Table 18) and an additional 61 takes for testing (Table 21).

Take Request

The January 2014 NWTT DEIS/OEIS considered all training and testing activities proposed to occur in the Study Area that have the potential to result in the MMPA defined take of marine mammals. The potential stressors associated with these activities included the following:

- Acoustic (sonar and other active non-impulse sources, explosives, swimmer defense airguns, weapons firing, launch and impact noise, vessel noise, aircraft noise);
- Energy (electromagnetic devices);
- Physical disturbance or strikes (vessels, in-water devices, military expended materials, seafloor devices);
- Entanglement (fiber optic cables, guidance wires, parachutes);
- Ingestion (munitions, military expended materials other than munitions); and
- Secondary stressors (sediments and water quality).

NMFS has determined that two stressors could potentially result in the incidental taking of marine mammals from training and testing activities within the Study Area: (1) Non-impulsive stressors (sonar and other active acoustic sources) and (2) impulsive stressors (explosives). Non-impulsive and impulsive stressors have the potential to result in incidental takes of marine mammals by harassment, injury, or mortality. NMFS also considered the potential for vessel strikes to impact marine mammals, and that assessment is presented below.

Training Activities

A detailed analysis of effects due to marine mammal exposures to impulsive and non-impulsive sources in the Study Area is presented in Chapter 6 of the LOA application. Based on the model and post-model analysis described in Chapter 6 of the LOA application, Table 17 summarizes the Navy's final take request for training activities for a year (a 12-month period) and the summation over a 5-year period (annual events occurring five times and the non-annual event occurring three times). The Civilian Port Defense exercise is a non-annual event and is analyzed as occurring every other year, or three times during the 5-year period considered in this analysis. Annual totals presented in the tables are the summation of all annual events plus all the proposed non-annual events occurring in a 12-month period as a maximum year.

TABLE 17—SUMMARY OF ANNUAL AND 5-YEAR TAKE REQUESTS FOR NWTT TRAINING ACTIVITIES

MMPA category	Source	Training activities	
		Annual authorization sought	5-Year authorization sought
Level A	Impulsive and Non-Impulsive	11—Species specific data shown in Tables 16 and 17.	55—Species specific data shown in Tables 16 and 17.
Level B	Impulsive and Non-Impulsive	107,459—Species specific data shown in Tables 16 and 17.	533,543—Species specific data shown in Tables 16 and 17.

Impulsive and Non-Impulsive Sources

Table 18 provides the Navy's take request for training activities by species from the acoustic effects modeling estimates. The numbers provided in the annual columns are the totals for a maximum year (*i.e.,* a year in which a Civilian Port Defense Occurs). Table 19 provides the contribution to the maximum year total (1,876 Level B exposures) resulting from the biennial Civilian Port Defense exercise. The 5-year totals presented assume the biennial event would occur three times over the 5-year period (in the first, third, and fifth years). Derivations of the numbers presented in Tables 18 and 19 are described in more detail within Chapter 6 of the LOA application. There are no mortalities predicted for any training activities resulting from the use of impulsive or non-impulsive sources. Values shown in Table 18 also include Level B values from non-annual Civilian Port Defense training events.

TABLE 18—SPECIES-SPECIFIC TAKE REQUESTS FROM MODELING AND POST-MODEL ESTIMATES OF IMPULSIVE AND NON-IMPULSIVE SOURCE EFFECTS FOR ALL TRAINING ACTIVITIES

Species	Stock	Annual		5-Year	
		Level B	Level A	Level B	Level A
North Pacific right whale	Eastern North Pacific	0	0	0	0
Humpback whale	Central North Pacific	0	0	0	0
	California, Oregon, & Washington	12	0	60	0
Blue whale	Eastern North Pacific	5	0	25	0
Fin whale	Northeast Pacific	0	0	0	0
	California, Oregon, & Washington	25	0	125	0
Sei whale	Eastern North Pacific	0	0	0	0
Minke whale	Alaska	0	0	0	0
	California, Oregon, & Washington	18	0	90	0
Gray whale	Eastern North Pacific	6	0	30	0
	Western North Pacific	0	0	0	0
Sperm whale	North Pacific	0	0	0	0
	California, Oregon, & Washington	81	0	405	0
Kogia (spp.)	California, Oregon, & Washington	73	0	365	0
Killer whale	Alaska Resident	0	0	0	0
	Northern Resident	0	0	0	0
	West Coast Transient	9	0	39	0
	East N. Pacific Offshore	13	0	65	0
	East N. Pacific Southern Resident	2	0	6	0
Short-finned pilot whale	California, Oregon, & Washington	0	0	0	0
Short-beaked common dolphin	California, Oregon, & Washington	734	0	3,670	0
Bottlenose dolphin	California, Oregon, & Washington	0	0	0	0
Striped dolphin	California, Oregon, & Washington	22	0	110	0
Pacific white-sided dolphin	North Pacific	0	0	0	0
	California, Oregon, & Washington	3,482	0	17,408	0
Northern right whale dolphin	California, Oregon, & Washington	1,332	0	6,660	0
Risso's dolphin	California, Oregon, & Washington	657	0	3,285	0
Harbor porpoise	Southeast Alaska	0	0	0	0
	Northern OR/WA Coast	35,006	0	175,030	0
	Northern CA/Southern OR	52,509	0	262,545	0
	WA Inland Waters	1,417	1	4,409	5
Dall's porpoise	Alaska	0	0	0	0
	California, Oregon, & Washington	3,732	4	18,188	20
Cuvier's beaked whale	Alaska	0	0	0	0
	California, Oregon, & Washington	353	0	1,765	0
Baird's beaked whale	Alaska	0	0	0	0
	California, Oregon, & Washington	591	0	2,955	0
Mesoplodon beaked whales	California, Oregon, & Washington	1,417	0	7,085	0
Steller sea lion	Eastern U.S.	404	0	1,986	0
Guadalupe fur seal	San Miguel Island	7	0	35	0
California sea lion	U.S. Stock	814	0	4,038	0
Northern fur seal	Eastern Pacific	2,495	0	12,475	0

TABLE 18—SPECIES-SPECIFIC TAKE REQUESTS FROM MODELING AND POST-MODEL ESTIMATES OF IMPULSIVE AND NON-IMPULSIVE SOURCE EFFECTS FOR ALL TRAINING ACTIVITIES—Continued

Species	Stock	Annual		5-Year	
		Level B	Level A	Level B	Level A
	California	37	0	185	0
Northern elephant seal	California Breeding	1,271	0	6,353	0
Harbor seal	Southeast Alaska (Clarence Strait)	0	0	0	0
	OR/WA Coast	0	0	0	0
	California	0	0	0	0
	WA Northern Inland Waters	427	4	1,855	20
	Southern Puget Sound	58	0	252	0
	Hood Canal	452	2	2,054	10

TABLE 19—TRAINING EXPOSURES SPECIFIC TO THE BIENNIAL CIVILIAN PORT DEFENSE EXERCISE

[Values provided for informational purposes and are included in Table 18 species-specific totals]

Species	Stock	Biennial	
		Level B	Level A
North Pacific right whale	Eastern North Pacific	0	0
Humpback whale	Central North Pacific	0	0
	California, Oregon, & Washington	0	0
Blue whale	Eastern North Pacific	0	0
Fin whale	Northeast Pacific	0	0
	California, Oregon, & Washington	0	0
Sei whale	Eastern North Pacific	0	0
Minke whale	Alaska	0	0
	California, Oregon, & Washington	0	0
Gray whale	Eastern North Pacific	0	0
	Western North Pacific	0	0
Sperm whale	North Pacific	0	0
	California, Oregon, & Washington	0	0
Kogia (spp.)	California, Oregon, & Washington	0	0
Killer whale	Alaska Resident	0	0
	Northern Resident	0	0
	West Coast Transient	3	0
	East N. Pacific Offshore	0	0
	East N. Pacific Southern Resident	2	0
Short-finned pilot whale	California, Oregon, & Washington	0	0
Short-beaked common dolphin	California, Oregon, & Washington	0	0
Bottlenose dolphin	California, Oregon, & Washington	0	0
Striped dolphin	California, Oregon, & Washington	0	0
Pacific white-sided dolphin	North Pacific	0	0
	California, Oregon, & Washington	1	0
Northern right whale dolphin	California, Oregon, & Washington	0	0
Risso's dolphin	California, Oregon, & Washington	0	0
Harbor porpoise	Southeast Alaska	0	0
	Northern OR/WA Coast	0	0
	Northern CA/Southern OR	0	0
	WA Inland Waters	1,338	0
Dall's porpoise	Alaska	0	0
	California, Oregon, & Washington	236	0
Cuvier's beaked whale	Alaska	0	0
	California, Oregon, & Washington	0	0
Baird's beaked whale	Alaska	0	0
	California, Oregon, & Washington	0	0
Mesoplodon beaked whales	California, Oregon, & Washington	0	0
Steller sea lion	Eastern U.S.	17	0
Guadalupe fur seal	San Miguel Island	0	0
California sea lion	U.S. Stock	16	0
Northern fur seal	Eastern Pacific	0	0
	California	0	0
Northern elephant seal	California Breeding	1	0
Harbor seal	Southeast Alaska (Clarence Strait)	0	0
	OR/WA Coast	0	0
	California	0	0
	WA Northern Inland Waters	140	0
	Southern Puget Sound	19	0
	Hood Canal	103	0

Vessel Strike

There has never been a vessel strike to marine mammals during any training activities in the Study Area. A detailed analysis of strike data is contained in Section 6.7 (Estimated Take of Large Whales by Navy Vessel Strike) of the LOA application. The Navy does not anticipate vessel strikes to marine mammals within the Study Area, nor were takes by injury or mortality resulting from vessel strike predicted in the Navy's analysis. Therefore, takes by injury or mortality resulting from vessel strikes are not authorized by NMFS in this proposed rule. However, the Navy has proposed measures (see Proposed Mitigation) to mitigate potential impacts to marine mammals from vessel strikes during training activities in the Study Area.

Testing Activities

A detailed analysis of effects due to marine mammal exposures to impulsive and non-impulsive sources in the Study Area is presented in Chapter 6 of the LOA application. Based on the model and post-model analysis described in Chapter 6 of the LOA application, Table 20 summarizes the Navy's final take request for testing activities for an annual (12-month) period and the summation over a 5-year period. There are no non-annual testing events.

TABLE 20—SUMMARY OF ANNUAL AND 5-YEAR TAKE REQUESTS FOR NWTT TESTING ACTIVITIES

MMPA category	Source	Testing activities	
		Annual authorization sought	5-Year authorization sought
Level A	Impulsive and Non-Impulsive.	176—Species specific data shown in Tables 18 and 19.	880—Species specific data shown in Tables 18 and 19.
Level B	Impulsive and Non-Impulsive.	139,815—Species specific data shown in Tables 18 and 19.	699,075—Species specific data shown in Tables 18 and 19.

Impulsive and Non-Impulsive Sources

Table 21 summarizes the Navy's take request for testing activities by species. There are no non-annual testing events. Derivation of these values is described in more detail within Chapter 6 of the LOA application. There are no mortalities predicted for any testing activities based on the analysis of impulsive and non-impulsive sources.

TABLE 21—SPECIES-SPECIFIC TAKE REQUESTS FROM MODELING AND POST-MODEL ESTIMATES OF IMPULSIVE AND NON-IMPULSIVE SOURCE EFFECTS FOR ALL TESTING ACTIVITIES

Species	Stock	Annual		5-Year	
		Level B	Level A	Level B	Level A
North Pacific right whale	Eastern North Pacific	0	0	0	0
Humpback whale	Central North Pacific	1	0	5	0
	California, Oregon, & Washington	44	0	220	0
Blue whale	Eastern North Pacific	6	0	30	0
Fin whale	Northeast Pacific	2	0	10	0
	California, Oregon, & Washington	34	0	170	0
Sei whale	Eastern North Pacific	2	0	10	0
Minke whale	Alaska	0	0	0	0
	California, Oregon, & Washington	18	0	90	0
Gray whale	Eastern North Pacific	11	0	55	0
	Western North Pacific	0	0	0	0
Sperm whale	North Pacific	0	0	0	0
	California, Oregon, & Washington	78	0	390	0
Kogia (spp.)	California, Oregon, & Washington	106	1	530	5
Killer Whale	Alaska Resident	2	0	10	0
	Northern Resident	0	0	0	0
	West Coast Transient	202	0	1,010	0
	East N. Pacific Offshore	22	0	110	0
	East N. Pacific Southern Resident	0	0	0	0
Short-finned pilot whale	California, Oregon, & Washington	0	0	0	0
Short-beaked common dolphin	California, Oregon, & Washington	1,628	0	8,140	0
Bottlenose dolphin	California, Oregon, & Washington	0	0	0	0
Striped dolphin	California, Oregon, & Washington	14	0	70	0
Pacific white-sided dolphin	North Pacific	3	0	15	0
	California, Oregon, & Washington	4,869	0	24,345	0
Northern right whale dolphin	California, Oregon, & Washington	2,038	0	10,190	0
Risso's dolphin	California, Oregon, & Washington	1,154	0	5,770	0
Harbor porpoise	Southeast Alaska	926	0	4,630	0
	Northern OR/WA Coast	17,212	15	86,060	75
	Northern CA/Southern OR	25,819	23	129,095	115
	WA Inland Waters	5,336	6	26,680	30
Dall's porpoise	Alaska	1,200	0	6,000	0
	California, Oregon, & Washington	10,139	43	50,695	215
Cuvier's beaked whale	Alaska	15	0	75	0
	California, Oregon, & Washington	91	0	455	0
Baird's beaked whale	Alaska	25	0	125	0

TABLE 21—SPECIES-SPECIFIC TAKE REQUESTS FROM MODELING AND POST-MODEL ESTIMATES OF IMPULSIVE AND NON-IMPULSIVE SOURCE EFFECTS FOR ALL TESTING ACTIVITIES—Continued

Species	Stock	Annual		5-Year	
		Level B	Level A	Level B	Level A
	California, Oregon, & Washington	149	0	745	0
Mesoplodon beaked whales	California, Oregon, & Washington	369	0	1,845	0
Steller sea lion	Eastern U.S.	504	0	2,520	0
Guadalupe fur seal	San Miguel Island	3	0	15	0
California sea lion	U.S. Stock	2,073	0	10,365	0
Northern fur seal	Eastern Pacific	1,830	0	9,150	0
	California	27	0	135	0
Northern elephant seal	California Breeding	1,325	2	6625	10
Harbor seal	Southeast Alaska (Clarence Strait)	22	0	110	0
	OR/WA Coast	1,655	4	8,275	20
	California	0	0	0	0
	WA Northern Inland Waters	1,448	14	7,240	70
	Southern Puget Sound	196	1	980	5
	Hood Canal	59,217	67	296,085	335

Vessel Strike

There has never been a vessel strike to marine mammals during any testing activities in the Study Area. A detailed analysis of strike data is contained in Section 6.7 (Estimated Take of Large Whales by Navy Vessel Strike) of the LOA application. Testing activities involving vessel movement could mainly occur in the Inland Waters and in Western Behm Canal with some additional testing activities in the offshore region. The majority of vessels used in the Inland Waters and Western Behm Canal are smaller vessels, which are less likely to be involved in a whale strike. The Navy's proposed actions would not result in any appreciable changes in locations or frequency of vessel activity, and there have been no whale strikes during any previous testing activities in the Study Area. The manner in which the Navy has tested would remain consistent with the range of variability observed over the last decade so the Navy does not anticipate vessel strikes would occur within the Study Area during testing events. Further, takes by injury or mortality resulting from vessel strike were not predicted in the Navy's analysis. As such, NMFS is not authorizing take by injury or mortality resulting from vessel strike this proposed rule. However, the Navy has proposed measures (see Proposed Mitigation) to mitigate potential impacts to marine mammals from vessel strikes during testing activities in the Study Area.

