DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 218

[Docket No. 170720687–8212–01]

RIN 0648–BH06

Taking and Importing Marine Mammals; Taking Marine Mammals Incidental to the U.S. Navy Training and Testing Activities in the Atlantic Fleet 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 Atlantic Fleet Training and Testing (AFTT) Study Area. Pursuant to the Marine Mammal Protection Act (MMPA), NMFS is requesting comments on its proposal to issue regulations and subsequent Letters of Authorization (LOAs) to the Navy to incidentally take marine mammals during the specified activities. NMFS will consider public comments prior to issuing any final rule and making final decisions on the issuance of the requested MMPA authorizations. Agency responses to public comments will be summarized in the final notice of our decision. The Navy's activities qualify as military readiness activities pursuant to the MMPA, as amended by the National Defense Authorization Act for Fiscal Year 2004 (2004 NDAA).

DATES: Comments and information must be received no later than April 26, 2018.

ADDRESSES: You may submit comments, identified by NOAA–NMFS–2018–0037, by any of the following methods:

- *Electronic submissions:* Submit all electronic public comments via the Federal eRulemaking Portal, Go to *www.regulations.gov/#!docketDetail;D=NOAA-NMFS-2018-0037,* click the ''Comment Now!'' icon, complete the required fields, and enter or attach your comments.
- *Mail:* Submit comments to Jolie Harrison, Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service, 1315 East-West Highway, Silver Spring, MD 20910–3225.
- *Fax:* (301) 713–0376; Attn: Jolie Harrison.

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

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

SUPPLEMENTARY INFORMATION:

Background

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

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

NMFS has defined ''negligible impact'' in 50 CFR 216.103 as ''. . . an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival.''

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

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

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

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

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

Summary of Request

On June 16, 2017, NMFS received an application from the Navy requesting incidental take regulations and LOAs to take individuals of 39 marine mammal species by Level A and B harassment incidental to training and testing activities (categorized as military readiness activities) from the use of sonar and other transducers, in-water detonations, airguns, and impact pile driving/vibratory extraction in the AFTT Study Area over five years. In addition, the Navy is requesting incidental take authorization for up to nine mortalities of four marine mammal species during ship shock trials, and authorization for up to three takes by serious injury or mortality from vessel strikes over the five-year period. The Navy's training and testing activities would occur over five years beginning November 2018. On August 4, 2017, the Navy sent an amendment to its application and Navy's rulemaking and LOA application was considered final and complete.

The Navy's requests for two five-year LOAs, one for training and one for testing activities to be conducted within the AFTT Study Area (which includes areas of the western Atlantic Ocean along the east coast of North America, portions of the Caribbean Sea, and the Gulf of Mexico), covers approximately 2.6 million square nautical miles (nmi^2) of ocean area, oriented from the mean high tide line along the U.S. coast and extends east to the 45-degree west longitude line, north to the 65-degree north latitude line, and south to approximately the 20-degree north latitude line. Please refer to the Navy's rulemaking and LOA application, specifically Figure 1.1–1 for a map of the AFTT Study Area and Figures 2.2–1 through Figure 2.2–3 for additional maps of the range complexes and testing ranges. The following types of training and testing, which are classified as military readiness activities pursuant to the MMPA, as amended by the 2004 NDAA, would be covered under the LOAs (if authorized): Amphibious warfare (in-water detonations), anti-submarine warfare (sonar and other transducers, in-water detonations), expeditionary warfare (in-water detonations), surface warfare (in-water detonations), mine warfare (sonar and other transducers, in-water detonations), and other warfare activities (sonar and other transducers, impact pile driving/vibratory extraction, airguns). In addition, ship shock trials, a specific testing activity related to vessel evaluation would be conducted.

This will be NMFS' third rulemaking for AFTT activities under the MMPA. NMFS published the first rule effective from January 22, 2009 through January 22, 2014 on January 27, 2009 (74 FR 4844) and the second rule applicable from November 14, 2013 through November 13, 2018 on December 4, 2013 (78 FR 73009). For this third rulemaking, the Navy is proposing to conduct similar activities as they have conducted over the past nine years under the previous two rulemakings.

Background of Request

The Navy's mission is to organize, train, equip, and maintain combat-ready naval forces capable of winning wars, deterring aggression, and maintaining freedom of the seas. This mission is mandated by federal law (10 U.S.C. 5062), which ensures the readiness of the naval forces of the United States. The Navy executes this responsibility by establishing and executing training programs, including at-sea training and exercises, and ensuring naval forces have access to the ranges, operating areas (OPAREAs), and airspace needed to develop and maintain skills for conducting naval activities.

The Navy proposes to conduct training and testing activities within the AFTT Study Area. The Navy has been conducting military readiness activities in the AFTT Study Area for well over a century and with active sonar for over 70 years. The tempo and types of training and testing activities have fluctuated because of the introduction of new technologies, the evolving nature of international events, advances in warfighting doctrine and procedures, and changes in force structure (organization of ships, weapons, and personnel). Such developments influenced the frequency, duration, intensity, and location of required training and testing activities. This rulemaking and LOA request reflects the most up to date compilation of training and testing activities deemed necessary to accomplish military readiness requirements. The types and numbers of activities included in the proposed rule accounts for fluctuations in training and testing in order to meet evolving or emergent military readiness requirements.

The Navy's rulemaking and LOA request covers training and testing activities that would occur for a 5-year period following the expiration of the current MMPA authorization for the AFTT Study Area, which expires on November 13, 2018.

Description of the Specified Activity

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

Overview of Training and Testing Activities

The Navy routinely trains in the AFTT Study Area in preparation for national defense missions. Training and testing activities and exercises covered in the Navy's rulemaking and LOA application are briefly described below, and in more detail within chapter 2 of the AFTT DEIS/OEIS. Each military training and testing activity described meets mandated Fleet requirements to deploy ready forces.

Primary Mission Areas

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

The Navy describes and analyzes the impacts of its training and testing activities within the AFTT DEIS/OEIS and the Navy's rulemaking and LOA application (documents available at *www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-military-readiness-activities*). In its assessment, the Navy concluded that sonar and other transducers, in-water detonations, airguns, and pile driving/extraction were the stressors that would result in impacts on marine mammals that could rise to the level of harassment (also serious injury or mortality in ship shock trials or by vessel strike) as defined under the MMPA. Therefore, the rulemaking and LOA application provides the Navy's assessment of potential effects from these stressors in terms of the various warfare mission areas in which they would be conducted. In terms of Navy's primary warfare areas, this includes:

- Amphibious warfare (in-water detonations)
- anti-submarine warfare (sonar and other transducers, in-water detonations)
- expeditionary warfare (in-water detonations)
- surface warfare (in-water detonations)
- mine warfare (sonar and other transducers, in-water detonations)
- other warfare activities (sonar and other transducers, impact pile driving/vibratory extraction, airguns)

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

Amphibious Warfare

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

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

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

Anti-Submarine Warfare (ASW)

The mission of anti-submarine warfare is to locate, neutralize, and defeat hostile submarine forces that threaten Navy forces. ASW is based on the principle that surveillance and attack aircraft, ships, and submarines all search for hostile submarines. These forces operate together or independently to gain early warning and detection, and to localize, track, target, and attack submarine threats. ASW training addresses basic skills such as detection and classifying submarines, as well as evaluating sounds to distinguish between enemy submarines and friendly submarines, ships, and marine life. More advanced training integrates the full spectrum of anti-submarine warfare from detecting and tracking a submarine to attacking a target using either exercise torpedoes (*i.e.,* torpedoes that do not contain a warhead) or simulated weapons. These integrated ASW exercises are conducted in coordinated, at-sea training events involving submarines, ships, and aircraft.

Testing of ASW systems is conducted to develop new technologies and assess weapon performance and operability with new systems and platforms, such as unmanned systems. Testing uses ships, submarines, and aircraft to demonstrate capabilities of torpedoes, missiles, countermeasure systems, and underwater surveillance and communications systems. Tests may be conducted as part of a large-scale fleet training event involving submarines, ships, fixed-wing aircraft, and helicopters. These integrated training events offer opportunities to conduct research and acquisition activities and to train aircrew in the use of new or newly enhanced systems during a largescale, complex exercise.

Expeditionary Warfare

The mission of expeditionary warfare is to provide security and surveillance in the littoral (at the shoreline), riparian (along a river), or coastal environments. Expeditionary warfare is wide ranging and includes defense of harbors, operation of remotely operated vehicles, defense against swimmers, and boarding/seizure operations. Expeditionary warfare training activities include underwater construction team training, dive and salvage operations, and insertion/extraction operations via air, surface, and subsurface platforms.

Mine Warfare (MIW)

The mission of MIW is to detect, classify, and avoid or neutralize (disable) mines to protect Navy ships and submarines and to maintain free access to ports and shipping lanes. MIW also includes offensive mine laying to gain control of or deny the enemy access to sea space. Naval mines can be laid by ships, submarines, or aircraft. MIW neutralization training includes exercises in which ships, aircraft, submarines, underwater vehicles, unmanned vehicles, or marine mammal detection systems search for mine shapes. Personnel train to destroy or disable mines by attaching underwater explosives to or near the mine or using remotely operated vehicles to destroy the mine.