Analysis and Negligible Impact Determination

Negligible impact is "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, as the severity of harassment may vary greatly depending on the context and duration of the behavioral response, many of which would not be expected to have deleterious impacts on the fitness of any individuals. In determining whether the expected takes will have a negligible impact, in addition to considering estimates of the number of marine mammals that might be "taken", NMFS must consider other factors, such as the likely nature of any responses (their intensity, duration, etc.), the context of any responses (critical reproductive time or location, migration, etc.), as well as the number and nature (*e.g.,* severity) of estimated Level A harassment takes, the number of estimated mortalities, and the status of the species.

The Navy's specified activities have been described based on best estimates of the maximum amount of sonar and other acoustic source use or detonations that the Navy would conduct. There may be some flexibility in that the exact number of hours, items, or detonations may vary from year to year, but take totals are not authorized to exceed the 5-year totals indicated in Tables 17–21. However, it is also worth noting here that while models that incorporate realistic environmental, operational, and biological parameters are the best way to satisfy our need to quantify takes, and are very useful in our analysis (especially where subsets of takes can be pared with factors associated with differential expected levels of severity or duration), due to the inherent variability and uncertainty in model inputs, modeled take estimates are never expected to represent the exact number of animals that will actually be taken, but rather can provide (depending on nature of model) a decent relative understanding of the portion of a population that might be affected and/or the number of repeat takes of individuals on subsequent days that might occur.

The Navy's take request is based on their model and post-model analysis. Generally speaking, and especially with other factors being equal, the Navy and NMFS anticipate more severe effects from takes resulting from exposure to higher received levels (though this is in no way a strictly linear relationship throughout species, individuals, or circumstances) and less severe effects from takes resulting from exposure to lower received levels. The requested number of Level B takes does not equate to the number of individual animals the Navy expects to harass (which is lower), but rather to the instances of take (*i.e.,* exposures above the Level B harassment threshold) that would occur. Additionally, these instances may represent either a very brief exposure (seconds) or, in some cases, longer durations of exposure within a day. Depending on the location, duration, and frequency of activities, along with the distribution and movement of marine mammals, individual animals may be exposed to impulse or non-impulse sounds at or above the Level B harassment threshold on multiple days. However, the Navy is currently unable to estimate the number of individuals that may be taken during training and testing activities. The model results estimate the total number of takes that may occur to a smaller number of individuals. While the model shows that an increased number of exposures may take place due to an increase in events/activities and ordnance, the types and severity of individual responses to training and testing activities are not expected to change.

It is important to note that, while NMFS does not expect that all of the requested and authorized takes (as shown in Tables 17–21 and based on the acoustic analysis) will actually occur, we nevertheless base our analysis and NID on the maximum number of takes requested and authorized (*i.e.,* not on a lower number of takes anticipated).

Behavioral Harassment

As discussed previously in this document, marine mammals can respond to MFAS/HFAS in many different ways, a subset of which qualifies as harassment (see Behavioral Harassment Section). One thing that the Level B harassment take estimates do not take into account is the fact that most marine mammals will likely avoid strong sound sources to one extent or another. Although an animal that avoids the sound source will likely still be taken in some instances (such as if the avoidance results in a missed opportunity to feed, interruption of reproductive behaviors, etc.), in other cases avoidance may result in fewer instances of take than were estimated or in the takes resulting from exposure to a lower received level than was estimated, which could result in a less severe response. For MFAS/HFAS, the Navy provided information (Table 22) estimating the percentage of behavioral harassment that would occur within the 6-dB bins (without considering mitigation or avoidance). As mentioned above, an animal's exposure to a higher received level is more likely to result in a behavioral response that is more likely to adversely affect the health of the animal. As illustrated below, the majority (about 73 percent, at least for hull-mounted sonar, which is responsible for most of the sonar takes) of calculated takes from MFAS result from exposures between 156 dB and 162 dB. Less than 0.5 percent of the takes are expected to result from exposures above 174 dB.

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 small percentage of the anticipated Level B harassment from Navy activities might necessarily be expected to potentially result in more severe responses, especially when the distance from the source at which the levels below are received is considered (see Table 22). Marine mammals are able to discern the distance of a given sound source, and given other equal factors (including received level), they have been reported to respond more to sounds that are closer (DeRuiter *et al.,* 2013). Further, the estimated number of responses do not reflect either the duration or context of those anticipated responses, some of which will be of very short duration, and other factors should be considered when predicting how the estimated takes may affect individual fitness.

TABLE 22—NON-IMPULSIVE RANGES IN 6-DB BINS AND PERCENTAGE OF BEHAVIORAL HARASSMENTS

Received Level	Sonar Bin MF1 (e.g., SQS–53; ASW Hull Mounted Sonar)		Sonar Bin MF4 (e.g., AQS–22; ASW Dipping Sonar)		Sonar Bin MF5 (e.g., SSQ–62; ASW Sonobuoy)	
	Distance at which levels occur within radius of source (m)	Percentage of behavioral harassments occurring at given levels	Distance at which levels occur within radius of source (m)	Percentage of behavioral harassments occurring at given levels	Distance at which levels occur within radius of source (m)	Percentage of behavioral harassments occurring at given levels
Low Frequency Cetaceans						
120 ≤SPL <126	178,750–156,450	0.00	100,000–92,200	0.00	22,800–15,650	0.00
126 ≤SPL <132	156,450–147,500	0.00	92,200–55,050	0.11	15,650–11,850	0.05
132 ≤SPL <138	147,500–103,700	0.21	55,050–46,550	1.08	11,850–6,950	2.84
138 ≤SPL <144	103,700–97,950	0.33	46,550–15,150	35.69	6,950–3,600	16.04
144 ≤SPL <150	97,950–55,050	13.73	15,150–5,900	26.40	3,600–1,700	33.63
150 ≤SPL <156	55,050–49,900	5.28	5,900–2,700	17.43	1,700–250	44.12
156 ≤SPL <162	49,900–10,700	72.62	2,700–1,500	9.99	250–100	2.56
162 ≤SPL <168	10,700–4,200	6.13	1,500–200	9.07	100–<50	0.76
168 ≤SPL <174	4,200–1,850	1.32	200–100	0.18	<50	0.00
174 ≤SPL <180	1,850–850	0.30	100–<50	0.05	<50	0.00
180 ≤SPL <186	850–400	0.07	<50	0.00	<50	0.00
186 ≤SPL <192	400–200	0.01	<50	0.00	<50	0.00
192 ≤SPL <198	200–100	0.00	<50	0.00	<50	0.00
Mid Frequency Cetaceans						
120 ≤SPL <126	179,400–156,450	0.00	100,000–92,200	0.00	23,413–16,125	0.00
126 ≤SPL <132	156,450–147,500	0.00	92,200–55,050	0.11	16,125–11,500	0.06
132 ≤SPL <138	147,500–103,750	0.21	55,050–46,550	1.08	11,500–6,738	2.56
138 ≤SPL <144	103,750–97,950	0.33	46,550–15,150	35.69	6,738–3,825	13.35
144 ≤SPL <150	97,950–55,900	13.36	15,150–5,900	26.40	3,825–1,713	37.37
150 ≤SPL <156	55,900–49,900	6.12	5,900–2,700	17.43	1,713–250	42.85
156 ≤SPL <162	49,900–11,450	71.18	2,700–1,500	9.99	250–150	1.87
162 ≤SPL <168	11,450–4,350	7.01	1,500–200	9.07	150–<50	1.93
168 ≤SPL <174	4,350–1,850	1.42	200–100	0.18	<50	0.00
174 ≤SPL <180	1,850–850	0.29	100–<50	0.05	<50	0.00
180 ≤SPL <186	850–400	0.07	<50	0.00	<50	0.00
186 ≤SPL <192	400–200	0.01	<50	0.00	<50	0.00
192 ≤SPL <198	200–100	0.00	<50	0.00	<50	0.00

Notes: (1) ASW = anti-submarine warfare, m = meters, SPL = sound pressure level; (2) Odontocete behavioral response function is also used for high-frequency cetaceans, phocid seals, otariid seals and sea lions, and sea otters.

Although the Navy has been monitoring the effects of MFAS/HFAS on marine mammals since 2006, and research on the effects of MFAS is advancing, our understanding of exactly how marine mammals in the Study Area will respond to MFAS/HFAS is still growing. The Navy has submitted reports from more than 60 major exercises across Navy range complexes that indicate no behavioral disturbance was observed. One cannot conclude from these results that marine mammals were not harassed from MFAS/HFAS, as a portion of animals within the area of concern were not seen (especially those more cryptic, deep-diving species, such as beaked whales or *Kogia* spp.), the full series of behaviors that would more accurately show an important change is not typically seen (*i.e.,* only the surface behaviors are observed), and some of the non-biologist watchstanders might not be well-qualified to characterize behaviors. However, one can say that the animals that were observed did not respond in any of the obviously more severe ways, such as panic, aggression, or anti-predator response.

Diel Cycle

As noted previously, many animals perform vital functions, such as feeding, resting, traveling, and socializing on a diel cycle (24-hour cycle). Behavioral reactions to noise exposure (when taking place in a biologically important context, such as disruption of critical life functions, displacement, or avoidance of important habitat) are more likely to be significant if they last more than one diel cycle or recur on subsequent days (Southall *et al.,* 2007). 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 at-sea exercises last 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 typically include assets that travel at high speeds (typically 10–15 knots, or higher) and likely cover large areas that are relatively far from shore, in addition to the fact that marine mammals are moving as well, which would make it unlikely that the same animal could remain in the immediate vicinity of the ship for the entire duration of the exercise. Additionally, 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 not to be likely for the majority of takes, does not mean that a behavioral response is necessarily sustained for multiple days, and still necessitates the consideration of likely duration and context to assess any effects on the individual's fitness.

Durations for non-impulsive activities utilizing tactical sonar sources vary and are fully described in Appendix A of the January 2014 DEIS/OEIS. ASW training and testing exercises using MFAS/HFAS generally last for 2–16 hours, and may have intervals of non-activity in between. Because of the need to train in a large variety of situations, the Navy does not typically conduct successive MTEs or other ASW exercises in the same locations. Given the average length of ASW exercises (times of continuous sonar use) and typical vessel speed, combined with the fact that the majority of the cetaceans in the Study Area would not likely remain in an area for successive days, it is unlikely that an animal would be exposed to MFAS/HFAS at levels likely to result in a substantive response that would then be carried on for more than one day or on successive days. There are no MTEs proposed for NWTT activities.

Most planned explosive exercises are of a short duration (1–6 hours). 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.

TTS

As mentioned previously, TTS can last from a few minutes to days, be of varying degree, and occur across various frequency bandwidths, all of which determine the severity of the impacts on the affected individual, which can range from minor to more severe. 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 more powerful MF sources used have center frequencies between 3.5 and 8 kHz and the other unidentified MF sources are, by definition, less than 10 kHz, which suggests that TTS induced by any of these MF sources would be in a frequency band somewhere between approximately 2 and 20 kHz. There are fewer hours of HF source use and the sounds would attenuate more quickly, plus they have lower source levels, but if an animal were to incur TTS from these sources, it would cover a higher frequency range (sources are between 20 and 100 kHz, which means that TTS could range up to 200 kHz; however, HF systems are typically used less frequently and for shorter time periods than surface ship and aircraft MF systems, so TTS from these sources is even less likely). TTS from explosives would be broadband. Vocalization data for each species, which would inform how TTS might specifically interfere with communications with conspecifics, was provided in the LOA application.

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 document. 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 knots). In the TTS studies, 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, MFAS emits a nominal ping every 50 seconds, and incurring those levels of TTS is highly unlikely.

3. Duration of TTS (recovery time)—In the TTS laboratory studies, 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 MFAS/HFAS training exercises in the 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 days (and any incident of TTS would likely be far less severe due to the short duration of the majority of the exercises and the speed of a typical vessel). Also, for the same reasons discussed in the Diel Cycle section, and because of the short distance within which animals would need to approach the sound source, it is unlikely that animals would be exposed to the levels necessary to induce TTS in subsequent time periods such that their recovery is impeded. Additionally, though the frequency range of TTS that marine mammals might sustain would overlap with some of the frequency ranges of their vocalization types, the frequency range of TTS from MFAS (the source from which TTS would most likely be sustained because the higher source level and slower attenuation make it more likely that an animal would be exposed to a higher received level) would not usually span the entire frequency range of one vocalization type, much less span all types of vocalizations or other critical auditory cues. If impaired, marine mammals would typically be aware of their impairment and are sometimes able to implement behaviors to compensate (see Acoustic Masking or Communication Impairment section), though these compensations may incur energetic costs.

Acoustic Masking or Communication Impairment

Masking only occurs during the time of the signal (and potential secondary arrivals of indirect rays), versus TTS, which continues beyond the duration of the signal. Standard MFAS nominally pings every 50 seconds for hull-mounted sources. For the sources for which we know the pulse length, most are significantly shorter than hull-mounted active sonar, on the order of several microseconds to tens of microseconds. For hull-mounted active sonar, though some of the vocalizations that marine mammals make are less than one second long, there is only a 1 in 50 chance that they would occur exactly when the ping was received, and when vocalizations are longer than one second, only parts of them are masked. Alternately, when the pulses are only several microseconds long, the majority of most animals' vocalizations would not be masked. Masking effects from MFAS/HFAS are expected to be minimal. If masking or communication impairment were to occur briefly, it would be in the frequency range of MFAS, which overlaps with some marine mammal vocalizations; however, it would likely not mask the entirety of any particular vocalization, communication series, or other critical auditory cue, because the signal length, frequency, and duty cycle of the MFAS/HFAS signal does not perfectly mimic the characteristics of any marine mammal's vocalizations.

PTS, Injury, or Mortality

NMFS believes that many marine mammals would deliberately avoid exposing themselves to the received levels of active sonar necessary to induce injury by moving away from or at least modifying their path to avoid a close approach. Additionally, in the unlikely event that an animal approaches the sonar vessel at a close distance, NMFS believes that the mitigation measures (*i.e.,* shutdown/powerdown zones for MFAS/HFAS) 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 all ASW exercises) in addition to watchstanders on vessels to detect marine mammals for mitigation implementation.

If a marine mammal is able to approach a surface vessel within the distance necessary to incur PTS, the likely speed of the vessel (nominal 10–15 knots) would make it very difficult for the animal to remain in range long enough to accumulate enough energy to result in more than a mild case of PTS. As mentioned previously and in relation to TTS, the likely consequences to the health of an individual that incurs PTS can range from mild to more serious, depending upon the degree of PTS and the frequency band it is in, and many animals are able to compensate for the shift, although it may include energetic costs.

As discussed previously, marine mammals (especially beaked whales) could potentially respond to MFAS at a received level lower than the injury threshold in a manner that indirectly results in the animals stranding. The exact mechanism of this potential response, behavioral or physiological, is not known. When naval exercises have been associated with strandings in the past, it has typically been when three or more vessels are operating simultaneously, in the presence of a strong surface duct, and in areas of constricted channels, semi-enclosed areas, and/or steep bathymetry. A combination of these environmental and operational parameters is not present in the NWTT action. When this is combined with consideration of the number of hours of active sonar training that will be conducted and the nature of the exercises—which do not typically include the use of multiple hull-mounted sonar sources—we believe that the probability is small that this will occur. Furthermore, given that there has never been a stranding in the Study Area associated with sonar use and based on the number of occurrences where strandings have been definitively associated with military sonar versus the number of hours of active sonar training that have been conducted, we believe that the probability is small that this will occur as a result of the Navy's proposed training and testing activities. Lastly, an active sonar shutdown protocol for strandings involving live animals milling in the water minimizes the chances that these types of events turn into mortalities.

As stated previously, there have been no recorded Navy vessel strikes of any marine mammals during training or testing in the NWTT Study Area to date, nor were takes by injury or mortality resulting from vessel strike predicted in the Navy's acoustic effects analysis.