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

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

Surface Warfare (SUW)

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

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

Other Warfare Activities

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

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

A major training exercise is comprised of several ''unit level'' range exercises conducted by several units operating together while commanded and controlled by a single commander. These exercises typically employ an exercise scenario developed to train and evaluate the strike group in naval tactical tasks. In a major training exercise, most of the activities being directed and coordinated by the strike group commander are identical in nature to the activities conducted during individual, crew, and smaller unit level training events. In a major training exercise, however, these disparate training tasks are conducted in concert, rather than in isolation.

Some integrated or coordinated anti-submarine warfare exercises are similar in that they are comprised of several unit level exercises but are generally on a smaller scale than a major training exercise, are shorter in duration, use fewer assets, and use fewer hours of hull-mounted sonar per exercise. These coordinated exercises are conducted under anti-submarine warfare. Three key factors used to identify and group the exercises are the scale of the exercise, duration of the exercise, and amount of hull-mounted sonar hours modeled/used for the exercise.

NMFS considered the effects of all training exercises, not just these major training exercises in this proposed rule.

Overview of Testing Activities Within the AFTT Study Area

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

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

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

Naval Air Systems Command Testing Activities

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

The majority of testing activities conducted by Naval Air Systems Command are similar to fleet training activities, and many platforms and systems currently being tested are already being used by the fleet or will ultimately be integrated into fleet training activities. However, some testing activities may be conducted in different locations and in a different manner than similar fleet training activities and, therefore, the analysis for those events and the potential environmental effects may differ.

Naval Sea Systems Command Testing Activities

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

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

One ship of each new class (or major upgrade) of combat ships constructed for the Navy typically undergoes an at-sea ship shock trial to allow the Navy to assess the survivability of the hull and ship's systems in a combat environment as well as the capability of the ship to protect the crew.

Office of Naval Research Testing Activities

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

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

Description of Acoustic and Explosive Stressors

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

Acoustic Stressors

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

In order to better organize and facilitate the analysis of approximately 300 sources of underwater sound used for training and testing by the Navy including sonars, other transducers, airguns, and explosives, a series of source classifications, or source bins, were developed.

Sonar and Other Transducers

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

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

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

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

Anti-Submarine Warfare

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

Most ASW sonars are mid frequency (1–10 kHz) because mid-frequency sound balances sufficient resolution to identify targets with distance over which threats can be identified. However, some sources may use higher or lower frequencies. Duty cycles can vary widely, from rarely used to continuously active. For example, a submarine‘s mission revolves around its stealth; therefore, submarine sonar is used infrequently because its use would also reveal a submarine's location. ASW sonars can be wide-ranging in a search mode or highly directional in a track mode.

Most ASW activities involving submarines or submarine targets would occur in waters greater than 600 feet (ft) deep due to safety concerns about running aground at shallower depths. Sonars used for ASW activities would typically be used beyond 12 nautical miles (nmi) from shore. Exceptions include use of dipping sonar by helicopters, maintenance of systems while in port, and system checks while transiting to or from port.

Mine Warfare, Small Object Detection, and Imaging

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

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

Navigation and Safety

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

Communication

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

Classification of Sonar and Other Transducers

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

▪ Frequency of the non-impulsive acoustic source.

- Low-frequency sources operate below 1 kHz
- Mid-frequency sources operate at and above 1 kHz, up to and including 10 kHz
- High-frequency sources operate above 10 kHz, up to and including 100 kHz
- very high-frequency sources operate above 100 kHz but below 200 kHz

▪ Sound pressure level of the non-impulsive source.

- Greater than 160 decibels (dB) re 1 micro Pascal (μPa), but less than 180 dB re 1 μPa
- Equal to 180 dB re 1 μPa and up to 200 dB re 1 μPa
- Greater than 200 dB re 1 μPa

▪ Application in which the source would be used.

- Sources with similar functions that have similar characteristics, such as pulse length (duration of each pulse), beam pattern, and duty cycle

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

TABLE 1—SONAR AND TRANSDUCERS QUANTITATIVELY ANALYZED

Source class category	Bin	Description
Low-Frequency (LF): Sources that produce signals less than 1 kHz.	LF3	LF sources greater than 200 dB.
	LF4	LF sources equal to 180 dB and up to 200 dB.
	LF5	LF sources less than 180 dB.
	LF6	LF sources greater than 200 dB with long pulse lengths.
Mid-Frequency (MF): Tactical and non-tactical sources that produce signals between 1–10 kHz.	MF1	Hull-mounted surface ship sonars (*e.g.,* AN/SQS–53C and AN/SQS–61).
	MF1K	Kingfisher mode associated with MF1 sonars.
	MF3	Hull-mounted submarine sonars (*e.g.,* AN/BQQ–10).
	MF4	Helicopter-deployed dipping sonars (*e.g.,* AN/AQS–22 and AN/AQS–13).
	MF5	Active acoustic sonobuoys (*e.g.,* DICASS).
	MF6	Active underwater sound signal devices (*e.g.,* MK84).
	MF8	Active sources (greater than 200 dB) not otherwise binned.
	MF9	Active sources (equal to 180 dB and up to 200 dB) not otherwise binned.
	MF10	Active sources (greater than 160 dB, but less than 180 dB) not otherwise binned.
	MF11	Hull-mounted surface ship sonars with an active duty cycle greater than 80%.

TABLE 1—SONAR AND TRANSDUCERS QUANTITATIVELY ANALYZED—Continued

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

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

Airguns

Airguns are essentially stainless steel tubes charged with high-pressure air via a compressor. An impulsive sound is generated when the air is almost instantaneously released into the surrounding water. Small airguns with capacities up to 60 cubic inches would be used during testing activities in various offshore areas in the AFTT Study Area, as well as near shore at Newport, RI.

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

Pile Driving/Extraction

Impact pile driving and vibratory pile removal would occur during construction of an Elevated Causeway System, a temporary pier that allows the offloading of ships in areas without a permanent port. Construction of the elevated causeway could occur in sandy shallow water coastal areas at Joint Expeditionary Base Little Creek-Fort Story in the Virginia Capes Range Complex or Marine Corps Base Camp Lejeune in the Navy Cherry Point Range Complex.

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

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

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

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

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

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

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

The size of the pier and number of piles used in an Elevated Causeway System (ELCAS) event is assumed to be no greater than 1,520 ft long, requiring 119 supporting piles. Construction of the ELCAS would involve intermittent impact pile driving over approximately 20 days. Crews work 24 hours (hrs) a day and would drive approximately 6 piles in that period. Each pile takes about 15 minutes to drive with time taken between piles to reposition the driver. When training events that use the ELCAS are complete, the structure would be removed using vibratory methods over approximately 10 days. Crews would remove about 12 piles per 24-hour period, each taking about six minutes to remove.

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

Explosive Stressors

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

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

Explosions in Water

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

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

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

TABLE 3—EXPLOSIVES ANALYZED

Bin	Net explosive weight[1] (lb.)	Example explosive source
E1	0.1–0.25	Medium-caliber projectile.
E2	>0.25–0.5	Medium-caliber projectile.
E3	>0.5–2.5	Large-caliber projectile.
E4	>2.5–5	Mine neutralization charge.
E5	>5–10	5-inch projectile.
E6	>10–20	Hellfire missile.
E7	>20–60	Demo block/shaped charge.
E8	>60–100	Light-weight torpedo.
E9	>100–250	500 lb. bomb.
E10	>250–500	Harpoon missile.
E11	>500–650	650 lb mine.
E12	>650–1,000	2,000 lb bomb.
E14[2]	>1,741–3,625	Line charge.
E16	>7,250–14,500	Littoral Combat Ship full ship shock trial.
E17	>14,500–58,000	Aircraft carrier full ship shock trial.

[1] Net Explosive Weight refers to the equivalent amount of TNT the actual weight of a munition may be larger due to other components.
[2] E14 is not modeled for protected species impacts in water because most energy is lost into the air or to the bottom substrate due to detonation in very shallow water.

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

Other Stressor—Vessel Strike

There is a very small chance that a vessel utilized in training or testing activities could strike a large whale. Vessel strikes are not specific to any particular training or testing activity, but rather a limited, sporadic, and incidental result of Navy vessel movement within the Study Area. Vessel strikes from commercial, recreational, and military vessels are known to seriously injure and occasionally kill cetaceans (Abramson *et al.,* 2011; Berman-Kowalewski *et al.,* 2010; Calambokidis, 2012; Douglas *et al.,* 2008; Laggner, 2009; Lammers *et al.,* 2003; Van der Hoop *et al.,* 2012; Van der Hoop *et al.,* 2013), although reviews of the literature on ship strikes mainly involve collisions between commercial vessels and whales (Jensen and Silber, 2003; Laist *et al.,* 2001). Vessel speed, size, and mass are all important factors in determining potential impacts of a vessel strike to marine mammals (Conn & Silber, 2013; Gende *et al.,* 2011; Silber *et al.,* 2010; Vanderlaan and Taggart, 2007; Wiley *et al.,* 2016). For large vessels, speed and angle of approach can influence the severity of a strike. The average speed of large Navy ships ranges between 10 and 15 knots and submarines generally operate at speeds in the range of 8–13 knots, while a few specialized vessels can travel at faster speeds. By comparison, this is slower than most commercial vessels where full speed for a container ship is typically 24 knots (Bonney and Leach, 2010). Additional information on Navy vessel movements is provided in Proposed Activities section. Large Navy vessels (greater than 18 m in length) within the offshore areas of range complexes and testing ranges operate differently from commercial vessels in ways that may reduce potential whale collisions. Surface ships operated by or for the Navy have multiple personnel assigned to stand watch at all times, when a ship or surfaced submarine is moving through the water (underway). A primary duty of personnel standing watch on surface ships is to detect and report all objects and disturbances sighted in the water that may indicate a threat to the vessel and its crew, such as debris, a periscope, surfaced submarine, or surface disturbance. Per vessel safety requirements, personnel standing watch also report any marine mammals sighted in the path of the vessel as a standard collision avoidance procedure. All vessels use extreme caution and proceed at a safe speed so they can take proper and effective action to avoid a collision with any sighted object or disturbance, and can be stopped within a distance appropriate to the prevailing circumstances and conditions. Vessel strikes have the potential to result in incidental take from serious injury and/or mortality.

Proposed Activities

Proposed Training Activities

The Navy's proposed activities are presented and analyzed as a representative year of training to account for the natural fluctuation of training cycles and deployment schedules that generally influences the maximum level of training from occurring year after year in any five-year period. Both unit-level training and major training exercises are adjusted to meet this representative year, as discussed below. For the purposes of this application, the Navy assumes that some unit-level training would be conducted using synthetic means *(e.g.,* simulators). Additionally, the Proposed Activity assumes that some unit-level active sonar training will be accounted for within major training exercises.

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

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

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

Stressor Category	*Activity Name*	*Description*	*Source Bin*	*Annual # of Activities*	*5-Year # of Activities*	*Location*[2]	*Duration per Activity*
Major Training Exercise – Large Integrated ASW							
Acoustic	Composite Training Unit Exercise	Aircraft carrier and its associated aircraft integrate with surface and submarine units in a challenging multi-threat operational environment in order to certify them for deployment.	ASW1, ASW2, ASW3, ASW4, ASW5, HF1, LF6, MF1, MF3, MF4, MF5, MF11, MF12	2–3[1]	12	VACAPES RC Navy Cherry Point RC JAX RC	21 days
Major Training Exercises – Medium Integrated Anti-Submarine Warfare							
Acoustic	Fleet Exercises/Sustainment Exercise	Aircraft carrier and its associated aircraft integrates with surface and submarine units in a challenging multi-threat operational environment in order to maintain their ability to deploy.	ASW1, ASW2, ASW3, ASW4, HF1, LF6, MF1, MF3, MF4, MF5, MF11, MF12	4	20	JAX RC	Up to 10 days
				2	10	VACAPES RC	
Integrated/Coordinated Training – Small Integrated Anti-Submarine Warfare Training							
Acoustic	Naval Undersea Warfare Training Assessment Course	Multiple ships, aircraft, and submarines integrate the use of their sensors to search for, detect, classify, localize, and track a threat submarine in order to launch an exercise torpedo.	ASW1, ASW3, ASW4, HF1, LF6, MF1, MF3, MF4, MF5, MF12	6	30	JAX RC	2-5 days
				3	15	Navy Cherry Point RC	
				3	15	VACAPES RC	
Integrated/Coordinated Training – Medium Coordinated Anti-Submarine Warfare Training							
Acoustic	Anti-Submarine Warfare Tactical Development Exercise	Surface ships, aircraft, and submarines coordinate to search for, detect, and track	ASW1, ASW3, ASW4, HF1,	2	10	JAX RC	5-7 days
				1	5	Navy Cherry Point RC	

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

Stressor Category	*Activity Name*	*Description*	*Source Bin*	*Annual # of Activities*	*5-Year # of Activities*	*Location*[2]	*Duration per Activity*
		submarines.	LF6, MF1, MF3, MF4, MF5, MF11, MF12	1	5	VACAPES RC	
Integrated/Coordinated Training – Small Coordinated Anti-Submarine Warfare Training							
Acoustic	Group Sail	Surface ships and helicopters search for, detect, and track threat submarines.	ASW2, ASW3, ASW4, HF1, MF1, MF3, MF4, MF5, MF11, MF12	4	20	JAX RC	2-3 days
				5	25	JAX RC	
				72	360	Navy Cherry Point RC	
				321	1,605	VACAPES RC	
Explosive	Integrated Live Fire Exercise	Naval forces defend against a swarm of surface threats (ships or small boats) with bombs, missiles, rockets, and small-, medium- and large-caliber guns.	E1, E3, E6, E10	2	10	VACAPES RC	6-8 hrs
				2	10	JAX RC	
Explosive	Missile Exercise Air-to-Surface	Fixed-wing and helicopter aircrews fire air-to-surface missiles at surface targets.	E6, E8, E10	102	510	JAX RC	1 hr
				52	260	Navy Cherry Point RC	
				88	440	VACAPES RC	
Explosive	Missile Exercise Air-to-Surface – Rocket	Helicopter aircrews fire both precision-guided and unguided rockets at surface targets.	E3	10	50	GOMEX RC	1 hr
				102	510	JAX RC	
				10	50	Navy Cherry Point RC	
				92	460	VACAPES RC	
Explosive	Missile Exercise Surface-to-Surface	Surface ship crews defend against surface threats (ships or small boats) and engage them with missiles.	E6, E10	16	80	JAX RC	2-5 hrs
				12	60	VACAPES RC	

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

Stressor Category	*Activity Name*	*Description*	*Source Bin*	*Annual # of Activities*	*5-Year # of Activities*	*Location*[2]	*Duration per Activity*
Acoustic, Explosive	Sinking Exercise	Aircraft, ship, and submarine crews deliberately sink a seaborne target, usually a decommissioned ship (made environmentally safe for sinking according to U.S. Environmental Protection Agency standards), with a variety of munitions.	TORP2, E5, E8, E9, E10, E11	1	5	SINKEX Box	4-8 hrs, possibly over 1-2 days
Other Training Activities							
Acoustic	Elevated Causeway System	A temporary pier is constructed off the beach. Supporting pilings are driven into the sand and then later removed.	Impact hammer or vibratory extractor	1	5	Lower Chesapeake Bay	Up to 20 days for construction, and up to 10 days for removal
				1	5	Navy Cherry Point RC	
Acoustic	Submarine Navigation	Submarine crews operate sonar for navigation and object detection while transiting into and out of port during reduced visibility.	HF1, MF3	169	845	NSB New London	Up to 2 hrs
				3	15	NSB Kings Bay	
				3	15	NS Mayport	
				84	420	NS Norfolk	
				23	115	Port Canaveral, FL	
Acoustic	Submarine Sonar Maintenance	Maintenance of submarine sonar systems is conducted pierside or at sea.	MF3	12	60	Other AFTT Areas	Up to 1 hr
				66	330	NSB New London	
				9	45	JAX RC	
				2	10	NSB Kings Bay	
				34	170	NS Norfolk	
				86	430	Northeast RC	
				2	10	Port Canaveral, FL	

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

Stressor Category	*Activity Name*	*Description*	*Source Bin*	*Annual # of Activities*	*5-Year # of Activities*	*Location*[2]	*Duration per Activity*
				13	63	Navy Cherry Point RC	
				47	233	VACAPES RC	
Acoustic	Submarine Under Ice Certification	Submarine crews train to operate under ice. Ice conditions are simulated during training and certification events.	HF1	3	15	JAX RC	Up to 6 hrs per day over 5 days
				3	15	Navy Cherry Point RC	
				9	45	Northeast RC	
				9	45	VACAPES RC	
Acoustic	Surface Ship Object Detection	Surface ship crews operate sonar for navigation and object detection while transiting in and out of port during reduced visibility.	HF8, MF1K	76	380	NS Mayport	Up to 2 hrs
				162	810	NS Norfolk	
Acoustic	Surface Ship sonar Maintenance	Maintenance of surface ship sonar systems is conducted pierside or at sea.	HF8, MF1	50	250	JAX RC	Up to 4 hours
				50	250	NS Mayport	
				120	600	Navy Cherry Point RC	
				235	1,175	NS Norfolk	
				120	600	VACAPES RC	

[1] For activities where the maximum number of events could vary between years, the information is presented as 'representative-maximum' number of events per year. For activities where no variation is anticipated, only the maximum number of events within a single year is provided.

[2] Locations given are areas where activities typically occur. However, activities could be conducted in other locations within the AFTT Study Area. Where multiple locations are provided within a single cell, the number of activities could occur in any of the locations, not in each of the locations.