Species/Group Specific Analysis

In the discussions below, the ''acoustic analysis'' refers to the Navy's model results and post-model analysis. The Navy performed a quantitative analysis to estimate the number of marine mammals that could be harassed by acoustic sources or explosives used during Navy training and testing activities. Inputs to the quantitative analysis included marine mammal density estimates; marine mammal depth occurrence distributions; oceanographic and environmental data; marine mammal hearing data; and criteria and thresholds for levels of potential effects. Marine mammal densities used in the model may overestimate actual densities when species data is limited and for species with seasonal migrations (*e.g.,* humpbacks, blue whales, sei whales, gray whales). The quantitative analysis consists of computer modeled estimates and a post-model analysis (which considers the potential for avoidance and highly effective mitigation to prevent Level A harassments) to determine the number of potential harassments. The model calculates sound energy propagation from sonars, 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 received by a marine mammal exceeds the thresholds for effects. The model estimates are then further analyzed and adjusted to consider animal avoidance and implementation of mitigation measures, resulting in final estimates of effects due to Navy training and testing.

Although this more complex computer modeling approach accounts for various environmental factors affecting acoustic propagation, the current software tools do not consider the likelihood that a marine mammal would attempt to avoid repeated exposures to a sound or avoid an area of intense activity where a training or testing event may be focused. Additionally, the software tools do not consider the implementation of mitigation (*e.g.,* stopping sonar transmissions when a marine mammal is within a certain distance of a ship or range clearance prior to detonations). In both of these situations, naval activities are modeled as though an activity would occur regardless of proximity to marine mammals and without any horizontal movement by the animal away from the sound source or human activities (*e.g.,* without accounting for likely animal avoidance). The initial model results overestimate the number of takes (as described previously). 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 injurious sound exposures, thus, reducing Level A takes. All adjusted effects resulting from likely avoidance behaviors and implementation of highly effective mitigation are quantified (added) as Level B harassment (TTS) and are part of the requested annual effects to marine mammals.

It is important to note that adjustments to take estimates as a result of implemented mitigation were only applied to those events having a very high likelihood of detecting marine mammals. It is also important to note that the Navy's take estimates represent the total number of takes and not the number of individuals taken, as a single individual may be taken multiple times over the course of a year. NMFS provided input to the Navy on this process and the Navy's qualitative analysis is described in detail in Chapter 6 of their LOA application. (*http://www.nmfs.noaa.gov/pr/permits/incidental/military.htm*).

Predicted harassment of marine mammals from sonar and other active acoustic sources and explosions during annual training and testing activities are shown in Tables 18–21. The acoustic analysis predicts the majority of marine mammal species in the Study Area would not be exposed to explosive (impulse) sources associated with training and testing activities, which would exceed the current impact thresholds (Table 4). Only harbor porpoise, Dall's porpoise, and Northern elephant seal are predicted to have exposures that would exceed the current impact thresholds for explosives, as presented in the following subsections.

The analysis below may in some cases (*e.g.,* mysticetes, porpoises, pinnipeds) address species collectively if they occupy the same functional hearing group (*i.e.,* low, mid, and high-frequency cetaceans and pinnipeds in water), have similar hearing capabilities, and/or are known to generally behaviorally respond similarly to acoustic stressors. Where there are meaningful differences between species in anticipated individual responses to activities, impact of expected take on the population due to differences in population status, or impacts on habitat, they will either be described within the section or the species will be included as a separate sub-section. See the Brief Background on Sound section earlier in this proposed rule for a description of marine mammal functional hearing groups as originally designated by Southall *et al.* (2007).

Mysticetes—The Navy's acoustic analysis predicts that 184 instances of Level B harassment of mysticete whales may occur in the Study Area each year from sonar and other active acoustic stressors during training and testing activities. Species-specific Level B take estimates are as follows: 57 humpback whales (Central North Pacific and California/Oregon/Washington stocks); 11 blue whales (Eastern North Pacific stock); 61 fin whales (Northeast Pacific and California/Oregon/Washington stocks); 2 sei whales (Eastern North Pacific stock); 36 minke whales (Alaska and California/Oregon/Washington stocks); and 17 gray whales (Eastern North Pacific and Western North Pacific stocks). Based on the distribution information presented in the LOA application, it is highly unlikely that North Pacific right whales would be encountered in the Study Area during events involving use of sonar and other active acoustic sources. The acoustic analysis did not predict any takes of North Pacific right whales, and NMFS is not authorizing any takes of this species. Of these species, humpback (This species is being considered by NMFS for removal or down-listing from the U.S. Endangered Species List [NMFS, 2009, 2013a; Bettridge *et al.* 2015; NOAA, 2015b]), blue, fin, and sei whales are listed as endangered under the ESA and depleted under the MMPA.

These exposure estimates represent a limited number of takes relative to population estimates for all mysticete stocks in the Study Area (Table 9). When the numbers of behavioral takes are compared to the estimated stock abundance and if one assumes that each take happens to a separate animal, less than 20 percent of each of these stocks would be behaviorally harassed during the course of a year. More likely, fewer individuals would be taken, but a subset would be taken more than one time per year.

Level B harassment takes are anticipated to be in the form of TTS and behavioral reactions and no injurious takes of humpback, blue, fin, or sei whales from sonar and other active acoustic stressors or explosives are expected. The majority of acoustic effects to mysticetes from sonar and other active sound sources during training activities would be primarily from anti-submarine warfare events involving surface ships and hull mounted sonar. Most Level B harassments to mysticetes from sonar would result from received levels less than 158 dB SPL. Recovery from a threshold shift (TTS) can take a few minutes to a few days (*i.e.,* there is recovery), depending on the severity of the initial shift; however, NMFS does not anticipate TTS of a long duration or severe degree to occur as a result of exposure to MFAS/HFAS in the Study Area. Threshold shifts do not necessarily affect all hearing frequencies equally, so some threshold shifts may not interfere with an animal's of biologically relevant sounds. Most low-frequency (mysticetes) cetaceans observed in studies usually avoided sound sources at levels of less than or equal to 160 dB re 1μPa. Mysticetes that are exposed to sonar and other active acoustic sources may react by alerting, ignoring the stimulus, changing their behaviors or vocalizations, or avoiding the area by swimming away or diving (Richardson, 1995; Nowacek, 2007; Southall *et al.,* 2007).

Specific to U.S. Navy systems using low frequency sound, studies were undertaken in 1997–98 pursuant to the Navy's Low Frequency Sound Scientific Research Program. These studies found only short-term responses to low frequency sound by mysticetes (fin, blue, and humpback), including changes in vocal activity and avoidance of the source vessel (Clark, 2001; Miller *et al.,* 2000; Croll *et al.,* 2001; Fristrup *et al.,* 2003; Nowacek *et al.,* 2007). Baleen whales exposed to moderate low-frequency signals demonstrated no variation in foraging activity (Croll *et al.,* 2001). Low-frequency signals of the

Acoustic Thermometry of Ocean Climate sound source were not found to affect dive times of humpback whales in Hawaiian waters (Frankel and Clark, 2000).

Specific to mid-frequency sounds, studies by Melcón *et al.* (2012) in the Southern California Bight found that the likelihood of blue whale low-frequency calling (usually associated with feeding behavior) decreased with an increased level of mid-frequency sonar, beginning at a SPL of approximately 110–120 dB re 1 µPa. However, 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. Preliminary results from the 2010–2011 field season of an ongoing behavioral response study in Southern California waters indicated that in some cases and at low received levels, tagged blue whales responded to mid-frequency sonar but that those responses were mild and there was a quick return to their baseline activity (Southall *et al.,* 2012b). Blue whales responded to a mid-frequency sound source, with a source level between 160 and 210 dB re 1 µPa at 1 m and a received sound level up to 160 dB re 1 µPa, by exhibiting generalized avoidance responses and changes to dive behavior during controlled exposure experiments (CEE) (Goldbogen *et al.,* 2013). However, reactions were not consistent across individuals based on received sound levels alone, and likely were the result of a complex interaction between sound exposure factors such as proximity to sound source and sound type (mid-frequency sonar simulation vs. pseudo-random noise), environmental conditions, and behavioral state. Surface feeding whales did not show a change in behavior during CEEs, but deep feeding and non-feeding whales showed temporary reactions that quickly abated after sound exposure. Distances of the sound source from the whales during CEEs were sometimes less than a mile. Furthermore, the more dramatic reactions reported by Goldbogen *et al.* (2013) were from non-sonar like signals, a pseudorandom noise that could likely have been a novel signal to blue whales. The preliminary findings from Goldbogen *et al.* (2013) and Melcón *et al.* (2012) are consistent with the Navy's criteria and thresholds for predicting behavioral effects to mysticetes from sonar and other active acoustic sources used in the quantitative acoustic effects analysis for NWTT. The behavioral response function predicts a probability of a substantive behavioral reaction for individuals exposed to a received SPL of 120 dB re 1 µPa or greater, with an increasing probability of reaction with increased received level as demonstrated in Melcón *et al.* (2012).

High-frequency systems are not within mysticetes' ideal hearing range and it is unlikely that they would cause a significant behavioral reaction resulting in takes.

Overall, the number of predicted behavioral reactions is low and occasional behavioral reactions are unlikely to cause long-term consequences for individual animals or populations. The implementation of mitigation and the sightability of mysticetes (due to their large size) reduces the potential for a significant behavioral reaction or a threshold shift to occur. Furthermore, there is no designated critical habitat for mysticetes in the NWTT Study Area. There are also no known specific breeding or calving areas for mysticete species within the Study Area. Some biologically-important mysticete feeding and migration areas (Northern Puget Sound Feeding Area for gray whales; Northbound Migration Phase A for gray whales; Northbound Migration Phase B for gray whales; Potential Presence Migration Area for gray whales; Northern Washington Feeding Area for humpback whales; Stonewall and Heceta Bank Feeding Area for humpback whales; Cape Blanco and Orford Reef Feeding Area for gray whale; and Point St. George Feeding Area for gray whales) may overlap slightly with the Study Area. However, a review of the BIAs for humpback whales and gray whales against areas where most acoustic activities are conducted in the Study Area (especially those that involve ASW hull-mounted sonar, sonobuoys, and use of explosive munitions) identified that there is no spatial overlap. The overall risk to species in these areas has been preliminarily determined to be low or biologically insignificant, in part due to the generally infrequent, temporally and spatially variable, and extreme offshore nature of sonar-related activities and sound propagation relative to the more coastally distributed biologically important areas; the probability that propagated receive levels within these areas would be relatively low in terms of behavioral criteria (Debich *et al.,* 2014; U.S. Department of the Navy, 2013d); the likelihood of TTS or PTS sound levels being extremely low; and the overall application of Navy mitigation procedures for marine mammals sighted within prescribed mitigation zones if such activities were to occur in or near these areas. If additional biologically important areas are identified by NMFS after finalization of this rule and the Navy's NWTT EIS/OEIS, the Navy and NMFS will use the Adaptive Management process to assess whether any additional mitigation should be considered in those areas. Consequently, the NWTT activities are not expected to adversely impact annual rates of recruitment or survival of mysticete whales.

There has never been a vessel strike to a whale during any active training or testing activities in the Study Area. A detailed analysis of strike data is contained in Chapter 6 (Section 6.7, Estimated Take of Large Whales by Navy Vessel Strike) of the LOA application. The Navy and NMFS do not anticipate vessel strikes to any marine mammals during training or testing activities within the Study Area, nor were takes by injury or mortality resulting from vessel strike predicted in the Navy's analysis. Therefore, NMFS is not authorizing mysticete takes (by injury or mortality) from vessel strikes during the 5-year period of the NWTT regulations.

Sperm Whales—The Navy's acoustic analysis predicts that 159 instances of Level B harassment of sperm whales (California/Oregon/Washington stock) may occur in the Study Area each year from sonar or other active acoustic stressors during training and testing activities. These Level B takes are anticipated to be in the form of TTS and behavioral reactions and no injurious takes of sperm whales from sonar and other active acoustic stressors or explosives are requested or proposed for authorization. Sperm whales have shown resilience to acoustic and human disturbance, although they may react to sound sources and activities within a few kilometers. Sperm whales that are exposed to activities that involve the use of sonar and other active acoustic sources may alert, ignore the stimulus, avoid the area by swimming away or diving, or display aggressive behavior (Richardson, 1995; Nowacek, 2007; Southall *et al.,* 2007). Some (but not all) sperm whale vocalizations might overlap with the MFAS/HFAS TTS frequency range, which could temporarily decrease an animal's sensitivity to the calls of conspecifics or returning echolocation signals. However, as noted previously, NMFS does not anticipate TTS of a long duration or severe degree to occur as a result of exposure to MFAS/HFAS. Recovery from a threshold shift (TTS) can take a few minutes to a few days, depending on the exposure duration, sound exposure level, and the magnitude of the initial shift, with larger threshold shifts and longer exposure durations requiring longer recovery times (Finneran *et al.,* 2005; Mooney *et al.,* 2009a; Mooney *et al.,* 2009b; Finneran and Schlundt, 2010). Large threshold shifts are not anticipated for these activities because of the unlikelihood that animals will remain within the ensonified area (due to the short duration of the majority of exercises, the speed of the vessels, and the short distance within which the animal would need to approach the sound source) at high levels for the duration necessary to induce larger threshold shifts. Threshold shifts do not necessarily affect all hearing frequencies equally, so some threshold shifts may not interfere with an animal's hearing of biologically relevant sounds. No sperm whales are predicted to be exposed to MFAS/HFAS sound levels associated with PTS or injury.

The majority of Level B takes are expected to be in the form of mild responses. Relative to the population size (stock abundance estimates are shown in Table 9), this activity is anticipated to result only in a limited number of Level B harassment takes. When the number of behavioral takes is compared to the estimated stock abundance and if one assumes that each take happens to a separate animal, less than 17 percent of the California/Oregon/Washington stock would be behaviorally harassed during the course of a year. More likely, fewer individuals would be taken, but a subset would be taken more than one time per year. Overall, the number of predicted behavioral reactions are unlikely to cause long-term consequences for individual animals or populations. The NWTT activities are not expected to occur in an area/time of specific importance for reproductive, feeding, or other known critical behaviors for sperm whales. Consequently, the activities are not expected to adversely impact annual rates of recruitment or survival of sperm whales. Sperm whales are listed as depleted under the MMPA and endangered under the ESA; however, there is no designated critical habitat in the Study Area.

There has never been a vessel strike to a sperm whale during any active training or testing activities in the Study Area. A detailed analysis of strike data is contained in Chapter 6 (Section 6.7, Estimated Take of Large Whales by Navy Vessel Strike) of the LOA application. The Navy and NMFS do not anticipate vessel strikes to any marine mammals during training or testing activities within the Study Area, nor were takes by injury or mortality resulting from vessel strikes predicted in the Navy's analysis. Therefore, NMFS is not authorizing sperm whale takes (by injury or mortality) from vessel strikes during the 5-year period of the NWTT regulations.

Porpoises—The Navy's acoustic analysis predicts that 15,071 instances of Level B harassment of Dall's porpoises (Alaska and California/Oregon/Washington stocks) and 138,225 instances of Level B harassment of harbor porpoises (Southeast Alaska, Northern Oregon/Washington Coast, Northern California/Southern Oregon, and Washington Inland Waters stocks) (mainly behavioral reaction) may occur each year from sonar and other active acoustic stressors and explosives associated with training and testing activities in the Study Area. These estimates represent the total number of exposures and not necessarily the number of individuals exposed, as a single individual may be exposed multiple times over the course of a year. Behavioral responses can range from a mild orienting response, or a shifting of attention, to flight and panic (Richardson, 1995; Nowacek, 2007; Southall *et al.,* 2007).