* For anti-submarine warfare tracking exercise – Ship, the Proposed Activity, 50 percent of requirements are met through synthetic training or other training exercises

Notes: GOMEX: Gulf of Mexico; JAX: Jacksonville; NS: Naval Station; NSB: Naval Submarine Base; NSWC: Naval Surface Warfare Center; RC: Range Complex; VACAPES: Virginia Capes

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

Stressor Category	*Activity Name*	*Activity Description*	*Source Bin*	*Annual # of Activities*[1]	*5-Year # of Activities*	*Location*[2]	*Duration per Activity*
Anti-Submarine Warfare							
Acoustic	Anti-Submarine Warfare Torpedo Test	This event is similar to the training event torpedo exercise. Test evaluates anti-submarine warfare systems onboard rotary-wing (e.g., helicopter) and fixed-wing aircraft and the ability to search for, detect, classify, localize, track, and attack a submarine or similar target.	MF5, TORP1	20–43	146	JAX RC	2 -6 flight hrs per event
				40–121	362	VACAPES RC	
Acoustic, Explosive	Anti-Submarine Warfare Tracking Test – Helicopter	This event is similar to the training event anti-submarine warfare tracking exercise – helicopter. The test evaluates the sensors and systems used to detect and track submarines and to ensure that helicopter systems used to deploy the tracking system perform to specifications.	MF4, MF5, E3	4–6	24	GOMEX RC	2 flight hrs per event
				0–12	24	JAX RC	
				2–27	35	Key West RC	
				28–110	304	Northeast RC	
				137–280	951	VACAPES RC	
Acoustic, Explosive	Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft	The test evaluates the sensors and systems used by maritime patrol aircraft to detect and track submarines and to ensure that aircraft systems used to deploy the tracking systems perform to specifications and meet operational requirements.	ASW2, ASW5, E1, E3, MF5, MF6	10–15	60	GOMEX RC	4-6 flight hrs per event
				19	95	JAX RC	
				10–12	54	Key West RC	
				14–15	72	Navy Cherry Point RC	
				36–45	198	Northeast Point RC	
				25	125	VACAPES RC	
Acoustic	Kilo Dip	Functional check of a helicopter deployed dipping sonar system prior to conducting a testing or training event using the dipping sonar system.	MF4	2–6	14	GOMEX RC	1.5 flight hrs per event
				0–6	6	JAX RC	
				0–6	6	Key West RC	
				0–4	8	Northeast RC	
				20–40	140	VACAPES RC	
Acoustic, Explosive	Sonobuoy Lot Acceptance Test	Sonobuoys are deployed from surface vessels and aircraft to verify the integrity and performance of a production lot or group of sonobuoys in	ASW2, ASW5, HF5, HF6, LF4,	160	800	Key West RC	6 flight hrs per event

		advance of delivery to the fleet for operational use.	MF5, MF6, E1, E3, E4				
Mine Warfare							
Acoustic	Airborne Dipping Sonar Minehunting Test	A mine-hunting dipping sonar system deployed from a helicopter and uses high-frequency sonar for the detection and classification of bottom and moored mines.	HF4	16-32	96	NSWC Panama City	2 flight hrs per event
				6-18	42	VACAPES RC	
Explosive	Airborne Mine Neutralization System Test	A test of the airborne mine neutralization system evaluates the system's ability to detect and destroy mines from an airborne mine countermeasures capable helicopter. The airborne mine neutralization system uses up to four unmanned underwater vehicles equipped with high-frequency sonar, video cameras, and explosive and non-explosive neutralizers	E4	20-27	107	NSWC Panama City	2.5 flight hrs per event
				25-45	145	VACAPES RC	
Acoustic	Airborne Sonobuoy Minehunting Test	A mine-hunting system made up of a field of sonobuoys deployed by a helicopter. A field of sonobuoys, using high-frequency sonar, is used to detect and classify bottom and moored mines.	HF6	52	260	NSWC Panama City	2 flight hrs per event
				24	120	VACAPES RC	
Surface Warfare							
Explosive	Air-to-Surface Bombing Test	This event is similar to the training event bombing exercise air-to-surface. Fixed-wing aircraft test the delivery of bombs against surface maritime targets with the goal of evaluating the bomb, the bomb carry and delivery system, and any associated systems that may have been newly developed or enhanced.	E9	20	100	VACAPES RC	2 flight hrs per event
Explosive	Air-to-Surface Gunnery Test	This event is similar to the training event gunnery exercise	E1	25–55	215	JAX RC	2-2.5 flight hrs

		air-to-surface. Fixed-wing and rotary-wing aircrews evaluate new or enhanced aircraft guns against surface maritime targets to test that the guns, gun ammunition, or associated systems meet required specifications or to train aircrews in the operation of a new or enhanced weapon system.		110–140	640	VACAPES RC	per event
Explosive	Air-to-Surface Missile Test	This event is similar to the training event missile exercise air-to-surface. Test may involve both fixed-wing and rotary-wing aircraft launching missiles at surface maritime targets to evaluate the weapon system or as part of another system's integration test.	E6, E9, E10	0–10	20	GOMEX RC	2-4 flight hrs per event
				29–38	167	JAX RC	
				117–148	663	VACAPES RC	
Explosive	Rocket Test	Rocket tests evaluate the integration, accuracy, performance, and safe separation of guided and unguided 2.75-inch rockets fired from a hovering or forward-flying helicopter.	E3	15–19	87	JAX RC	1.5-2.5 hrs per event
				31–35	167	VACAPES RC	
Other Testing Activities							
Acoustic	Undersea Range System Test	Following installation of a Navy underwater warfare training and testing range, tests of the nodes (components of the range) will be conducted to include node surveys and testing of node transmission functionality.	MF9	4–20	42	JAX RC	8 hrs

[1] For activities where the maximum number of events could vary between years, the information is presented as 'representative-maximum' number of events per year. For activities where no variation is anticipated, only the maximum number of events within a single year is provided.

[2] Locations given are areas where activities typically occur. However, activities could be conducted in other locations within the AFTT Study Area.

Notes: GOMEX: Gulf of Mexico; JAX: Jacksonville; NSWC: Naval Surface Warfare Center; RC: Range Complex; VACAPES: Virginia Capes

Testing activities covered in this rulemaking and LOA request are described in Table 5 through Table 7. The five-year Proposed Activity presented here is based on the level of testing activities anticipated to be conducted into the reasonably foreseeable future, with adjustments that account for changes in the types and tempo (increases or decreases) of testing activities to meet current and future military readiness requirements. The Proposed Activity includes the testing of new platforms, systems, and related equipment that will be introduced after November 2018 and during the period of the rule. The majority of testing activities that would be conducted under the Proposed Activity are the same as or similar as those conducted currently or in the past. The Proposed Activity includes the testing of some new systems using new technologies and takes into account inherent uncertainties in this type of testing.

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

Naval Air Systems Command

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

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

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

Stressor Category	*Activity Name*	*Activity Description*	*Source Bin*	*Annual # of Activities*[1]	*5-Year # of Activities*	*Location*[2]	*Duration*
Anti-Submarine Warfare							
Acoustic	Anti-Submarine Warfare Mission Package Testing	Ships and their supporting platforms (e.g., helicopters, unmanned aerial systems) detect, localize, and attack submarines.	ASW1, ASW2, ASW3, ASW5, MF1, MF4, MF5, MF12, TORP1	42	210	JAX RC	1-2 wks, with 4-8 hrs of active sonar use with intervals on non-activity in between
				4	20	Newport, RI	
				4	20	NUWC Newport	
				26	130	VACAPES RC	
Acoustic	At-Sea Sonar Testing	At-sea testing to ensure systems are fully functional in an open ocean environment.	ASW3, ASW4, HF1, LF5, M3, MF1, MF1K, MF3, MF5, MF9, MF11, TORP2	2	10	JAX RC Navy Cherry Point RC Northeast RC VACAPES RC	From 4 hrs to 11 days
				1	5	JAX RC Navy Cherry Point RC VACAPES RC	
				2	10	offshore Fort Pierce, FL GOMEX RC JAX RC SFOMF Northeast RC VACAPES RC	
				4	20	JAX RC	
				2	10	Navy Cherry Point RC	
				8	40	NUWC Newport	
				12	60	VACAPES RC	
Acoustic	Pierside Sonar Testing	Pierside testing to ensure systems are fully functional in a controlled pierside environment prior to at-sea test activities.	ASW3, HF1, HF3, HF8, M3, MF1, MF1K, MF3, MF9, MF10	1	5	NSB New London NS Norfolk Port Canaveral, FL	Up to 3 wks total per ship, with each source run independently and not continuously during this time.
				11	55	Bath, ME	
				5	25	NSB New London	
				4	20	NSB Kings Bay	
				8	40	Newport, RI	
				13	65	NS Norfolk	
				2	10	Pascagoula, MS	
				3	15	Port Canaveral, FL	
				2	10	PNS	
Acoustic	Submarine Sonar Testing/ Maintenance	Pierside testing of submarine systems occurs periodically following major	HF1, HF3, M3, MF3	16	80	Norfolk, VA	Up to 3 wks, with intermittent use of active sonar
				24	120	PNS	

		maintenance periods and for routine maintenance.		31-35	167	VACAPES RC	
Acoustic	Surface Ship Sonar Testing/ Maintenance	Pierside and at-sea testing of ship systems occur periodically following major maintenance periods and for routine maintenance.	ASW3, MF1, MF1K, MF9, MF10	1	5	JAX RC	Up to 3 wks, with intermittent use of active sonar
				1	5	NS Mayport	
				3	15	NS Norfolk	
				3	15	VACAPES RC	
Acoustic, Explosive	Torpedo (Explosive) Testing	Air, surface, or submarine crews employ explosive and non-explosive torpedoes against artificial targets.	ASW3, HF1, HF5, HF6, MF1, MF3, MF4, MF5, MF6, TORP1, TORP2, E8, E11	4	20	GOMEX RC offshore Fort Pierce, FL Key West RC Navy Cherry Point RC Northeast RC VACAPES RC	1-2 day during daylight hrs
				2	10	GOMEX RC JAX RC Northeast RC VACAPES RC	
Acoustic	Torpedo (Non-Explosive) Testing	Air, surface, or submarine crews employ non-explosive torpedoes against submarines or surface vessels. When performed on a testing range, these torpedoes may be launched from a range craft or fixed structures and may use artificial targets.	ASW3, ASW4, HF1, HF6, MF1, MF3, MF4, MF5, MF6, TORP1, TORP2, TORP 3	7	35	GOMEX RC	Up to 2 wks
				11	55	offshore Fort Pierce, FL	
				2	8	JAX RC	
				7	35	Navy Cherry Point RC	
				8	38	Northeast RC	
				30	150	NUWC Newport	
				11	55	VACAPES RC	
Acoustic	Counter-measure Testing	Countermeasure testing involves the testing of systems that will detect, localize, track, and attack incoming weapons	ASW3, HF5, TORP1, TORP2	5	25	GOMEX RC JAX RC NUWC Newport VACAPES RC Key West RC	From 4 hrs to 6 days, depending on countermeasure being tested

		including marine vessel targets. Testing includes surface ship torpedo defense systems and marine vessel stopping payloads.		2-4	14	GOMEX RC JAX RC Northeast RC VACAPES RC	
Mine Warfare							
Acoustic, Explosive	Mine Counter-measure and Neutralization Testing	Air, surface, and subsurface vessels neutralize threat mines and mine-like objects.	E4, E11	13	65	NSWC Panama City	1-10 days, with intermittent use of countermeasure/ neutralization system during this period
				6	30	VACAPES RC	
Acoustic, Explosive	Mine Counter-measure Mission Package Testing	Vessels and associated aircraft conduct mine countermeasure operations.	HF4, SAS2, E4	19	95	GOMEX RC	1-2 wks with intervals of mine countermeasure mission package use during this time
				10	50	JAX RC	
				11	55	NSWC Panama City	
				2	10	SFOMF	
				5	25	VACAPES RC	
Acoustic	Mine Detection and Classification Testing	Air, surface, and subsurface vessels and systems detect, classify, and avoid mines and mine-like objects. Vessels also assess their potential susceptibility to mines and mine-like objects.	HF1,HF 4, HF8, MF1, MF1K, MF9	6	30	GOMEX RC	Up to 24 days, with up to 12 hrs of acoustic activity each day
				10	50	Navy Cherry Point RC	
				47-55	250	NSWC Panama City	
				7-12	43	Riviera Beach, FL	
				4	20	SFOMF	
				3	15	VACAPES RC	
Surface Warfare							
Explosive	Gun Testing – Large Caliber	Crews defend against targets with large-caliber guns.	E3, E5	12	60	GOMEX RC JAX RC Key West RC Navy Cherry Point RC Northeast RC VACAPES RC	1-2 wks
				1	5	GOMEX RC	
				1	5	JAX RC	
				1	5	Key West RC	
				1	5	Navy Cherry Point RC	
				1	5	Northeast RC	
				33	165	NSWC Panama City	
				5	25	VACAPES RC	

Explosive	Gun Testing – Medium-Caliber	Airborne and surface crews defend against targets with medium-caliber guns.	E1	12	60	GOMEX RC JAX RC Key West RC Navy Cherry Point RC Northeast RC VACAPES RC	1-2 wks, with intervals of gun testing
				102	510	NSWC Panama City	
				5	24	VACAPES RC	
Explosive	Missile and Rocket Testing	Missile and rocket testing includes various missiles or rockets fired from submarines and surface combatants. Testing of the launching system and ship defense is performed.	E6, E10	13	65	GOMEX RC JAX RC Key West RC Navy Cherry Point RC Northeast RC VACAPES RC	1 day to 2 wks
				1	5	GOMEX RC	
				2	10	JAX RC	
				5	25	Northeast RC	
				22	110	VACAPES RC	
Unmanned Systems							
Acoustic, Explosive	Unmanned Underwater Vehicle Testing	Testing involves the development or upgrade of unmanned underwater vehicles. This may include testing of mine detection capabilities, evaluating the basic functions of individual platforms, or complex events with multiple vehicles.	ASW4, FLS2, HF1, HF4, HF5, HF6, HF7, LF5, MF9, MF10, SAS1, SA2, SAS3, VHF1, E8	16	80	GOMEX RC JAX RC NUWC Newport	Up to 35 days. Some propulsion systems (gliders) could operate continuously for multiple months.
				41	205	GOMEX RC	
				25	125	JAX RC	
				145-146	727	NSWC Panama City	
				308-309	1,541	NUWC Newport	
				9	45	Riviera Beach, FL	
				42	210	SFOMF	
Vessel Evaluation							
Explosive	Large Ship Shock Trial	Underwater detonations are used to test new ships or major upgrades.	E17	0-1	1	GOMEX JAX RC VACAPES RC	Typically over 4 wks, with 1 detonation per week. However, smaller charges may be detonated on consecutive days.

Explosive	Surface Warfare Testing	Tests capability of shipboard sensors to detect, track, and engage surface targets. Testing may include ships defending against surface targets using explosive and non-explosive rounds, gun system structural test firing and demonstration of the response to Call for Fire against land-based targets (simulated by sea-based locations).	E1, E5, E8	2	10	GOMEX RC	7 days
				13	65	JAX RC	
				1	5	Key West RC	
				10	50	Northeast RC	
				9	45	VACAPES RC	
Acoustic	Undersea Warfare Testing	Ships demonstrate capability of countermeasure systems and underwater surveillance, weapons engagement, and communications systems. This tests ships' ability to detect, track, and engage underwater targets.	ASW3, ASW4, HF4, HF8, MF1, MF1K, MF4, MF5, MF9, MF10, TORP1, TORP2	2	10	JAX RC Northeast RC VACAPES RC	Up to 10 days
				0-2	4	JAX RC Northeast RC VACAPES RC Navy Cherry Point RC SFOMF	
				2	10	GOMEX RC	
				6	30	JAX RC	
				3	15	Northeast RC	
				2	10	VACAPES RC	
Explosive	Small Ship Shock Trial	Underwater detonations are used to test new ships or major upgrades.	E16	0-3	3	JAX RC VACAPES RC	Typically over 4 wks, with 1 detonation per week. However, smaller charges may be detonated on consecutive days.
Acoustic	Submarine Sea Trials – Weapons System Testing	Submarine weapons and sonar systems are tested at-sea to meet integrated combat system certification	HF1, M3, MF3, MF9, MF10, TORP2	2	10	offshore Fort Pierce, FL	Up to 7 days

		requirements.		2	10	GOMEX RC	
				6	30	JAX RC	
				6	30	Northeast RC	
				2	10	SFOMF	
				6	30	VACAPES RC	
Other Testing Activities							
Acoustic	Insertion/ Extraction	Testing of submersibles capable of inserting and extracting personnel and payloads into denied areas from strategic distances.	MF3, MF9	4	20	Key West RC	Up to 30 days
				264	1,320	NSWC Panama City	
Acoustic	Acoustic Component Testing	Various surface vessels, moored equipment, and materials are tested to evaluate performance in the marine environment.	FLS2, HF5, HF7, LF5, MF9, SAS2	33	165	SFOMF	1 day to multiple months
Acoustic	Semi-Stationary Equipment Testing	Semi-stationary equipment (e.g., hydrophones) is deployed to determine functionality.	AG, ASW3, ASW4, HF5, HF6, LF4, LF5, MF9, MF10, SD1,SD 2	4	20	Newport, RI	From 20 min to multiple days
				11	55	NSWC Panama City	
				190	950	NUWC Newport	
Acoustic	Towed Equipment Testing	Surface vessels or unmanned surface vehicles deploy and tow equipment to determine functionality of towed systems.	HF6, LF4, MF9	36	180	NUWC Newport	Typically 2-8 hrs
Acoustic	Signature Analysis Operations	Surface ship and submarine testing of electromagnetic, acoustic, optical, and radar signature measurements.	ASW2, HF1, LF4, LF5, LF6, M3, MF9, MF10	1	5	JAX RC	Periodically over multiple days
				59	295	SFOMF	

Notes: JEB LC-FS: Joint Expeditionary Base Little Creek-Fort Story; NS: Naval Station; NSB: Naval Submarine Base; NSWC: Naval Surface Warfare Center; NUWC: Naval Undersea Warfare Center; PNS: Portsmouth Naval Shipyard; SFOMF: South Florida Ocean Measurement Facility Testing Range

[1] For activities where the maximum number of events could vary between years, the information is presented as 'representative-maximum' number of events per year. For activities where no variation is anticipated, only the maximum number of events within a single year is provided.

[2] Locations given are areas where activities typically occur. However, activities could be conducted in other locations within the AFTT Study Area. Where multiple locations are provided within a single cell, the number of activities could occur in any of the locations, not in each of the locations.