Acoustic analysis (factoring in the post-model correction for avoidance and mitigation) also predicted that 47 Dall's porpoises and 45 harbor porpoises might be exposed to sound levels likely to result in PTS or injury (Level A harassment) from mainly sonar and other active acoustic stressors, and explosives. In the case of all explosive exercises, it is worth noting that the amount of explosive and acoustic energy entering the water, and therefore the effects on marine mammals, may be overestimated, as many explosions actually occur upon impact with above-water targets. However, sources such as these were modeled as exploding at 1-meter depth. Furthermore, in the case of all explosive exercises, the exclusion zones are considerably larger than the estimated distance at which an animal would be exposed to injurious sounds or pressure waves.

Animals that do experience hearing loss (TTS or PTS) may have reduced ability to detect relevant sounds such as predators, prey, or social vocalizations. Some porpoise vocalizations might overlap with the MFAS/HFAS TTS frequency range (2–20 kHz). It is worth noting that TTS in the range induced by MFAS/HFAS would reduce sensitivity in the band that killer whales (a potential predator) click and echolocate in. Recovery from a threshold shift (TTS; partial hearing loss) can take a few minutes to a few days, depending on the exposure duration, sound exposure level, and the magnitude of the initial shift, with larger threshold shifts and longer exposure durations requiring longer recovery times (Finneran *et al.,* 2005; Mooney *et al.,* 2009a; Mooney *et al.,* 2009b; Finneran and Schlundt, 2010). More severe shifts may not fully recover and thus would be considered PTS. However, large degrees of PTS are not anticipated for these activities because of the unlikelihood that animals will remain within the ensonified area (due to the short duration of the majority of exercises, the speed of the vessels, and the short distance within which the animal would need to approach the sound source) at high levels for the duration necessary to induce larger threshold shifts. Threshold shifts do not necessarily affect all hearing frequencies equally, so some threshold shifts may not interfere with an animal hearing biologically relevant sounds. The likely consequences to the health of an individual that incurs PTS can range from mild to more serious, depending upon the degree of PTS and the frequency band it is in, and many animals are able to compensate for the shift, although it may include energetic costs. Furthermore, likely avoidance of intense activity and sound coupled with mitigation measures would further reduce the potential for severe PTS exposures to occur. If a marine mammal is able to approach a surface vessel within the distance necessary to incur PTS, the likely speed of the vessel (nominal 10–15 knots) 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.

Harbor porpoises have been observed to be especially sensitive to human activity (Tyack *et al.,* 2011; Pirotta *et al.,* 2012). The information currently available regarding harbor porpoises suggests a very low threshold level of response for both captive (Kastelein *et al.,* 2000; Kastelein *et al.,* 2005) and wild (Johnston, 2002) animals. Southall *et al.* (2007) concluded that harbor porpoises are likely sensitive to a wide range of anthropogenic sounds at low received levels (~90 to 120 dB). Research and observations of harbor porpoises for other locations show that this small species is wary of human activity and will display profound avoidance behavior for anthropogenic sound sources in many situations at levels down to 120 dB re 1 µPa (Southall, 2007). Harbor porpoises routinely avoid and swim away from large motorized vessels (Barlow *et al.,* 1988; Evans *et al.,* 1994; Palka and Hammond, 2001; Polacheck and

Thorpe, 1990). The vaquita, which is closely related to the harbor porpoise in the Study Area, appears to avoid large vessels at about 2,995 ft. (913 m) (Jaramillo-Legorreta *et al.,* 1999). The assumption is that the harbor porpoise would respond similarly to large Navy vessels, possibly prior to commencement of sonar or explosive activity (*i.e.,* pre-activity avoidance). Harbor porpoises may startle and temporarily leave the immediate area of the training or testing until after the event ends. Since a large proportion of training and testing activities occur within harbor porpoise habitat in the Study Area and given their very low behavioral threshold, predicted effects are more likely than with most other odontocetes, especially at closer ranges (within a few kilometers). Since this species is typically found in nearshore and inshore habitats, resident animals that are present throughout the Study Area could receive multiple exposures over a short period of time year round. As mentioned earlier in the Analysis and Negligible Impact Determination section, we anticipate more severe effects from takes when animals are exposed to higher received levels. Animals that do not exhibit a significant behavioral reaction would likely recover from any incurred costs, which reduces the likelihood of long-term consequences, such as reduced fitness, for the individual or population.

Stock abundance estimates for Dall's and harbor porpoises are shown in Table 9. When the numbers of takes for Dall's porpoise are compared to the estimated stock abundances and if one assumes that each take happens to a separate animal, approximately 30 percent of the Alaska stock and less than 2 percent of the California/Oregon/Washington stock would be harassed (behaviorally) during the course of a year. More likely, fewer individuals are harassed, but a subset are harassed more than one time during the course of the year. The number of harbor porpoises—in particular, Northern Oregon/Washington Coast and Northern California/Southern Oregon stocks—behaviorally harassed by exposure to MFAS/HFAS in the Study Area is higher than the other species (and, in fact, suggests that every member of the stock could potentially be taken by Level B harassment multiple times, although it is more likely that fewer individuals are harassed but a subset are harassed more than one time during the course of the year) because of the low Level B harassment threshold (we assume for the purpose of estimating take that all harbor porpoises exposed to 120 dB or higher MFAS/HFAS will be taken by Level B behavioral harassment), which essentially makes the ensonified area of effects significantly larger than for the other species. However, the fact that the threshold is a step function and not a curve (and assuming uniform density) means that the vast majority of the takes occur in the very lowest levels that exceed the threshold (it is estimated that approximately 80 percent of the takes are from exposures to 120 dB to 126 dB), which means that anticipated behavioral effects are not expected to be severe (*e.g.,* temporary avoidance). As mentioned above, an animal's exposure to a higher received level is more likely to result in a behavioral response that is more likely to adversely affect the health of an animal. ASW training and testing exercises using MFAS/HFAS generally last for 2–16 hours, and may have intervals of non-activity in between. In addition, the Navy does not typically conduct successive MTEs (no MTEs are proposed for NWTT) or other ASW exercises in the same locations. Given the average length of ASW exercises (times of continuous sonar use) and typical vessel speed, combined with the fact that the majority of the harbor porpoises in the Study Area would not likely remain in an area for successive days, it is unlikely that an animal would be exposed to MFAS/HFAS at levels likely to result in a substantive response (*e.g.,* interruption of feeding) that would then be carried on for more than one day or on successive days. Thompson *et al.* (2013) showed that seismic surveys conducted over a 10-day period in the North Sea did not result in the broad-scale displacement of harbor porpoises away from preferred habitat. The harbor porpoises were observed to leave the area at the onset of survey, but returned within a few hours, and the overall response of the porpoises decreased over the 10-day period.

The harbor porpoise is a common species in the nearshore coastal waters of the Study Area year-round (Barlow, 1988; Green *et al.,* 1992; Osmek *et al.,* 1996, 1998; Forney and Barlow, 1998; Carretta *et al.,* 2009). Since 1999, Puget Sound Ambient Monitoring Program data and stranding data documented increasing numbers of harbor porpoise in Puget Sound, indicating that the species may be returning to the area (Nysewander, 2008; Washington Department of Fish and Wildlife, 2008; Jeffries, 2013a). Sightings in northern Hood Canal (north of the Hood Canal Bridge) have increased in recent years (Calambokidis, 2010). Harbor porpoise continue to inhabit the waters of Hood Canal (including Dabob Bay), which has for decades served as the location for training and testing events using sonar and other active acoustic sources.

Considering the information above, the predicted effects to Dall's and harbor porpoises are unlikely to cause long-term consequences for individual animals or the population. The NWTT activities are not expected to occur in an area/time of specific importance for reproductive, feeding, or other known critical behaviors for Dall's and harbor porpoises. Pacific stocks of Dall's and harbor porpoises are not listed as depleted under the MMPA. Consequently, the activities are not expected to adversely impact annual rates of recruitment or survival of porpoises.

Pygmy and Dwarf Sperm Whales (Kogia spp.)—Due to the difficulty in differentiating these two species at sea, an estimate of the effects on the two species have been combined. The Navy's acoustic analysis predicts that 179 instances of Level B harassment (TTS and behavioral reaction) of the California/Oregon/Washington stock of *Kogia* spp. may occur each year from sonar and other active acoustic stressors associated with training and testing activities in the Study Area. The Navy's acoustics analysis (factoring in the post-model correction for avoidance and mitigation) also indicates that 1 exposure of *Kogia* to sound levels from non-impulsive acoustic sources likely to result in level A harassment (PTS) may occur during testing activities in the Study Area. Stock abundance estimates for California/Oregon/Washington stocks of *Kogia* spp. are shown in Table 9. Relative to population size these represent only a limited number of takes if one assumes that each take happens to a separate animal. More likely, fewer individuals would be taken, but a subset would be taken more than one time per year.

Recovery from a threshold shift (TTS; partial hearing loss) can take a few minutes to a few days, depending on the exposure duration, sound exposure level, and the magnitude of the initial shift, with larger threshold shifts and longer exposure durations requiring longer recovery times (Finneran *et al.,* 2005; Mooney *et al.,* 2009a; Mooney *et al.,* 2009b; Finneran and Schlundt, 2010). PTS would not fully recover. However, large degrees of PTS are not anticipated for these activities because of the unlikelihood that animals will remain within the ensonified area (due to the short duration of the majority of exercises, the speed of the vessels, and the short distance within which the animal would need to approach the sound source) at high levels for the duration necessary to induce larger threshold shifts. Threshold shifts do not necessarily affect all hearing frequencies equally, so some threshold shifts may not interfere with an animal hearing biologically relevant sounds. The likely consequences to the health of an individual that incurs PTS can range from mild to more serious, depending upon the degree of PTS and the frequency band it is in, and many animals are able to compensate for the shift, although it may include energetic costs. Furthermore, likely avoidance of intense activity and sound coupled with mitigation measures would further reduce the potential for severe PTS exposures to occur. If a marine mammal is able to approach a surface vessel within the distance necessary to incur PTS, the likely speed of the vessel (nominal 10–15 knots) 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.

Some *Kogia* spp. vocalizations might overlap with the MFAS/HFAS TTS frequency range (2–20 kHz), but the limited information for *Kogia* spp. indicates that their clicks are at a much higher frequency and that their maximum hearing sensitivity is between 90 and 150 kHz. It is worth noting that TTS in the range induced by MFAS would reduce sensitivity in the band that killer whales (a potential predator) click and echolocate in. However, as noted previously, NMFS does not anticipate TTS of a long duration or severe degree to occur as a result of exposure to MFA/HFAS.

Research and observations on *Kogia* spp. are limited. These species tend to avoid human activity and presumably anthropogenic sounds. Pygmy and dwarf sperm whales may startle and leave the immediate area of activity, reducing potential impacts. Pygmy and dwarf sperm whales have been 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). Based on their tendency to avoid acoustic stressors (*e.g.,* quick diving and other vertical avoidance maneuvers) coupled with the short duration and intermittent nature (*e.g.,* sonar pings during ASW activities occur about every 50 seconds) of the majority of training and testing exercises and the speed of the Navy vessels involved, it is unlikely that animals would receive multiple exposures over a short period of time, allowing animals to recover lost resources (*e.g.,* food) or opportunities (*e.g.,* mating).

The predicted effects to *Kogia* spp. are expected to be temporary and unlikely to cause long-term consequences for individual animals or populations. The NWTT activities are not expected to occur in an area/time of specific importance for reproductive, feeding, or other known critical behaviors. Pacific stocks of *Kogia* are not depleted under the MMPA. Consequently, the activities are not expected to adversely impact annual rates of recruitment or survival of pygmy and dwarf sperm whales.

Beaked Whales—The Navy's acoustic analysis predicts that the following numbers of Level B harassment of beaked whales may occur annually from sonar and other active acoustic stressors associated with training and testing activities in the Study Area: 665 Baird's beaked whales (California/Oregon/Washington and Alaska stocks), 459 Cuvier's beaked whales (California/Oregon/Washington and Alaska stocks), and 1,616 *Mesoplodon* beaked whales (California/Oregon/Washington stock). These estimates represent the total number of exposures and not necessarily the number of individuals exposed, as a single individual may be exposed multiple times over the course of a year. These takes are anticipated to be in the form of behavioral harassment (TTS and behavioral reaction) and no injurious takes of beaked whales from active acoustic stressors or explosives are requested or proposed. Stock abundance estimates for beaked whales in the Study Area are shown in Table 9. When the numbers of behavioral takes are compared to the estimated stock abundances and if one assumes that each take happens to a separate animal, less than 7 percent of the California/Oregon/Washington stock of Cuvier's beaked whale would be behaviorally harassed during the course of a year. Virtually all of the Baird's and *Mesoplodon* beaked whale stocks (California/Oregon/Washington) would potentially be behaviorally harassed each year, although it is more likely that fewer individuals would be harassed but a subset would be harassed more than one time during the course of the year. As is the case with harbor porpoises, beaked whales have been shown to be particularly sensitive to sound and therefore have been assigned a lower harassment threshold based on observations of wild animals by McCarthy *et al.* (2011) and Tyack *et al.* (2011). The fact that the Level B harassment threshold is a step function (The Navy has adopted an unweighted 140 dB re 1 μPa SPL threshold for significant behavioral effects for all beaked whales) and not a curve (and assuming uniform density) means that the vast majority of the takes occur in the very lowest levels that exceed the threshold (it is estimated that approximately 80 percent of the takes are from exposures to 140 dB to 146 dB), which means that the anticipated effects for the majority of exposures are not expected to be severe (As mentioned above, an animal's exposure to a higher received level is more likely to result in a behavioral response that is more likely to adversely affect the health of an animal). Further, Moretti *et al.* (2014) recently derived an empirical risk function for Blainville's beaked whale that predicts there is a 0.5 probability of disturbance at a received level of 150 dB (CI: 144–155), suggesting that in some cases the current Navy step function may over-estimate the effects of an activity using sonar on beaked whales. Irrespective of the Moretti *et al.* (2014) risk function, NMFS' analysis assumes that all of the beaked whale Level B takes that are proposed for authorization will occur, and we base our negligible impact determination, in part, on the fact that these exposures would mainly occur at the very lowest end of the 140-dB behavioral harassment threshold where behavioral effects are expected to be much less severe and generally temporary in nature.

Behavioral responses can range from a mild orienting response, or a shifting of attention, to flight and panic (Richardson, 1995; Nowacek, 2007; Southall *et al.,* 2007). Research has also shown that beaked whales are especially sensitive to the presence of human activity (Tyack *et al.,* 2011; Pirotta *et al.,* 2012). Beaked whales have been documented to exhibit avoidance of human activity or respond to vessel presence (Pirotta *et al.,* 2012). Beaked whales were observed to react negatively to survey vessels or low altitude aircraft by quick diving and other avoidance maneuvers, and none were observed to approach vessels (Wursig *et al.,* 1998). Some beaked whale vocalizations may overlap with the MFAS/HFAS TTS frequency range (2–20 kHz); however, as noted above, NMFS does not anticipate TTS of a serious degree or extended duration to occur as a result of exposure to MFA/HFAS. Recovery from a threshold shift (TTS) can take a few minutes to a few days, depending on the exposure duration, sound exposure level, and the magnitude of the initial shift, with larger threshold shifts and longer exposure durations requiring longer recovery times (Finneran *et al.,* 2005; Mooney *et al.,* 2009a; Mooney *et al.,* 2009b; Finneran and Schlundt, 2010). Large threshold shifts are not anticipated for these activities because of the unlikelihood that animals will remain within the ensonified area (due to the short duration of the majority of exercises, the speed of the vessels, and the short distance within which the animal would need to approach the sound source) at high levels for the duration necessary to induce larger threshold shifts. Threshold shifts do not necessarily affect all hearing frequencies equally, so some threshold shifts may not interfere with an animal's hearing of biologically relevant sounds.