Office of Naval Research

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

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

Stressor Activity	*Activity Name*	*Activity Description*	*Source Bin*	*Annual # of Activities*	*5-Year # of Activities*	*Location*	*Duration*
Acoustic and Oceanographic Science and Technology							
Acoustic, Explosive	Acoustic and Oceanographic Research	Research using active transmissions from sources deployed from ships and unmanned underwater vehicles. Research sources can be used as proxies for current and future Navy systems.	AG, ASW2, BB4, BB5, BB6, BB7, LF3, LF4, LF5, MF8, MF9, E1, E3	4	18	GOMEX RC	Up to 14 days
				7	35	Northeast RC	
				2	8	VACAPES RC	
Acoustic	Emerging Mine Countermeasure Technology Research	Test involves the use of broadband acoustic sources on unmanned underwater vehicles.	BB1, BB2, SAS4	1	5	JAX RC	Up to 14 days
				2	10	Northeast RC	
				1	5	VACAPES RC	

Notes: GOMEX: Gulf of Mexico; JAX: Jacksonville, Florida; RC: Range Complex; VACAPES: Virginia Capes

Summary of Acoustic and Explosive Sources Analyzed for Training and Testing

Table 8 through Table 11 show the acoustic source classes and numbers, explosive source bins and numbers, airgun sources, and pile driving and removal activities associated with Navy training and testing activities in the AFTT Study Area that were analyzed in the Navy's rulemaking and LOA application. Table 8 shows the acoustic source classes (*i.e.,* LF, MF, and HF) that could occur in any year under the Proposed Activity for training and testing activities. Under the Proposed Activity, acoustic source class use would vary annually, consistent with the number of annual activities summarized above. The five-year total for the Proposed Activity takes into account that annual variability.

Table 8. Acoustic Source Classes Analyzed and Numbers Used during Training and Testing Activities.

Source Class Category	Bin	Description	Unit[1]	Training		Testing	
				Annual[2]	5-year Total	Annual[2]	5-year Total
Low-Frequency (LF): Sources that produce signals less than 1 kHz	LF3	LF sources greater than 200 dB	H	0	0	1,308	6,540
	LF4	LF sources equal to 180 dB and up to 200 dB	H	0	0	971	4,855
			C	0	0	20	100
	LF5	LF sources less than 180 dB	H	9	43	1,752	8,760
	LF6	LF sources greater than 200 dB with long pulse lengths	H	145 – 175	784	40	200
Mid-Frequency (MF): Tactical and non-tactical sources that produce signals between 1 – 10 kHz	MF1	Hull-mounted surface ship sonars (*e.g.*, AN/SQS-53C and AN/SQS-61)	H	5,005 – 5,605	26,224	3,337	16,684
	MF1 K	Kingfisher mode associated with MF1 sonars	H	117	585	152	760
	MF3	Hull-mounted submarine sonars (*e.g.*, AN/BQQ-10)	H	2,078 – 2,097	10,428	1,257	6,271
	MF4	Helicopter-deployed dipping sonars (*e.g.*, AN/AQS-22 and AN/AQS-13)	H	591 – 611	2,994	370 – 803	2,624
	MF5	Active acoustic sonobuoys (*e.g.*, DICASS)	C	6,708– 6,836	33,796	5,070 – 6,182	27,412
	MF6	Active underwater sound signal devices (*e.g.*, MK84)	C	0	0	1,256 – 1,341	6,390
	MF8	Active sources (greater than 200 dB) not otherwise binned	H	0	0	348	1,740

Source Class Category	Bin	Description	Unit [1]	Training		Testing	
				Annual[2]	5-year Total	Annual[2]	5-year Total
	MF9	Active sources (equal to 180 dB and up to 200 dB) not otherwise binned	H	0	0	7,395–7,562	37,173
	MF10	Active sources (greater than 160 dB, but less than 180 dB) not otherwise binned	H	870	4,348	5,690	28,450
	MF11	Hull-mounted surface ship sonars with an active duty cycle greater than 80%	H	873 – 1,001	4,621	1,424	7,120
	MF12	Towed array surface ship sonars with an active duty cycle greater than 80%	H	367 – 397	1,894	1,388	6,940
	MF14	Oceanographic MF sonar	H	0	0	1,440	7,200
High-Frequency (HF): Tactical and non-tactical sources that produce signals between 10 – 100 kHz	HF1	Hull-mounted submarine sonars (*e.g.*, AN/BQQ-10)	H	1,928 – 1,932	9,646	397	1,979
	HF3	Other hull-mounted submarine sonars (classified)	H	0	0	31	154
	HF4	Mine detection, classification, and neutralization sonar (*e.g.*, AN/SQS-20)	H	5,411 – 6,371	29,935	30,772 – 30,828	117,916
	HF5	Active sources (greater than 200 dB) not otherwise binned	H	0	0	1,864 – 2,056	9,704
			C	0	0	40	200
	HF6	Active sources (equal to 180 dB and up to 200 dB) not otherwise binned	H	0	0	2,193	10,868
	HF7	Active sources (greater than 160 dB, but less than 180 dB) not otherwise binned	H	0	0	1,224	6,120
	HF8	Hull-mounted surface ship sonars (*e.g.*, AN/SQS-61)	H	20	100	2,084	10,419
Very High-Frequency Sonars (VHF): Non-tactical sources that produce signals between 100 – 200 kHz	VHF1	VHF sources greater than 200 dB	H	0	0	12	60
Anti-Submarine Warfare (ASW): Tactical sources (*e.g.*, active sonobuoys and acoustic counter-measures systems) used during	ASW 1	MF systems operating above 200 dB	H	582 – 641	3,028	820	4,100
	ASW	MF Multistatic	C	1,476 –	7,540	4,756 –	25,480

Source Class Category	*Bin*	*Description*	*Unit* [1]	*Training*		*Testing*	
				Annual[2]	*5-year Total*	*Annual*[2]	*5-year Total*
ASW training and testing activities	2	Active Coherent sonobuoy (*e.g.*, AN/SSQ-125)		1,556		5,606	
	ASW 3	MF towed active acoustic countermeasure systems (*e.g.*, AN/SLQ-25)	H	4,485 – 5,445	24,345	2,941–3,325	15,472
	ASW 4	MF expendable active acoustic device countermeasures (*e.g.*, MK 3)	C	425 – 431	2,137	3,493	17,057
	ASW 5	MF sonobuoys with high duty cycles	H	572 – 652	3,020	608 – 628	3,080
Torpedoes (TORP): Source classes associated with the active acoustic signals produced by torpedoes	TORP 1	Lightweight torpedo (*e.g.*, MK 46, MK 54, or Anti-Torpedo Torpedo)	C	57	285	806 – 980	4,336
	TORP 2	Heavyweight torpedo (*e.g.*, MK 48)	C	80	400	344 – 408	1,848
	TORP 3	Heavyweight torpedo (*e.g.*, MK 48)	C	0	0	100	440
Forward Looking Sonar (FLS): Forward or upward looking object avoidance sonars used for ship navigation and safety	FLS2	HF sources with short pulse lengths, narrow beam widths, and focused beam patterns	H	0	0	1,224	6,120
Acoustic Modems (M): Systems used to transmit data through the water	M3	MF acoustic modems (greater than 190 dB)	H	0	0	634	3,169
Swimmer Detection Sonars (SD): Systems used to detect divers and sub- merged swimmers	SD1 – SD2	HF and VHF sources with short pulse lengths, used for the detection of swimmers and other objects for the purpose of port security	H	0	0	176	880
Synthetic Aperture Sonars (SAS): Sonars in which active acoustic signals are post-processed to form high-resolution images of the seafloor	SAS1	MF SAS systems	H	0	0	960	4,800
	SAS2	HF SAS systems	H	0 – 8,400	25,200	3,512	17,560
	SAS3	VHF SAS systems	H	0	0	960	4,800
	SAS4	MF to HF broadband mine countermeasure sonar	H	0	0	960	4,800
Broadband Sound Sources (BB): Sonar systems with large frequency spectra, used for various purposes	BB1	MF to HF mine countermeasure sonar	H	0	0	960	4,800
	BB2	HF to VHF mine countermeasure sonar	H	0	0	960	4,800
	BB4	LF to MF oceanographic source	H	0	0	876 – 3,252	6,756
	BB5	LF to MF oceanographic source	H	0	0	672	3,360

Source Class Category	Bin	Description	Unit 1	Training		Testing	
				Annual[2]	5-year Total	Annual[2]	5-year Total
	BB6	HF oceanographic source	H	0	0	672	3,360
	BB7	LF oceanographic source	C	0	0	120	600

1: C = Count; H = Hours
2: Expected annual use may vary per bin because the number of events may vary from year to year, as described in Section 1.5 (Proposed Activity) of the Navy's rulemaking and LOA application.

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Table 9 shows the number of airguns shots proposed in AFTT Study Area for training and testing activities.