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 mid-frequency sonar use. Research and observations show that if beaked whales are exposed to sonar or other active acoustic sources they may startle, break off feeding dives, and avoid the area of the sound source to levels of 157 dB re 1 μPa, or below (McCarthy *et al.,* 2011). Acoustic monitoring during actual sonar exercises revealed some beaked whales continuing to forage at levels up to 157 dB re 1 μPa (Tyack *et al.* 2011). Stimpert *et al.* (2014) tagged a Baird's beaked whale, which was subsequently exposed to simulated mid-frequency sonar. Changes in the animal's dive behavior and locomotion were observed when received level reached 127 dB re 1 μPa. 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; Moretti *et al.,* 2009, 2010; Tyack *et al.,* 2010, 2011; McCarthy *et al.,* 2011). Tyack *et al.* (2011) report that, in reaction to sonar playbacks, most beaked whales stopped echolocating, made long slow ascent to the surface, and moved away from the sound. A similar behavioral response study conducted in Southern California waters during the 2010–2011 field season found that Cuvier's beaked whales exposed to MFAS displayed behavior ranging from initial orientation changes to avoidance responses characterized by energetic fluking and swimming away from the source (DeRuiter *et al.,* 2013b). However, the authors did not detect similar responses to incidental exposure to distant naval sonar exercises at comparable received levels, indicating that context of the exposures (*e.g.,* source proximity, controlled source ramp-up) may have been a significant factor. The study itself found the results inconclusive and meriting further investigation. Cuvier's beaked whale responses suggested particular sensitivity to sound exposure as consistent with results for Blainville's beaked whale. Populations of beaked whales and other odontocetes on the Bahamas and other Navy fixed ranges that have been operating for decades, appear to be stable. Behavioral reactions (avoidance of the area of Navy activity) seem likely in most cases if beaked whales are exposed to anti-submarine sonar within a few tens of kilometers, especially for prolonged periods (a few hours or more) since this is one of the most sensitive marine mammal groups to anthropogenic sound of any species or group studied to date and research indicates beaked whales will leave an area where anthropogenic sound is present (Tyack *et al.,* 2011; De Ruiter *et al.,* 2013; Manzano-Roth *et al.,* 2013; Moretti *et al.,* 2014). Research involving tagged Cuvier's beaked whales in the SOCAL Range Complex reported on by Falcone and Schorr (2012, 2014) indicates year-round prolonged use of the Navy's training and testing area by these beaked whales and has documented movements in excess of hundreds of kilometers by some of those animals. Given that some of these animals may routinely move hundreds of kilometers as part of their normal pattern, leaving an area where sonar or other anthropogenic sound is present may have little, if any, cost to such an animal. Photo identification studies in the SOCAL Range Complex, a Navy range that is utilized for training and testing more frequently than the NWTT Study Area, have identified approximately 100 individual Cuvier's beaked whale individuals with 40 percent having been seen in one or more prior years, with re-sightings up to 7 years apart (Falcone and Schorr, 2014). These results indicate long-term residency by individuals in an intensively used Navy training and testing area, which may also suggest a lack of long-term consequences as a result of exposure to Navy training and testing activities. Finally, results from passive acoustic monitoring estimated regional Cuvier's beaked whale densities were higher than indicated by the NMFS's broad scale visual surveys for the U.S. west coast (Hildebrand and McDonald, 2009).

Based on the findings above, it is clear that the Navy's long-term ongoing use of sonar and other active acoustic sources has not precluded beaked whales from also continuing to inhabit those areas. In summary, based on the best available science, the Navy and NMFS believe that beaked whales that exhibit a significant TTS or behavioral reaction due to sonar and other active acoustic testing activities would generally not have long-term consequences for individuals or populations. Claridge (2013) speculates that sonar use in a Bahamas range could have ''a possible population-level effect'' on beaked whales based on lower abundance in comparison to control sites. However, the study suffers from several shortcomings and incorrectly assumes that the Navy range and control sites were identical. The author also acknowledged that ''information currently available cannot provide a quantitative answer to whether frequent sonar use at [the Bahamas range] is causing stress to resident beaked whales,'' and cautioned that the outcome of ongoing studies ''is a critical component to understanding if there are population-level effects.'' Moore and Barlow (2013) have noted a decline in beaked whale populations in a broad area of the Pacific Ocean area out to 300 nm from the coast and extending from the Canadian-U.S. border to the tip of Baja Mexico. There are scientific caveats and limitations to the data used for that analysis, as well as oceanographic and species assemblage changes on the U.S. Pacific coast not thoroughly addressed. Interestingly, however, in the small portion of that area overlapping the Navy's SOCAL Range Complex, long-term residency by individual Cuvier's beaked whales and higher densities provide indications that the proposed decline noted elsewhere is not apparent where for decades the Navy has been intensively training and testing with sonar and other systems.

NMFS also considered New *et al.* (2013) and their mathematical model simulating a functional link between foraging energetics and requirements for survival and reproduction for 21 species of beaked whales. However, NMFS concluded that New *et al.* (2013) model lacks critical data and accurate inputs necessary to form valid conclusions specifically about impacts of anthropogenic sound from Navy activities on beaked whale populations. The study itself notes the need for ''future research,'' identifies ''key data needs'' relating to input parameters that ''particularly affected'' the model results, and states only that the use of the model ''in combination with more detailed research'' *could* help predict the effects of management actions on beaked whale species. In short, information is not currently available to specifically support the use of this model in a project-specific evaluation of the effects of navy activities on the impacted beaked whale species in NWTT.

No beaked whales are predicted in the acoustic analysis to be exposed to sound levels associated with PTS, other injury, or mortality. After decades of the Navy conducting similar activities in the NWTT Study Area without incident, NMFS does not expect strandings, injury, or mortality of beaked whales to occur as a result of training and testing activities. Additionally, through the MMPA process (which allows for adaptive management), NMFS and the Navy will determine the appropriate way to proceed in the event that a causal relationship were to be found between Navy activities and a future stranding.

The NWTT training and testing activities are not expected to occur in an area/time of specific importance for reproductive, feeding, or other known critical behaviors for beaked whales. Although no areas of specific importance for reproduction or feeding of beaked whales have been identified in the Study Area, beaked whales are generally found in deep waters over the continental slope, oceanic seamounts, and areas with submarine escarpments (very seldom over the continental shelf). None of the Pacific stocks for beaked whales species found in the Study Area are depleted under the MMPA. Consequently, the activities are not expected to adversely impact annual rates of recruitment or survival of beaked whales.

Dolphins and Small Whales—The Navy's acoustic analysis predicts the following numbers of Level B harassment of the associated species of delphinids (dolphins and small whales, excluding killer whales) may occur each year from sonar and other active acoustic sources during training and testing activities in the Study Area: 2,362 short-beaked common dolphins (California/Oregon/Washington stock); 36 striped dolphins (California/Oregon/Washington stock); 8,354 Pacific white-sided dolphins (California/Oregon/Washington and North Pacific stocks); 3,370 Northern right whale dolphins (California/Oregon/Washington stock); and 1,811 Risso's dolphins (California/Oregon/Washington stock). Based on the distribution information presented in the LOA application, it is highly unlikely that short-finned pilot whales or common bottlenose dolphins would be encountered in the Study Area. The acoustic analysis did not predict any takes of short-finned pilot whales or bottlenose dolphins and NMFS is not authorizing any takes of these species. Relative to delphinid population sizes (stock abundance estimates are shown in Table 9), these activities are anticipated to generally result only in a limited number of level B harassment takes. When the numbers of behavioral takes are compared to the estimated stock abundance and if one assumes that each take happens to a separate animal, less than 30 percent of the California/Oregon/Washington stock of Risso's dolphin; less than 30 percent of the California/Oregon/Washington stock and less than 0.02 percent of the North Pacific stock of pacific white-sided dolphin; less than 28 percent of the California/Oregon/Washington stock of northern right whale dolphin; less than 0.6 percent of the California/Oregon/Washington stock of short-beaked common dolphin; and less than 0.4 percent of the California/Oregon/Washington stock of striped dolphin would be behaviorally harassed during the course of a year. More likely, slightly fewer individuals are harassed, but a subset are harassed more than one time during the course of the year.

All of these takes are anticipated to be in the form of behavioral harassment (TTS and behavioral reaction) and no injurious takes of delphinids from sonar and other active acoustic stressors or explosives are requested or proposed for authorization. Further, the majority of takes are anticipated to be by behavioral harassment in the form of mild responses. Behavioral responses can range from a mild orienting response, or a shifting of attention, to flight and panic (Richardson, 1995; Nowacek, 2007; Southall *et al.,* 2007). Delphinid species generally travel in large pods and should be visible from a distance in order to implement mitigation measures and reduce potential impacts. Many of the recorded delphinid vocalizations overlap with the MFAS/HFAS TTS frequency range (2–20 kHz); however, as noted above, NMFS does not anticipate TTS of a serious degree or extended duration to occur as a result of exposure to MFAS/HFAS. Recovery from a threshold shift (TTS) can take a few minutes to a few days, depending on the exposure duration, sound exposure level, and the magnitude of the initial shift, with larger threshold shifts and longer exposure durations requiring longer recovery times (Finneran *et al.,* 2005; Mooney *et al.,* 2009a; Mooney *et al.,* 2009b; Finneran and Schlundt, 2010). Large threshold shifts are not anticipated for these activities because of the unlikelihood that animals will remain within the ensonified area (due to the short duration of the majority of exercises, the speed of the vessels, and the short distance within which the animal would need to approach the sound source) at high levels for the duration necessary to induce larger threshold shifts. Threshold shifts do not necessarily affect all hearing frequencies equally, so some threshold shifts may not interfere with an animal's hearing of biologically relevant sounds.

The predicted effects to delphinids are unlikely to cause long-term consequences for individual animals or populations. The NWTT activities are not expected to occur in an area/time of specific importance for reproductive, feeding, or other known critical behaviors for delphinids. Pacific stocks of delphinid species found in the Study Area are not depleted under the MMPA. Consequently, the activities are not expected to adversely impact annual rates of recruitment or survival of delphinid species.

Killer Whales—The Navy's acoustic analysis predicts 250 instances of Level B harassment of killer whales (Alaska Resident, Northern Resident, West Coast Transient, Eastern North Pacific Offshore, and Eastern North Pacific Southern Resident stocks), including 2 Level B takes of southern resident killer whales, from sonar and other active acoustic sources during annual training activities in the Study Area. Relative to population sizes (killer whale stock abundance estimates are shown in Table 9), these activities are anticipated to generally result only in a limited number of level B harassment takes. When the numbers of behavioral takes are compared to the estimated stock abundance and if one assumes that each take happens to a separate animal, less than 15 percent of all killer whale stocks—and 2 percent of the Southern Resident stock of killer whale—would be behaviorally harassed during the course of a year. More likely, slightly fewer individuals would harassed, but a subset would be harassed more than one time during the course of the year.

All of these takes are anticipated to be in the form of behavioral harassment (TTS and behavioral reaction) and no injurious takes of killer whales from sonar and other active acoustic stressors or explosives are requested or proposed for authorization. Further, the majority of takes are anticipated to be by behavioral harassment in the form of mild responses. Behavioral responses can range from a mild orienting response, or a shifting of attention, to flight and panic (Richardson, 1995; Nowacek, 2007; Southall *et al.,* 2007). Killer whales generally travel in pods and should be visible from a distance in order to implement mitigation measures and reduce potential impacts. Recovery from a threshold shift (TTS) can take a few minutes to a few days, depending on the exposure duration, sound exposure level, and the magnitude of the initial shift, with larger threshold shifts and longer exposure durations requiring longer recovery times (Finneran *et al.,* 2005; Mooney *et al.,* 2009a; Mooney *et al.,* 2009b; Finneran and Schlundt, 2010). Large threshold shifts are not anticipated for these activities because of the unlikelihood that animals will remain within the ensonified area (due to the short duration of the majority of exercises, the speed of the vessels, and the short distance within which the animal would need to approach the sound source) at high levels for the duration necessary to induce larger threshold shifts. Threshold shifts do not necessarily affect all hearing frequencies equally, so some threshold shifts may not interfere with an animal's hearing of biologically relevant sounds.

The southern resident killer whale is the only ESA-listed marine mammal species with designated critical habitat located in the NWTT Study Area (NMFS, 2006). The majority of the Navy's proposed training and testing activities would, however, not occur in the southern resident killer whale's designated critical habitat (NMFS, 2006). For all substressors that would occur within the critical habitat, those training and testing activities are not expected to impact the identified primary constituent elements of that habitat and therefore would have no effect on that critical habitat. Furthermore, the majority of testing events would occur in Hood Canal, where southern resident killer whales are not believed to be present, while the majority of training activities would occur in the offshore portions of the Study Area where they are only present briefly during their annual migration period. Effects to designated critical habitat will be fully analyzed in the Navy's and NMFS' internal ESA Section 7 consultations for NWTT.

The whale's size and detectability makes it unlikely that these animals would be exposed to the higher energy or pressure expected to result in more severe effects. As stated above, the vocalizations of killer whales fall directly into the frequency range in which TTS would be incurred from the MFAS sources used during ASW exercises; however, the Navy is conducting ASW exercises mainly in the Offshore Area while killer whales are predominantly situated in the Inland Waters Area. Both behavioral and auditory brainstem response techniques indicate killer whales can hear a frequency range of 1 to 100 kHz and are most sensitive at 20 kHz. This is one the lowest maximum-sensitivity frequencies known among toothed whales (Szymanski *et al.,* 1999).

The NWTT training and testing activities are generally not expected to occur in an area/time of specific importance for reproductive, feeding, or other known critical behaviors for killer whales. Consequently, the activities are not expected to adversely impact annual rates of recruitment or survival of killer whale species and will therefore not result in population-level impacts.

Pinnipeds—The Navy's acoustic analysis predicts that the following numbers of Level B harassment (TTS and behavioral reaction) may occur annually from sonar and other active acoustic stressors and sound or energy from explosions associated with training and testing activities in the Study Area: 908 Steller sea lions (Eastern U.S. stock); 10 Guadalupe fur seals (San Miguel Island stock); 2,887 California sea lions (U.S. stock); 4,389 northern fur seals (Eastern Pacific and California stocks); 2,596 northern elephant seals (California Breeding stock); and 63,475 harbor seals (Southeast Alaska [Clarence Strait], Oregon/Washington Coast, Washington Northern Inland Waters, Southern Puget Sound, and Hood Canal stocks). These estimates represents the total number of exposures and not necessarily the number of individuals exposed, as a single individual may be exposed multiple times over the course of a year. Northern elephant seals are the only pinnipeds predicted to incur takes (one Level B take) from exposure to explosives. The acoustic analysis (factoring in the post-model correction for avoidance and mitigation) also indicates that 2 Northern elephant seals and 92 harbor seals would be exposed to sound levels likely to result in Level A harassment (PTS) from sonar or other active acoustic sources.

Research has demonstrated that for pinnipeds, as for other mammals, recovery from a hearing threshold shift (*i.e.,* TTS; temporary partial hearing loss) can take a few minutes to a few days depending on the severity of the initial shift. More severe shifts may not fully recover and thus would be considered PTS. However, large degrees of PTS are not anticipated for these activities because of the unlikelihood that animals will remain within the ensonified area (due to the short duration of the majority of exercises, the speed of the vessels, and the short distance within which the animal would need to approach the sound source) at high levels for the duration necessary to induce larger threshold shifts. Threshold shifts do not necessarily affect all hearing frequencies equally, so threshold shifts may not necessarily interfere with an animal's ability to hear biologically relevant sounds. The likely consequences to the health of an individual that incurs PTS can range from mild to more serious, depending upon the degree of PTS and the frequency band it is in, and many animals are able to compensate for the shift, although it may include energetic costs. Likely avoidance of intense activity and sound coupled with mitigation measures would further reduce the potential for severe PTS exposures to occur. If a marine mammal is able to approach a surface vessel within the distance necessary to incur PTS, the likely speed of the vessel (nominal 10–15 knots) 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.