TABLE 9—TRAINING AND TESTING AIRGUN SOURCES QUANTITATIVELY ANALYZED IN THE AFTT STUDY AREA

Source class category	Bin	Unit [1]	Training		Testing	
			Annual	5-year total	Annual	5-year total
Airguns (AG): Small underwater airguns	AG	C	0	0	604	3,020

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

Table 10 summarizes the impact pile driving and vibratory pile removal activities that would occur during a 24-hour period. Annually, for impact pile driving, the Navy will drive 119 piles, two times a year for a total of 238 piles. Over the five-year period of the rule, the Navy will drive a total of 1190 piles by impact pile driving. Annually, for vibratory pile driving, the Navy will drive 119 piles, two times a year for a total of 238 piles. Over the 5-year period of the rule, the Navy will drive a total of 1190 piles by vibratory pile driving.

TABLE 10—SUMMARY OF PILE DRIVING AND REMOVAL ACTIVITIES PER 24-HOUR PERIOD

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

Table 11 shows the number of in-water explosives that could be used in any year under the Proposed Activity for training and testing activities. Under the Proposed Activity, bin use would vary annually, consistent with the number of annual activities summarized above. The five-year total for the Proposed Activity takes into account that annual variability.

TABLE 11—EXPLOSIVE SOURCE BINS ANALYZED AND NUMBERS USED DURING TRAINING AND TESTING ACTIVITIES

Bin	Net explosive weight [1] (lb)	Example explosive source	Training		Testing	
			Annual [2]	5-year total	Annual [2]	5-year total
E1	0.1–0.25	Medium-caliber projectile	7,700	38,500	17,840–26,840	116,200
E2	>0.25–0.5	Medium-caliber projectile	210–214	1,062	0	0
E3	>0.5–2.5	Large-caliber projectile	4,592	22,960	3,054–3,422	16,206
E4	>2.5–5	Mine neutralization charge	127–133	653	746–800	3,784
E5	>5–10	5-inch projectile	1,436	7,180	1,325	6,625
E6	>10–20	Hellfire missile	602	3,010	28–48	200
E7	>20–60	Demo block/shaped charge	4	20	0	0
E8	>60–100	Light-weight torpedo	22	110	33	165
E9	>100–250	500 lb bomb	66	330	4	20
E10	>250–500	Harpoon missile	90	450	68–98	400
E11	>500–650	650 lb mine	1	5	10	50
E12	>650–1,000	2,000 lb bomb	18	90	0	0
E16 [3]	>7,250–14,500	Littoral Combat Ship full ship shock trial.	0	0	0–12	12

TABLE 11—EXPLOSIVE SOURCE BINS ANALYZED AND NUMBERS USED DURING TRAINING AND TESTING ACTIVITIES—Continued

Bin	Net explosive weight [1] (lb)	Example explosive source	Training		Testing	
			Annual [2]	5-year total	Annual [2]	5-year total
E17 [3]	>14,500–58,000	Aircraft carrier full ship shock trial	0	0	0–4	4

[1] Net Explosive Weight refers to the equivalent amount of TNT the actual weight of a munition may be larger due to other components.
[2] Expected annual use may vary per bin because the number of events may vary from year to year, as described in Section 1.5 (Proposed Activity).
[3] Shock trials consist of four explosions each. In any given year there could be 0–3 small ship shock trials (E16) and 0–1 large ship shock trials (E17). Over a 5-year period, there could be three small ship shock trials (E16) and one large ship shock trial (E17).

Vessel Movement

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

The number of Navy vessels used in the AFTT Study Area varies based on military training and testing requirements, deployment schedules, annual budgets, and other unpredictable factors. Most training and testing activities involve the use of vessels. These activities could be widely dispersed throughout the AFTT Study Area, but would be typically conducted near naval ports, piers, and range areas. Activities involving vessel movements occur intermittently and are variable in duration, ranging from a few hours up to two weeks. The number of activities that include the use of vessels for testing events is lower (around 10 percent) than the number of training activities.

Standard Operating Procedures

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

Because standard operating procedures are essential to safety and mission success, the Navy considers them to be part of the proposed activities under the Proposed Activity, and has included them in the environmental analysis. Standard operating procedures that are recognized as providing a potential secondary benefit on marine mammals during training and testing activities are noted below and discussed in more detail within the AFTT Draft EIS/OEIS.

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

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

Duration and Location

Training and testing activities would be conducted in the AFTT Study Area throughout the year from 2018 through 2023 for the five-year period covered by the regulations.

The AFTT Study Area (see Figure 1.1–1 of the Navy's rulemaking and LOA application) includes areas of the western Atlantic Ocean along the east coast of North America, portions of the Caribbean Sea, and the Gulf of Mexico. The AFTT Study Area begins at the mean high tide line along the U.S. coast and extends east to the 45-degree west longitude line, north to the 65 degree north latitude line, and south to approximately the 20-degree north latitude line. The AFTT Study Area also includes Navy pierside locations, bays, harbors, and inland waterways, and civilian ports where training and testing occurs. The AFTT Study Area generally follows the Commander Task Force 80 area of operations, covering approximately 2.6 million nmi^2 of ocean area, and includes designated Navy range complexes and associated operating areas (OPAREAs) and special use airspace. While the AFTT Study Area itself is very large, it is important to note that the vast majority of Navy training and testing occurs in designated range complexes and testing ranges.

A Navy range complex consists of geographic areas that encompasses a water component (above and below the surface) and airspace, and may encompass a land component where training and testing of military platforms, tactics, munitions, explosives, and electronic warfare systems occur. Range complexes include established operating areas and special use airspace, which may be further divided to provide better control of the area for safety reasons. Please refer to the regional maps provided in the Navy's rulemaking and LOA application (Figure 2.2–1 through Figure 2.2–3) for additional detail of the range complexes and testing ranges. The range complexes and testing ranges are described in the following sections.

Northeast Range Complex

The Northeast Range Complexes include the Boston Range Complex, Narragansett Bay Range Complex, and Atlantic City Range Complex (see Figure 2.2–1 in the Navy's rulemaking and LOA application). These range complexes span 761 miles (mi) along the coast from Maine to New Jersey. The Northeast Range Complexes include special use airspace with associated warning areas and surface and subsurface sea space of the Boston OPAREA, Narragansett Bay OPAREA, and Atlantic City OPAREA. The Northeast Range Complexes include over 25,000 nmi^2 of special use airspace. The altitude at which aircraft may fly varies from just above the surface to 60,000 ft, except for one specific warning area (W–107A) in the Atlantic City Range Complex, which is

18,000 ft to unlimited altitudes. Six warning areas are located within the Northeast Range Complexes. The Boston, Narragansett Bay, and Atlantic City OPAREAs Encompass over 45,000 nmi^2 of sea space and undersea space. The Boston, Narragansett Bay, and Atlantic City OPAREAs are offshore of the states of Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, and New Jersey. The OPAREAs of the three complexes are outside 3 nmi but within 200 nmi from shore.

Naval Undersea Warfare Center Division, Newport Testing Range

The Naval Undersea Warfare Center Division, Newport Testing Range includes the waters of Narragansett Bay, Rhode Island Sound, Block Island Sound, Buzzards Bay, Vineyard Sound, and Long Island Sound (see Figure 2.2–1 in the Navy's rulemaking and LOA application). A portion of Naval Undersea Warfare Center Division, Newport Testing Range air space is under restricted area R–4105A, known as No Man's Land Island, and a minimal amount of testing occurs in this airspace. Three restricted areas are located within the Naval Undersea Warfare Center Division, Newport Testing Range:

- Coddington Cove Restricted Area, 0.5 nmi^2 adjacent to Naval Undersea Warfare Center Division, Newport;
- Narragansett Bay Restricted Area (6.1 nmi^2 area surrounding Gould Island) including the Hole Test Area and the North Test Range; and
- Rhode Island Sound Restricted Area, a rectangular box (27.2 nmi^2) located in Rhode Island and Block Island Sounds.

Virginia Capes Range Complex

The Virginia Capes (VACAPES) Range Complex spans 270 mi. along the coast from Delaware to North Carolina from the shoreline to 155 nmi seaward (see Figure 2.2–1 in the Navy's rulemaking and LOA application). The VACAPES Range Complex includes special use airspace with associated warning and restricted areas, and surface and subsurface sea space of the VACAPES OPAREA. The VACAPES Range Complex also includes established mine warfare training areas located within the lower Chesapeake Bay and off the coast of Virginia. The VACAPES Range Complex includes over 28,000 nmi^2 of special use airspace. Flight altitudes range from surface to ceilings of 18,000 ft to unlimited altitudes. Five warning areas are located within the VACAPES Range Complex. Restricted airspace extends from the shoreline to approximately the 3 nmi state territorial sea limit within the VACAPES Range Complex, and is designated as R–6606. The VACAPES Range Complex shore boundary roughly follows the shoreline from Delaware to North Carolina; the seaward boundary extends 155 nmi into the Atlantic Ocean proximate to Norfolk, Virginia. The VACAPES OPAREA encompasses over 27,000 nmi^2 of sea space and undersea space. The VACAPES OPAREA is offshore of the states of Delaware, Maryland, Virginia, and North Carolina.