Research and observations show that pinnipeds in the water may be tolerant of anthropogenic noise and activity (a review of behavioral reactions by pinnipeds to impulsive and non-impulsive noise can be found in Richardson *et al.,* 1995 and Southall *et al.,* 2007). Available data, though limited, suggest that exposures between approximately 90 and 140 dB SPL do not appear to induce strong behavioral responses in pinnipeds exposed to nonpulse sounds in water (Jacobs and Terhune, 2002; Costa *et al.,* 2003; Kastelein *et al.,* 2006c). Based on the limited data on pinnipeds in the water exposed to multiple pulses (small explosives, impact pile driving, and seismic sources), exposures in the approximately 150 to 180 dB SPL range generally have limited potential to induce avoidance behavior in pinnipeds (Harris *et al.,* 2001; Blackwell *et al.,* 2004; Miller *et al.,* 2004). If pinnipeds are exposed to sonar or other active acoustic sources they may react in a number of ways depending on their experience with the sound source and what activity they are engaged in at the time of the acoustic exposure. Pinnipeds may not react at all until the sound source is approaching within a few hundred meters and then may alert, ignore the stimulus, change their behaviors, or avoid the immediate area by swimming away or diving. Effects on pinnipeds in the Study Area that are taken by Level B harassment, on the basis of reports in the literature as well as Navy monitoring from past activities, will likely be limited to reactions such as increased swimming speeds, increased surfacing time, or decreased foraging (if such activity were occurring). Most likely, individuals will simply move away from the sound source and be temporarily displaced from those areas, or not respond at all. In areas of repeated and frequent acoustic disturbance, some animals may habituate or learn to tolerate the new baseline or fluctuations in noise level. Habituation can occur when an animal's response to a stimulus wanes with repeated exposure, usually in the absence of unpleasant associated events (Wartzok *et al.,* 2003). While some animals may not return to an area, or may begin using an area differently due to training and testing activities, most animals are expected to return to their usual locations and behavior. Given their documented tolerance of anthropogenic sound (Richardson *et al.,* 1995 and Southall *et al.,* 2007), repeated exposures of individuals (*e.g.,* harbor seals) to levels of sound that may cause Level B harassment are unlikely to result in hearing impairment or to significantly disrupt foraging behavior. As stated above, pinnipeds may habituate to or become tolerant of repeated exposures over time, learning to ignore a stimulus that in the past has not accompanied any overt threat.

Thus, even repeated Level B harassment of some small subset of the overall stock is unlikely to result in any significant realized decrease in fitness to those individuals, and would not result in any adverse impact to the stock as a whole. Evidence from areas where the Navy extensively trains and tests provides some indication of the possible consequences resulting from those proposed activities. In the confined waters of Washington State's Hood Canal where the Navy has been training and intensively testing for decades and harbor seals are present year-round, the population level has remained stable suggesting the area's carrying capacity may have been reached (Jeffries *et al.,* 2003). Within Puget Sound there are several locations where pinnipeds use Navy structures (*e.g.,* submarines, security barriers) for haulouts. Given that animals continue to choose these areas for their resting behavior, it would appear there are no long-term effects or consequences to those animals as a result of ongoing and routine Navy activities.

Generally speaking, pinniped stocks in the Study Area are thought to be stable or increasing. Abundance estimates for pinniped stocks in the Study Area are shown in Table 9. Relative to population size, training and testing activities are anticipated to result only in a limited number of takes for the majority of pinniped species. When the numbers of takes are compared to the estimated stock abundances and if one assumes that each take happens to a separate animal, less than 2 percent of each Steller sea lion, California sea lion, northern fur seal, and northern elephant seal stock would be harassed (behaviorally) during the course of a year. More likely, fewer individuals are harassed, but a subset are harassed more than one time during the course of the year. Takes of depleted (as defined under the MMPA) stocks of northern fur seals (Eastern Pacific) and Guadalupe fur seals (Mexoco) represent only 0.7 percent and 0.07 percent of their respective stock.

NMFS has determined that the Level A and Level B harassment exposures to the Hood Canal stock of harbor seals are not biologically significant to the population because (1) the vast majority of the exposures are within the non-injurious TTS or behavioral effects zones and none of the estimated exposures result in mortality; (2) the majority of predicted harbor seal exposures result from testing activities which are generally of an intermittent or short duration and should prevent animals from being exposed to stressors on a continuous basis; (3) there are no indications that the historically occurring activities resulting in these behavioral harassment exposures are having any effect on this population's survival by altering behavior patterns such as breeding, nursing, feeding, or sheltering; (4) the population has been stable and likely at carrying capacity (Jeffries *et al.,* 2003; Gaydos *et al.,* 2013); (5) the population continues to use known large haulouts in Hood Canal and Dabob Bay that are adjacent to Navy testing and training activities (London *et al.,* 2012); (6) the population continues to use known haulouts for pupping; and (7) the population continues to use the waters in and around Dabob Bay and Hood Canal.

The Guadalupe fur seal is the only ESA-listed pinniped species found within the NWTT Study Area. Guadalupe fur seals are considered ''seasonally migrant'' and are present within the offshore portion of the Study Area during the warm season (summer and early autumn) and during that portion of the year may be exposed to sonar and other active acoustic sources associated with training and testing activities. Predicted Level B takes of Guadalupe fur seals in the Study Area represent a negligible percentage of the San Miguel Island stock. Furthermore, critical habitat has not been designated for Guadalupe fur seals.

We believe that factors described above, as well as the available body of evidence from past Navy activities in the Study Area, demonstrate that the potential effects of the specified activity will have only short-term effects on individuals. The NWTT training and testing activities are not expected to occur in an area/time of specific importance for reproductive, feeding, or other known critical behaviors for pinnipeds. Consequently, the activities are not expected to adversely impact annual rates of recruitment or survival of pinniped species and will therefore not result in population-level impacts.

Long-Term Consequences

The best assessment of long-term consequences from training and testing activities will be to monitor the populations over time within a given Navy range complex. A U.S. workshop on Marine Mammals and Sound (Fitch *et al.,* 2011) indicated a critical need for baseline biological data on marine mammal abundance, distribution, habitat, and behavior over sufficient time and space to evaluate impacts from human-generated activities on long-term population survival. The Navy has developed monitoring plans for protected marine mammals occurring on Navy ranges with the goal of assessing the impacts of training and testing activities on marine species and the effectiveness of the Navy's current mitigation practices. Continued monitoring efforts over time will be necessary to completely evaluate the long-term consequences of exposure to noise sources.

Since 2006 across all Navy Range Complexes (in the Atlantic, Gulf of Mexico, and the Pacific), there have been more than 80 reports; Major Exercise Reports, Annual Exercise Reports, and Monitoring Reports. For the Pacific since 2011, there have been 29 monitoring and exercise reports (as shown in Table 6–1 of the LOA application) submitted to NMFS to further research goals aimed at understanding the Navy's impact on the environment as it carries out its mission to train and test.

In addition to this multi-year record of reports from across the Navy, there have also been ongoing Behavioral Response Study research efforts (in

Southern California and the Bahamas) specifically focused on determining the potential effects from Navy mid-frequency sonar (Southall *et al.,* 2011, 2012; Tyack *et al.,* 2011; DeRuiter *et al.,* 2013b; Goldbogen *et al.,* 2013; Moretti *et al.,* 2014). This multi-year compendium of monitoring, observation, study, and broad scientific research is informative with regard to assessing the effects of Navy training and testing in general. Given that this record involves many of the same Navy training and testing activities being considered for the Study Area, and because it includes all the marine mammal taxonomic families and many of the same species, this compendium of Navy reporting is directly applicable to the Study Area. Other research findings related to the general topic of long-term impacts are discussed above in the Species/Group Specific Analysis.

Based on the findings from surveys in Puget Sound and research efforts and monitoring before, during, and after training and testing events across the Navy since 2006, NMFS' assessment is that it is unlikely there would be impacts to populations of marine mammals having any long-term consequences as a result of the proposed continuation of training and testing in the ocean areas historically used by the Navy, including the Study Area. This assessment of likelihood is based on four indicators from areas in the Pacific where Navy training and testing has been ongoing for decades: (1) Evidence suggesting or documenting increases in the numbers of marine mammals present (Calambokidis and Barlow, 2004; Calambokidis *et al.,* 2009a; Falcone *et al.,* 2009; Hildebrand and McDonald, 2009; Berman-Kowalewski *et al.,* 2010; Moore and Barlow, 2011; Barlow *et al.* 2011; Falcone and Shorr, 2012; Kerosky *et al.,* 2012; Smultea *et al.,* 2013), (2) examples of documented presence and site fidelity of species and long-term residence by individual animals of some species (Hooker *et al.,* 2002; McSweeney *et al.,* 2007; McSweeney *et al.,* 2009; McSweeney *et al.,* 2010; Martin and Kok, 2011; Baumann-Pickering *et al.,* 2012; Falcone and Schorr, 2014), (3) use of training and testing areas for breeding and nursing activities (Littnan, 2010), and (4) 6 years of comprehensive monitoring data indicating a lack of any observable effects to marine mammal populations as a result of Navy training and testing activities.

To summarize, while the evidence covers most marine mammal taxonomic suborders, it is limited to a few species and only suggestive of the general viability of those species in intensively used Navy training and testing areas. There is no direct evidence that routine Navy training and testing spanning decades has negatively impacted marine mammal populations at any Navy Range Complex. Although there have been a few strandings associated with use of sonar in other locations (see U.S. Department of the Navy, 2013b), Ketten (2012) has recently summarized, ''to date, there has been no demonstrable evidence of acute, traumatic, disruptive, or profound auditory damage in any marine mammal as the result of anthropogenic noise exposures, including sonar.'' Therefore, based on the best available science (Barlow *et al.,* 2011; Falcone *et al.,* 2009; Falcone and Schorr, 2012, 2014; Littnan, 2011; Martin and Kok, 2011; McCarthy *et al.,* 2011; McSweeney *et al.,* 2007; McSweeney *et al.,* 2009; Moore and Barlow, 2011; Tyack *et al.,* 2011; Southall *et al.,* 2012; Manzano-Roth *et al.,* 2013; DeRuiter *et al.,* 2013b; Goldbogen *et al.,* 2013; Moretti *et al.,* 2014; Smultea and Jefferson, 2014), including data developed in the series of reports submitted to NMFS, we believe that long-term consequences for individuals or populations are unlikely to result from Navy training and testing activities in the Study Area.

Preliminary Determination

Training and testing activities proposed in the NWTT Study Area would result in Level B and Level A takes, as summarized in Tables 17–21. Based on best available science, as summarized in this proposed rule and in the January 2014 DEIS/OEIS (Section 3.4.4.1), NMFS concludes that exposures to marine mammal species and stocks due to NWTT activities would result in only short-term (temporary and short in duration) and relatively infrequent effects to most individuals exposed, and not of the type or severity that would be expected to be additive for the generally small portion of the stocks and species likely to be exposed. Marine mammal takes from Navy activities are not expected to impact annual rates of recruitment or survival and will therefore not result in population-level impacts for the following reasons:

- Most acoustic exposures (greater than 99 percent) are within the non-injurious TTS or behavioral effects zones (Level B harassment consisting of generally temporary modifications in behavior) and none of the estimated exposures result in mortality.
- Although the numbers presented in Tables 17–21 represent estimated harassment under the MMPA, as described above, they are conservative estimates of harassment, primarily by behavioral disturbance, and made without taking into consideration *all* possible reductions as a result of standard operating procedures and mitigation measures (only a subset of mitigations are factored into the post-modeling analysis).
- Additionally, the protective measures described in the Proposed Mitigation section above are designed to reduce sound exposure and explosive effects on marine mammals to levels below those that may cause physiological effects (injury) and to achieve the least practicable adverse effect on marine mammal species or stocks.
- Range complexes where intensive training and testing have been occurring for decades have populations of multiple species with strong site fidelity (including highly sensitive resident beaked whales at some locations) and increases in the number of some species.
- Years of monitoring of Navy-wide activities (since 2006) have documented hundreds of thousands of marine mammals on the range complexes and there are only two instances of overt behavioral change that have been observed.
- Years of monitoring of Navy-wide activities on the range complexes have documented no demonstrable instances of injury to marine mammals as a direct result of non-impulsive acoustic sources.
- In at least three decades of the same type of activities, only one instance of injury to marine mammals (March 4, 2011; three long-beaked common dolphin off Southern California) has occurred as a known result of training or testing using an impulsive source (underwater explosion). Of note, the time-delay firing underwater explosive training activity implicated in the March 4 incident is not proposed for the training activities in the NWTT Study Area.

Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat and dependent upon the implementation of the mitigation and monitoring measures, NMFS preliminarily finds that the total taking from Navy training and testing exercises in the NWTT Study Area will have a negligible impact on the affected species or stocks. NMFS has proposed regulations for these exercises that prescribe the means of effecting the least practicable adverse impact on marine mammals and their habitat and set forth requirements pertaining to the monitoring and reporting of that taking.

Subsistence Harvest of Marine Mammals

There are no relevant subsistence uses of marine mammals implicated by this action. Therefore, NMFS has determined that the total taking of affected species or stocks would not have an unmitigable adverse impact on the availability of such species or stocks for taking for subsistence purposes.

ESA

There are nine marine mammal species under NMFS jurisdiction that are listed as endangered or threatened under the ESA with confirmed or possible occurrence in the NWTT Study Area: North Pacific right whale, blue whale, humpback whale, fin whale, sei whale, gray whale (Western North Pacific stock), sperm whale, killer whale (Eastern North Pacific Southern Resident stock), and Guadalupe fur seal. The Navy will consult with NMFS pursuant to section 7 of the ESA, and NMFS will also consult internally on the issuance of LOAs under section 101(a)(5)(A) of the MMPA for NWTT activities. Consultation will be concluded prior to a determination on the issuance of the final rule and an LOA.

NEPA

NMFS is a cooperating agency on the Navy's NWTT DEIS/OEIS, which was prepared and released to the public in January 2014. Upon completion, the Final EIS/OEIS (FEIS/OEIS) will be made available for public review and posted on NMFS' Web site: *http://www.nmfs.noaa.gov/pr/permits/incidental/military.htm.* NMFS intends to adopt the Navy's NWTT FEIS/OEIS, if adequate and appropriate. Currently, we believe that the adoption of the Navy's NWTT FEIS/OEIS will allow NMFS to meet its responsibilities under NEPA for the issuance of regulations and LOAs for NWTT. If necessary, however, NMFS will supplement the existing analysis to ensure that we comply with NEPA prior to the issuance of the final rule or LOA.

NMSA

Some Navy NWTT activities will occur within the Olympic Coast National Marine Sanctuary (OCNMS). Federal agency actions that are likely to injure sanctuary resources are subject to consultation with the NOAA Office of National Marine Sanctuaries (ONMS) under section 304(d) of the National Marine Sanctuaries Act (NMSA). The Navy analyzed potential impacts to sanctuary resources and has provided the analysis in the January 2014 NWTT DEIS/OEIS. Where the Navy either proposes new military activities or proposes to modify existing military activities that are otherwise exempted by individual sanctuary regulations at 15 CFR part 922 in a way that the modified activities would adversely impact sanctuary resources and qualities, the Navy will initiate consultation with ONMS.

NMFS is currently consulting with ONMS on the issuance of regulations and LOAs for NWTT activities. Consultation will be concluded prior to a determination on the issuance of the final rule and an LOA.

Classification

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

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

List of Subjects in 50 CFR Part 218

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

Dated: May 26, 2015.

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 follow:

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

■ 2. In § 218.75, revise introductory paragraph (f)(1)(ii)(F) as follows:

§ 218.75 Requirements for monitoring and reporting.

* * * * *

(f) * * *

(1) * * *

(ii) * * *

(F) Individual marine mammal sighting information for each sighting when mitigation occurred during each MTE.

* * * * *

■ 3. In § 218.85, revise introductory paragraph (f)(1)(ii)(F) as follows:

§ 218.85 Requirements for monitoring and reporting.

* * * * *

(f) * * *

(1) * * *

(ii) * * *

(F) Individual marine mammal sighting information for each sighting when mitigation occurred during each MTE.

* * * * *

■ 4. In § 218.125, revise introductory paragraph (f)(1)(ii) as follows:

§ 218.125 Requirements for monitoring and reporting.

* * * * *

(f) * * *

(1) * * *

(ii) Individual marine mammal sighting information for each sighting in each exercise when mitigation occurred.

* * * * *

Subpart M—[Removed and Reserved]

■ 5. Remove and reserve subpart M, consisting of §§ 218.110 through 218.119.

Subpart R—[Removed and Reserved]

■ 6. Remove and reserve subpart R, consisting of §§ 218.170 through 218.178.

■ 7. Subpart O is added to part 218 to read as follows:

Subpart O—Taking and Importing Marine Mammals; U.S. Navy's Northwest Training and Testing (NWTT) Study Area

Subpart O—Taking and Importing Marine Mammals; U.S. Navy's Northwest Training and Testing (NWTT) Study Area

§ 218.140 Specified activity and specified geographical region.

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

(b) The taking of marine mammals by the Navy is only authorized if it occurs within the NWTT Study Area, which is composed of established maritime operating and warning areas in the eastern North Pacific Ocean region, including areas of the Strait of Juan de Fuca, Puget Sound, and Western Behm Canal in southeastern Alaska. The Study Area includes air and water space within and outside Washington state waters, and outside state waters of Oregon and Northern California. The Study Area includes four existing range complexes and facilities: The Northwest Training Range Complex (NWTRC), the Keyport Range Complex, Carr Inlet Operations Area, and SEAFAC. In addition to these range complexes, the Study Area also includes Navy pierside locations where sonar maintenance and testing occurs as part of overhaul, modernization, maintenance and repair activities at NAVBASE Kitsap, Bremerton; NAVBASE Kitsap, Bangor; and Naval Station Everett.

(c) The taking of marine mammals by the Navy is only authorized if it occurs incidental to the following activities within the designated amounts of use:

(1) Sonar and other Active Sources Used During Training:

(i) Mid-frequency (MF) Source Classes:

(A) MF1—an average of 166 hours per year.

(B) MF3—an average of 70 hours per year.

(C) MF4—an average of 4 hours per year.

(D) MF5—an average of 896 items per year.

(E) MF11—an average of 16 hours per year.

(ii) High-frequency (HF) Source Classes:

(A) HF1—an average of 48 hours per year.

(B) HF4—an average of 384 hours per year.

(C) HF6—an average of 192 items per year.

(iii) Anti-Submarine Warfare (ASW) Source Classes:

(A) ASW2—an average of 720 items per year per year.

(B) ASW3—an average of 78 hours per year.

(2) Sonar and other Active Sources Used During Testing:

(i) Low-frequency (LF) Source Classes:

(A) LF4—an average of 110 hours per year.

(B) LF5—an average of 71 hours per year.

(ii) Mid-frequency (MF):

(A) MF3—an average of 161 hours per year.

(B) MF4—an average of 10 hours per year.

(C) MF5—an average of 273 items per year.

(D) MF6—an average of 12 items per year.

(E) MF8—an average of 40 hours per year.

(F) MF9—an average of 1,183 hours per year.

(G) MF10—an average of 1,156 hours per year.

(H) MF11—an average of 34 hours per year.

(I) MF12—an average of 24 hours per year.

(iii) High-frequency (HF) and Very High-frequency (VHF):

(A) HF1—an average of 161 hours per year.

(B) HF3—an average of 145 hours per year.

(C) HF5—an average of 360 hours per year.

(D) HF6—an average of 2,099 hours per year.

(iv) VHF:

(A) VHF2—an average of 35 hours per year.

(v) ASW:

(A) ASW1—an average of 16 hours per year.

(B) ASW2—an average of 64 hours per year.

(C) ASW2—an average of 170 items per year.

(D) ASW3—an average of 444 hours per year.

(E) ASW4—an average of 1,182 items per year.

(vi) Acoustic Modems (M):

(A) M3—an average of 1,519 hours per year.

(vii) Torpedoes (TORP):

(A) TORP1—an average of 315 items per year.

(B) TORP2—an average of 299 items per year.

(viii) Swimmer Detection Sonar (SD):

(A) SD1—an average of 757 hours per year.

(ix) Synthetic Aperture Sonar (SAS):

(A) SAS2—an average of 798 hours per year.

(3) Impulsive Source Detonations During Training:

(i) Explosive Classes:

(A) E1 (0.1 to 0.25 pound [lb] NEW)—an average of 48 detonations per year.

(B) E3 (>0.5 to 2.5 lb NEW)—an average of 6 detonations per year.

(C) E5 (>5 to 10 lb NEW)—an average of 80 detonations per year.

(D) E10 (>250 to 500 lb NEW)—an average of 4 detonations per year.

(E) E12 (>650 to 1,000 lb NEW)—an average of 10 detonations per year.

(ii) [Reserved].

(4) Impulsive Source Detonations During Testing:

(i) Explosive Classes:

(A) E3 (>0.5 to 2.5 lb NEW)—an average of 72 detonations per year.

(B) E4 (>2.5 to 5 lb NEW)—an average of 70 detonations per year.

(C) E8 (>60 to 100 lb NEW)—an average of 3 detonations per year.

(D) E11 (>500 to 650 lb NEW)—an average of 3 detonations per year.

(ii) [Reserved]

§ 218.141 Effective dates.

Regulations in this subpart are effective June 2, 2015 through June 2, 2020.

§ 218.142 Permissible methods of taking.

(a) Under Letters of Authorization (LOAs) issued pursuant to § 218.147, the Holder of LOA may incidentally, but not intentionally, take marine mammals within the area described in § 218.140, provided the activity is in compliance with all terms, conditions, and requirements of these regulations and the appropriate LOA.

(b) The activities identified in § 218.140(c) must be conducted in a manner that minimizes, to the greatest extent practicable, any adverse impacts on marine mammals and their habitat.

(c) The incidental take of marine mammals under the activities identified in § 218.140(c) is limited to the following species, by the identified method of take and the indicated number of times:

(1) Level B Harassment for all Training Activities:

(i) Mysticetes:
(A) Blue whale (Balaenoptera musculus)—25 (an average of 5 per year).
(B) Fin whale (Balaenoptera physalus)—125 (an average of 25 per year).
(C) Gray whale (Eschrichtius robustus)—30 (an average of 6 per year).
(D) Humpback whale (Megaptera novaeangliae)—60 (an average of 12 per year).
(E) Minke whale (Balaenoptera acutorostrata)—90 (an average of 18 per year).
(ii) Odontocetes:
(A) Baird's beaked whale (Berardius bairdii)—2,955 (an average of 591 per year).
(B) Mesoplodont beaked whale Mesoplodon spp.)—7,085 (an average of 1,417 per year).
(C) Cuvier's beaked whale Ziphius cavirostris—1,765 (an average of 353 per year).
(D) Dall's porpoise Phocoenoidea dalli—18,188 (an average of 3,732 per year).
(E) Harbor porpoise Phocoena phocoena—441,984 (an average of 88,932 per year).
(F) Killer whale Orcinus orca—110 (an average of 24 per year).
(G) Kogia spp.—365 (an average of 73 per year).
(H) Northern right whale dolphin Lissodelphis borealis—6,660 (an average of 1,332 per year).
(I) Pacific white-sided dolphin Lagenorhynchus obliquidens—17,408 (an average of 3,482 per year).
(J) Risso's dolphin Grampus griseus—3,285 (an average of 657 per year).
(K) Short-beaked common dolphin Delphinus delphis—3,670 (an average of 734 per year).
(L) Sperm whale Physeter macrocephalus—405 (an average of 81 per year).
(M) Striped dolphin Stenella coerulealba—110 (an average of 22 per year).
(iii) Pinnipeds:
(A) California sea lion Zalophus californianus—4,038 (an average of 814 per year).
(B) Steller sea lion Eumetopias jubatus—1,986 (an average of 404 per year).
(C) Guadalupe fur seal Arctocephalus townsendi—35 (an average of 7 per year).
(D) Harbor seal Phoca vitulina—4,161 (an average of 832 per year).
(E) Northern elephant seal Mirounga angustirostris—6,353 (an average of 1,271 per year).
(F) Northern fur seal Callorhinus ursinus—12,660 (an average of 2,532 per year).
(2) Level A Harassment for all Training Activities:
(i) Mysticetes:
(A) [Reserved]
(B) [Reserved]
(ii) Odontocetes:
(A) Dall's porpoise (Phocoenoidea dalli)—20 (an average of 4 per year).
(B) Harbor porpoise (Phocoena phocoena)—5 (an average of 1 per year).
(iii) Pinnipeds:
(A) Harbor seal (Phoca vitulina)—30 (an average of 6 per year).
(B) [Reserved]
(3) Level B Harassment for all Testing Activities:
(i) Mysticetes:
(A) Blue whale (Balaenoptera musculus)—30 (an average of 6 per year).
(B) Fin whale (Balaenoptera physalus)—180 (an average of 36 per year).
(C) Gray whale (Eschrichtius robustus)—55 (an average of 11 per year).
(D) Humpback whale (Megaptera novaeangliae)—225 (an average of 45 per year).
(E) Minke whale (Balaenoptera acutorostrata)—90 (an average of 18 per year).
(F) Sei whale (Balaenoptera borealis)—10 (an average of 2 per year).
(ii) Odontocetes:
(A) Baird's beaked whale (Berardius bairdii)—870 (an average of 174 per year).
(B) Mesoplodont beaked whale (Mesoplodon spp.)—1,845 (an average of 369 per year).
(C) Cuvier's beaked whale (Ziphius cavirostris)—530 (an average of 106 per year).
(D) Dall's porpoise (Phocoenoidea dalli)—56,695 (an average of 11,339 per year).
(E) Harbor porpoise (Phocoena phocoena)—246,465 (an average of 49,293 per year).
(F) Killer whale (Orcinus orca)—1, 130 (an average of 226 per year).
(G) Kogia spp.—530 (an average of 106 per year).
(H) Northern right whale dolphin (Lissodelphis borealis)—10 (an average of 2,038 per year).
(I) Pacific white-sided dolphin (Lagenorhynchus obliquidens)—24,360 (an average of 4,872 per year).
(J) Risso's dolphin (Grampus griseus)—5,770 (an average of 1,154 per year).
(K) Short-beaked common dolphin (Delphinus delphis)—8,140 (an average of 1,628 per year).
(L) Sperm whale (Physeter macrocephalus)—390 (an average of 78 per year).
(M) Striped dolphin (Stenella coerulealba)—70 (an average of 14 per year).
(iii) Pinnipeds:
(A) California sea lion (Zalophus californianus)—10,365 (an average of 2,073 per year).
(B) Steller sea lion (Eumetopias jubatus)—2,520 (an average of 504 per year).
(C) Guadalupe fur seal (Arctocephalus townsendi)—15 (an average of 3 per year).
(D) Harbor seal (Phoca vitulina)—312,690 (an average of 62,538 per year).
(E) Northern elephant seal (Mirounga angustirostris)—6,625 (an average of 1,325 per year).
(F) Northern fur seal (Callorhinus ursinus)—9,285 (an average of 1,857 per year).
(4) Level A Harassment for all Testing Activities:
(i) Mysticetes:
(A) [Reserved]
(B) [Reserved]
(ii) Odontocetes:
(A) Kogia spp.—5 (an average of 1 per year).
(B) Dall' porpoise (Phocoenoidea dalli)—215 (an average of 43 per year).
(C) Harbor porpoise (Phocoena phocoena)—220 (an average of 44 per year).
(iii) Pinnipeds:
(A) Harbor seal (Phoca vitulina)—430 (an average of 86 per year).(B) Northern elephant seal (Mirounga angustirostris)—10 (an average of 2 per year).
(C) [Reserved]

§ 218.143 Prohibitions.

Notwithstanding takings contemplated in § 218.142 and authorized by an LOA issued under §§ 216.106 and 218.147 of this chapter, no person in connection with the activities described in § 218.140 may:
(a) Take any marine mammal not specified in § 218.142(c);
(b) Take any marine mammal specified in § 218.142(c) other than by incidental take as specified in § 218.142(c);
(c) Take a marine mammal specified in § 218.142(c) if such taking results in more than a negligible impact on the species or stocks of such marine mammal; or
(d) Violate, or fail to comply with, the terms, conditions, and requirements of these regulations or an LOA issued under §§ 216.106 and 218.147.

§ 218.144 Mitigation.

(a) When conducting training and testing activities, as identified in § 218.140, the mitigation measures contained in the LOA issued under §§ 216.106 and 218.147 of this chapter must be implemented. These mitigation measures include, but are not limited to:

(1) *Lookouts*—The following are protective measures concerning the use of Lookouts.

(i) Lookouts positioned on surface ships will be dedicated solely to diligent observation of the air and surface of the water. Their observation objectives will include, but are not limited to, detecting the presence of biological resources and recreational or fishing boats, observing mitigation zones, and monitoring for vessel and personnel safety concerns.

(ii) Lookouts positioned ashore, in aircraft or on boats will, to the maximum extent practicable and consistent with aircraft and boat safety and training and testing requirements, comply with the observation objectives described in paragraph (a)(1)(i) of this section.

(iii) Lookout measures for non-impulsive sound:

(A) With the exception of vessels less than 65 ft (20 m) in length and the Littoral Combat Ship (and similar vessels which are minimally manned), ships using low-frequency or hull-mounted mid-frequency active sonar sources associated with anti-submarine warfare and mine warfare activities at sea will have two Lookouts at the forward position of the vessel. For the purposes of this rule, low-frequency active sonar does not include surface towed array surveillance system low-frequency active sonar.

(B) While using low-frequency or hull-mounted mid-frequency active sonar sources associated with anti-submarine warfare and mine warfare activities at sea, vessels less than 65 ft (20 m) in length and the Littoral Combat Ship (and similar vessels which are minimally manned) will have one Lookout at the forward position of the vessel due to space and manning restrictions.

(C) Ships conducting active sonar activities while moored or at anchor (including pierside or shore-based testing or maintenance) will maintain one Lookout.

(D) Small boats, range craft, minimally manned vessels, or aircraft conducting hull-mounted mid-frequency testing will employ one Lookout.

(E) Ships or aircraft conducting non-hull-mounted mid-frequency active sonar, such as helicopter dipping sonar systems, will maintain one Lookout.

(F) Surface ships or aircraft conducting high-frequency or non-hull-mounted mid-frequency active sonar activities associated with anti-submarine warfare and mine warfare activities at sea will have one Lookout.

(iv) Lookout measures for explosives and impulsive sound:

(A) Aircraft conducting improved extended echo ranging sonobuoy activities will have one Lookout.

(B) Aircraft conducting explosive sonobuoy activities using >0.5 to 2.5-lb net explosive weight (NEW) will have one Lookout.

(C) General mine countermeasure and neutralization activities involving positive control diver placed charges using >0.5 to 2.5 lb NEW will have a total of two Lookouts (one Lookout positioned in each of the two support vessels). All divers placing the charges on mines will support the Lookouts while performing their regular duties. The divers and Lookouts will report all marine mammal sightings to their dive support vessel.

(D) Surface vessels or aircraft conducting small- and medium-caliber gunnery exercises will have one Lookout. Towing vessels, if applicable, will also maintain one Lookout.

(E) Aircraft conducting missile exercises against a surface target will have one Lookout.

(F) Aircraft conducting explosive bombing exercises will have one Lookout and any surface vessels involved will have trained Lookouts.

(G) During explosive torpedo testing from aircraft one Lookout will be used and positioned in an aircraft. During explosive torpedo testing from a surface ship the Lookout procedures implemented for hull-mounted mid-frequency active sonar activities will be used.

(H) Ships conducting explosive and non-explosive large-caliber gunnery exercises will have one Lookout. This may be the same Lookout used for small, medium, and large-caliber gunnery exercises using a surface target when that activity is conducted from a ship against a surface target.

(v) Lookout measures for physical strike and disturbance:

(A) While underway, surface ships will have at least one Lookout.

(B) During activities using towed in-water devices towed from a manned platform, one Lookout will be used. During activities in which in-water devices are towed by unmanned platforms, a manned escort vessel will be included and one Lookout will be employed.

(C) Activities involving non-explosive practice munitions (*e.g.,* small-, medium-, and large-caliber gunnery exercises) using a surface target will have one Lookout.

(D) During non-explosive bombing exercises one Lookout will be positioned in an aircraft and trained Lookouts will be positioned in any surface vessels involved.

(2) *Mitigation zones*—The following are protective measures concerning the implementation of mitigation zones.

(i) Mitigation zones will be measured as the radius from a source and represent a distance to be monitored.

(ii) Visual detections of marine mammals (or sea turtles) within a mitigation zone will be communicated immediately to a watch station for information dissemination and appropriate action.

(iii) Mitigation zones for non-impulsive sound:

(A) The Navy shall ensure that hull-mounted mid-frequency active sonar transmission levels are limited to at least 6 dB below normal operating levels if any detected marine mammals (or sea turtles) are within 1,000 yd. (914 m) of the sonar dome (the bow).

(B) The Navy shall ensure that hull-mounted mid-frequency active sonar transmissions are limited to at least 10 dB below the equipment's normal operating level if any detected marine mammals (or sea turtles) are within 500 yd. (457 m) of the sonar dome.

(C) The Navy shall ensure that hull-mounted mid-frequency active sonar transmissions are ceased if any detected cetaceans (or sea turtles) are within 200 yd. (180 m) and pinnipeds are within 100 yd. (90 m) of the sonar dome. Transmissions will not resume until the marine mammal has been observed exiting the mitigation zone, is thought to have exited the mitigation zone based on its course and speed, has not been detected for 30 minutes, the vessel has transited more than 2,000 yd. beyond the location of the last detection, or the Lookout concludes that dolphins are deliberately closing in on the ship to ride the ship's bow wave (and there are no other marine mammal sightings within the mitigation zone). Active transmission may resume when dolphins are bow riding because they are out of the main transmission axis of the active sonar while in the shallow-wave area of the ship bow. The pinniped mitigation zone does not apply for pierside or shore-based testing in the vicinity of pinnipeds hauled out on man-made structures and vessels.

(D) The Navy shall ensure that low-frequency active sonar transmission levels are ceased if any detected cetaceans (or sea turtles) are within 200 yd. (180 m) and pinnipeds are within 100 yd. (90 m) of the source. Transmissions will not resume until the marine mammal has been observed exiting the mitigation zone, is thought to have exited the mitigation zone based on its course and speed, has not been detected for 30 minutes, or the vessel has transited more than 2,000 yd. beyond the location of the last detection. The pinniped mitigation zone does not apply for pierside testing in the vicinity of pinnipeds hauled out on man-made structures and vessels.

(E) The Navy shall ensure that high-frequency and non-hull-mounted mid-frequency active sonar transmission levels are ceased if any detected cetaceans are within 200 yd. (180 m) and pinnipeds are within 100 yd. (90 m) of the source. Transmissions will not resume until the marine mammal has been observed exiting the mitigation zone, is thought to have exited the mitigation zone based on its course and speed, the mitigation zone has been clear from any additional sightings for a period of 10 minutes for an aircraft-deployed source, the mitigation zone has been clear from any additional sightings for a period of 30 minutes for a vessel-deployed source, the vessel or aircraft has repositioned itself more than 400 yd. (370 m) away from the location of the last sighting, or the vessel concludes that dolphins are deliberately closing in to ride the vessel's bow wave (and there are no other marine mammal sightings within the mitigation zone). The pinniped mitigation zone does not apply for pierside or shore-based testing in the vicinity of pinnipeds hauled out on man-made structures and vessels.

(iv) Mitigation zones for explosive and impulsive sound:

(A) For activities using IEERs, explosive detonations will cease if a marine mammal, sea turtle, or concentrations of floating vegetation are sighted within a 600-yd. (550 m) mitigation zone. Detonations will recommence if the animal is observed exiting the mitigation zone, the animal is thought to have exited the mitigation zone based on its course and speed, or the mitigation zone has been clear from any additional sightings for a period of 30 minutes.

(B) A mitigation zone with a radius of 350 yd. (320 m) shall be established for explosive signal underwater sonobuoys using >0.5 to 2.5 lb net explosive weight. Detonations will recommence if the animal is observed exiting the mitigation zone, the animal is thought to have exited the mitigation zone based on its course and speed, or the mitigation zone has been clear from any additional sightings for a period of 10 minutes.

(C) A mitigation zone with a radius of 400 yd. (366 m) shall be established for mine countermeasures and neutralization activities using positive control firing devices. Explosive detonations will cease if a marine mammal is sighted in the water portion of the mitigation zone (*i.e.,* not on shore). Detonations will recommence if the animal is observed exiting the mitigation zone, the animal is thought to have exited the mitigation zone based on its course and speed, or the mitigation zone has been clear from any additional sightings for a period of 30 minutes.

(D) A mitigation zone with a radius of 200 yd. (180 m) shall be established for small- and medium-caliber gunnery exercises with a surface target. Firing will cease if a marine mammal is sighted within the mitigation zone. Firing will recommence if the animal is observed exiting the mitigation zone, the animal is thought to have exited the mitigation zone based on its course and speed, the mitigation zone has been clear from any additional sightings for a period of 10 minutes for a firing aircraft, the mitigation zone has been clear from any additional sightings for a period of 30 minutes for a firing ship, or the intended target location has been repositioned more than 400 yd. (370 m) away from the location of the last sighting.

(E) A mitigation zone with a radius of 600 yd. (550 m) shall be established for large-caliber gunnery exercises with a surface target. Firing will cease if a marine mammal is sighted within the mitigation zone. Firing will recommence if the animal is observed exiting the mitigation zone, the animal is thought to have exited the mitigation zone based on its course and speed, or the mitigation zone has been clear from any additional sightings for a period of 30 minutes.

(F) The Navy is not proposing to use missiles with less than a 251 lb NEW warhead in the NWTT Study Area. However, should the need arise to conduct training activities using missiles in this category, a mitigation zone with a radius of 2,000 yd. (1.8 km) shall be established for missile exercises with up to 250 lb net explosive weight and a surface target. Firing will cease if a marine mammal is sighted within the mitigation zone. Firing will recommence if the animal is observed exiting the mitigation zone, the animal is thought to have exited the mitigation zone based on its course and speed, or the mitigation zone has been clear from any additional sightings for a period of 10 minutes or 30 minutes (depending on aircraft type).

(G) A mitigation zone with a radius of 2,000 yd. (1.8 km) shall be established for missile exercises with 251 to 500 lb NEW using a surface target. Firing will cease if a marine mammal is sighted within the mitigation zone. Firing will recommence if the animal is observed exiting the mitigation zone, the animal is thought to have exited the mitigation zone based on its course and speed, or the mitigation zone has been clear from any additional sightings for a period of 10 minutes or 30 minutes (depending on aircraft type).

(H) A mitigation zone with a radius of 2,500 yd. (2.3 km) around the intended impact location for explosive bombs shall be established for bombing exercises. Bombing will cease if a marine mammal is sighted within the mitigation zone. Bombing will recommence if the animal is observed exiting the mitigation zone, the animal is thought to have exited the mitigation zone based on its course and speed, or the mitigation zone has been clear from any additional sightings for a period of 10 minutes.

(I) A mitigation zone with a radius of 2,100 yd. (1.9 km) shall be established for torpedo (explosive) testing. Firing will cease if a marine mammal, sea turtle, or concentrations of floating vegetation are sighted within the mitigation zone. Firing will recommence if the animal is observed exiting the mitigation zone, the animal is thought to have exited the mitigation zone based on its course and speed, or the mitigation zone has been clear from any additional sightings for a period of 10 minutes or 30 minutes (depending on aircraft type).

(iii) Mitigation zones for vessels and in-water devices:

(A) A mitigation zone of 500 yd. (460 m) for observed whales and 200 yd (183 m) for all other marine mammals (except bow riding dolphins) shall be established for all vessel movement during training activities, providing it is safe to do so. During testing activities, all range craft (vessels and aircraft, including helicopters) shall not approach within 100 yd. (90 m) of marine mammals.

(B) A mitigation zone of 250 yd. (230 m) shall be established for all towed in-water devices, providing it is safe to do so.

(vi) Mitigation zones for non-explosive practice munitions:

(A) A mitigation zone of 200 yd. (180 m) shall be established for small, medium, and large caliber gunnery exercises using a surface target. Firing will cease if a marine mammal is sighted within the mitigation zone. Firing will recommence if the animal is observed exiting the mitigation zone, the animal is thought to have exited the mitigation zone based on its course and speed, the mitigation zone has been clear from any additional sightings for a period of 10 minutes for a firing aircraft, the mitigation zone has been clear from any additional sightings for a period of 30 minutes for a firing ship, or the intended target location has been repositioned more than 400 yd. (370 m) away from the location of the last sighting.

(B) A mitigation zone of 1,000 yd. (920 m) shall be established for bombing exercises. Bombing will cease if a marine mammal is sighted within the mitigation zone. Bombing will recommence if the animal is observed exiting the mitigation zone, the animal is thought to have exited the mitigation zone based on its course and speed, or the mitigation zone has been clear from any additional sightings for a period of 10 minutes.

§ 218.145 Requirements for monitoring and reporting.

(a) The Navy is required to cooperate with the NMFS, and any other Federal, state or local agency monitoring the impacts of the activity on marine mammals.

(b) General Notification of Injured or Dead Marine Mammals—Navy personnel shall ensure that NMFS is notified immediately (or as soon as clearance procedures allow) if an injured, stranded, or dead marine mammal is found during or shortly after, and in the vicinity of, any Navy training exercise utilizing MFAS, HFAS, or underwater explosive detonations. The Navy will provide NMFS with species or description of the animal(s), the condition of the animal(s) (including carcass condition if the animal is dead), location, time of first discovery, observed behaviors (if alive), and photo or video (if available). In the event that an injured, stranded, or dead marine mammal is found by the Navy that is not in the vicinity of, or during or shortly after, MFAS, HFAS, or underwater explosive detonations, the Navy will report the same information as listed above as soon as operationally feasible and clearance procedures allow.

(c) General Notification of Ship Strike—In the event of a ship strike by any Navy vessel, at any time or place, the Navy shall do the following:

(1) Immediately report to NMFS the species identification (if known), location (lat/long) of the animal (or the strike if the animal has disappeared), and whether the animal is alive or dead (or unknown)

(2) Report to NMFS as soon as operationally feasible the size and length of animal, an estimate of the injury status (ex., dead, injured but alive, injured and moving, unknown, etc.), vessel class/type and operational status.

(3) Report to NMFS the vessel length, speed, and heading as soon as feasible.

(4) Provide NMFS a photo or video, if equipment is available

(d) Event Communication Plan—The Navy shall develop a communication plan that will include all of the communication protocols (phone trees, etc.) and associated contact information required for NMFS and the Navy to carry out the necessary expeditious communication required in the event of a stranding or ship strike, including as described in the proposed notification measures above.

(e) The Navy must conduct all monitoring and/or research required under the Letter of Authorization including abiding by the NWTT Monitoring Plan (*http://www.nmfs.noaa.gov/pr/permits/incidental/military.htm*).

(f) Annual NWTT Monitoring Plan Report—The Navy shall submit an annual report of the NWTT Monitoring Plan describing the implementation and results of the NWTT Monitoring Plan from the previous calendar year. Data collection methods will be standardized across range complexes and study areas to allow for comparison in different geographic locations. Although additional information will be gathered, the protected species observers collecting marine mammal data pursuant to the NWTT Monitoring Plan shall, at a minimum, provide the same marine mammal observation data required in § 218.145. The report shall be submitted either 90 days after the calendar year, or 90 days after the conclusion of the monitoring year to be determined by the Adaptive Management process.

The NWTT Monitoring Plan may be provided to NMFS within a larger report that includes the required Monitoring Plan reports from multiple range complexes and study areas (the multi-Range Complex Annual Monitoring Report). Such a report would describe progress of knowledge made with respect to monitoring plan study questions across all Navy ranges associated with the ICMP. Similar study questions shall be treated together so that progress on each topic shall be summarized across all Navy ranges. The report need not include analyses and content that does not provide direct assessment of cumulative progress on the monitoring plan study questions.

(g) Annual NWTT Exercise and Testing Reports—The Navy shall submit preliminary reports detailing the status of authorized sound sources within 21 days after the anniversary of the date of issuance of the LOA. The Navy shall submit detailed reports 3 months after the anniversary of the date of issuance of the LOA. The detailed annual reports shall describe the level of training and testing conducted during the reporting period, and a summary of sound sources used (total annual 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; total annual expended/detonated rounds [missiles, bombs, etc.] for each explosive bin; and improved Extended Echo-Ranging System (IEER)/sonobuoy summary, including total number of IEER events conducted in the Study Area, total expended/detonated rounds (buoys), and total number of self-scuttled IEER rounds. The analysis in the detailed reports will be based on the accumulation of data from the current year's report and data collected from previous reports.

(h) 5-year Close-out Exercise and Testing Report—This report will be included as part of the 2020 annual exercise or testing report. This report will provide the annual totals for each sound source bin with a comparison to the annual allowance and the 5-year total for each sound source bin with a comparison to the 5-year allowance. Additionally, if there were any changes to the sound source allowance, this report will include a discussion of why the change was made and include the analysis to support how the change did or did not result in a change in the SEIS and final rule determinations. The report will be submitted 3 months after the expiration of the rule. NMFS will submit comments on the draft close-out report, if any, within 3 months of receipt. The report will be considered final after the Navy has addressed NMFS' comments, or 3 months after the submittal of the draft if NMFS does not provide comments.

§ 218.146 Applications for Letters of Authorization.

To incidentally take marine mammals pursuant to the regulations in this subpart, the U.S. citizen (as defined by § 216.106) conducting the activity identified in § 218.140(c) (the U.S. Navy) must apply for and obtain either an initial LOA in accordance with § 218.147 or a renewal under § 218.148.

§ 218.147 Letters of Authorization.

(a) An LOA, unless suspended or revoked, will be valid for a period of time not to exceed the period of validity of this subpart.

(b) Each LOA will set forth:

(1) Permissible methods of incidental taking;

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

(3) Requirements for mitigation, monitoring and reporting.

(c) Issuance and renewal of the LOA will be based on a determination that the total number of marine mammals taken by the activity as a whole will have no more than a negligible impact on the affected species or stock of marine mammal(s).

§ 218.148 Renewals and Modifications of Letters of Authorization and Adaptive Management.

(a) A Letter of Authorization issued under §§ 216.106 and 218.147 of this chapter for the activity identified in § 218.140(c) will be renewed or modified upon request of the applicant, provided that:

(1) The proposed specified activity and mitigation, monitoring, and reporting measures, as well as the anticipated impacts, are the same as those described and analyzed for these regulations (excluding changes made pursuant to the adaptive management provision of this chapter), and;

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

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

(c) An LOA issued under § 216.106 and § 218.147 of this chapter for the activity identified in § 218.144 of this chapter may be modified by NMFS under the following circumstances:

(1) Adaptive Management—NMFS may modify (including augment) the existing mitigation, monitoring, or reporting measures (after consulting with the Navy regarding the practicability of the modifications) if doing so creates a reasonable likelihood of more effectively accomplishing the goals of the mitigation and monitoring set forth in the preamble for these regulations.

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

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

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

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

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

(2) Emergencies—If NMFS determines that an emergency exists that poses a significant risk to the well-being of the species or stocks of marine mammals specified in § 218.142(c), an LOA may be modified without prior notification and an opportunity for public comment. Notification would be published in the **Federal Register** within 30 days of the action.

[FR Doc. 2015–13038 Filed 6–2–15; 8:45 am]

BILLING CODE 3510–22–P