Navy Cherry Point Complex

The Navy Cherry Point Range Complex, off the coast of North Carolina and South Carolina, encompasses the sea space from the shoreline to 120 nmi seaward. The Navy Cherry Point Range Complex includes special use airspace with associated warning areas and surface and subsurface sea space of the Navy's Cherry Point OPAREA (see Figure 2.2–2 in the Navy's rulemaking and LOA application). The Navy Cherry Point Range Complex is adjacent to the U.S. Marine Corps Cherry Point and Camp Lejeune Range Complexes associated with Marine Corps Air Station Cherry Point and Marine Corps Base Camp Lejeune. The Navy Cherry Point Range Complex includes over 18,000 nmi^2 of special use airspace. The airspace varies from the surface to unlimited altitudes. A single warning area is located within the Navy Cherry Point Range Complex. The Navy Cherry Point Range Complex is roughly aligned with the shoreline and extends out 120 nmi into the Atlantic Ocean. The Navy Cherry Point OPAREA encompasses over 18,000 nmi^2 of sea space and undersea space.

Jacksonville Range Complex

The Jacksonville (JAX) Range Complex spans 520 mi along the coast from North Carolina to Florida from the shoreline to 250 nmi seaward. The JAX Range Complex includes special use airspace with associated warning areas and surface and subsurface sea space of the Charleston and JAX OPAREAs. The Undersea Warfare Training Range is located within the JAX Range Complex (see Figure 2.2–2 in the Navy's rulemaking and LOA application).

Naval Surface Warfare Center Carderock Division, South Florida Ocean Measurement Facility Testing Range

The Naval Surface Warfare Center Carderock Division operates the South Florida Ocean Measurement Facility Testing Range, an offshore testing area in support of various Navy and non-Navy programs. The South Florida Ocean Measurement Facility Testing Range is located adjacent to the Port Everglades entrance channel in Fort Lauderdale, Florida (see Figure 2.2–2 in the Navy's rulemaking and LOA application). The test area at the South Florida Ocean Measurement Facility Testing Range includes an extensive cable field located within a restricted anchorage area and two designated submarine operating areas. The South Florida Ocean Measurement Facility Testing Range does not have associated special use airspace. The airspace adjacent to the South Florida Ocean Measurement Facility Testing Range is managed by the Fort Lauderdale International Airport. Air operations at the South Florida Ocean Measurement Facility Testing Range are coordinated with Fort Lauderdale International Airport by the air units involved in the testing events. The South Florida Ocean Measurement Facility Testing Range is divided into four subareas:

- The Port Everglades Shallow Submarine Operating Area is a 120-nmi^2 area that encompasses nearshore waters from the shoreline to 900 ft deep and 8 nmi offshore.
- The Training Minefield is a 41-nmi^2 area used for special purpose surface ship and submarine testing where the test vessels are restricted from maneuvering and require additional protection. This Training Minefield encompasses waters from 60 to 600 ft deep and from 1 to 3 nmi offshore.
- The Port Everglades Deep Submarine Operating Area is a 335-nmi^2 area that encompasses the offshore range from 900 to 2,500 ft in depth and from 9 to 25 nmi offshore.
- The Port Everglades Restricted Anchorage Area is an 11-nmi^2 restricted anchorage area ranging in depths from 60 to 600 ft where the majority of the South Florida Ocean Measurement Facility Testing Range cables run from offshore sensors to the shore facility and where several permanent measurement arrays are used for vessel signature acquisition.

Key West Range Complex

The Key West Range Complex lies off the southwestern coast of mainland Florida and along the southern Florida Keys, extending seaward into the Gulf of Mexico 150 nmi and south into the Straits of Florida 60 nmi. The Key West Range Complex includes special use airspace with associated warning areas and surface and subsurface sea space of the Key West OPAREA (see Figure 2.2–3 in the Navy's rulemaking and LOA application). The Key West Range Complex includes over 20,000 nmi^2 of special use airspace. Flight altitudes range from the surface to unlimited altitudes. Eight warning areas, Bonefish Air Traffic Control Assigned Airspace, and Tortugas Military Operating Area are located within the Key West Range Complex. The Key West OPAREA is over 8,000 nmi^2 of sea space and undersea space south of Key West, Florida.

Naval Surface Warfare Center, Panama City Division Testing Range

The Naval Surface Warfare Center, Panama City Division Testing Range is located off the panhandle of Florida and Alabama, extending from the shoreline to 120 nmi seaward, and includes St. Andrew Bay. Naval Surface Warfare Center, Panama City Division Testing Range also includes special use airspace and offshore surface and subsurface waters of offshore OPAREAs (see Figure 2.2–3 of the Navy's rulemaking and LOA application). Special use airspace associated with Naval Surface Warfare Center, Panama City Division Testing Range includes three warning areas. The Naval Surface Warfare Center, Panama City Division Testing Range includes the waters of St. Andrew Bay and the sea space within the Gulf of Mexico from the mean high tide line to 120 nmi offshore. The Panama City OPAREA covers just over 3,000 nmi^2 of sea space and lies off the coast of the Florida panhandle. The Pensacola OPAREA lies off the coast of Alabama and Florida west of the Panama City OPAREA and totals just under 5,000 nmi^2.

Gulf of Mexico Range Complex

Unlike most of the range complexes previously described, the Gulf of Mexico (GOMEX) Range Complex includes geographically separated areas throughout the Gulf of Mexico. The GOMEX Range Complex includes special use airspace with associated warning areas and restricted airspace and surface and subsurface sea space of the Panama City, Pensacola, New Orleans, and Corpus Christi OPAREAs (see Figure 2.2–3 of the Navy's rulemaking and LOA application). The GOMEX Range Complex includes approximately 20,000 nmi^2 of special use airspace. Flight altitudes range from the surface to unlimited. Six warning areas are located within the GOMEX Range Complex. Restricted airspace associated with the Pensacola OPAREA, designated R–2908, extends from the shoreline to approximately 3 nmi offshore. The GOMEX Range Complex encompasses approximately 17,000 nmi^2 of sea and undersea space and includes 285 nmi of coastline. The OPAREAs span from the eastern shores of Texas to the western panhandle of Florida. They are described as follows:

- Panama City OPAREA lies off the coast of the Florida panhandle and totals approximately 3,000 nmi^2;
- Pensacola OPAREA lies off the coast of Florida west of the Panama City OPAREA and totals approximately 4,900 nmi^2;
- New Orleans OPAREA lies off the coast of Louisiana and totals approximately 2,600 nmi^2; and
- Corpus Christi OPAREA lies off the coast of Texas and totals approximately 6,900 nmi^2.

Inshore Locations

Although within the boundaries of the Range Complexes and testing ranges detailed above, various inshore locations including piers, bays, and civilian ports are identified in Figure 2.2–1 through Figure 2.2–3 of the Navy's rulemaking and LOA application.

Pierside locations include channels and transit routes in ports and facilities associated with the following Navy ports and naval shipyards:

- Portsmouth Naval Shipyard, Kittery, Maine;
- Naval Submarine Base New London, Groton, Connecticut;
- Naval Station Norfolk, Norfolk, Virginia;
- Joint Expeditionary Base Little Creek-Fort Story, Virginia Beach, Virginia;
- Norfolk Naval Shipyard, Portsmouth, Virginia;
- Naval Submarine Base Kings Bay, Kings Bay, Georgia;
- Naval Station Mayport, Jacksonville, Florida; and
- Port Canaveral, Cape Canaveral, Florida.

Commercial shipbuilding facilities in the following cities are also in the AFTT Study Area:

- Bath, Maine;
- Groton, Connecticut;
- Newport News, Virginia;
- Mobile, Alabama; and
- Pascagoula, Mississippi.

Bays, Harbors, and Inland Waterways

Inland waterways used for training and testing activities include:

- Narragansett Bay Range Complex/Naval Undersea Warfare Center Division, Newport Testing Range: Thames River, Narragansett Bay;
- VACAPES Complex: James River and tributaries, Broad Bay, York River, Lower Chesapeake Bay;
- JAX Range Complex: southeast Kings Bay, Cooper River, St. Johns River; and
- GOMEX Range Complex/Naval Surface Warfare Center, Panama City Division (including Naval Surface Warfare Center, Panama City Division): St. Andrew Bay Civilian Ports.

Civilian ports included for civilian port defense training events are listed in Section A.2.7.3 of Appendix A (Navy Activity Descriptions) of the Navy's AFTT DEIS/OEIS and include:

- Boston, Massachusetts;
- Earle, New Jersey;
- Delaware Bay, Delaware;
- Hampton Roads, Virginia;
- Morehead City, North Carolina;
- Wilmington, North Carolina;
- Savannah, Georgia;
- Kings Bay, Georgia;
- Mayport, Florida;
- Port Canaveral, Florida;
- Tampa, Florida;
- Beaumont, Texas; and
- Corpus Christi, Texas.

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

Marine mammal species that have the potential to occur in the AFTT Study Area and their associated stocks are presented in Table 12 along with an abundance estimate, an associated coefficient of variation value, and best/minimum abundance estimates. Some marine mammal species, such as manatees, are not managed by NMFS, but by the U.S. Fish and Wildlife Service and therefore not discussed below. The Navy proposes to take individuals of 39 marine mammal species by Level A and B harassment incidental to training and testing activities from the use of sonar and other transducers, in-water detonations, airguns, and impact pile driving/vibratory extraction. In addition, the Navy is requesting nine mortalities of four marine mammal stocks during ship shock trials, and three takes by serious injury or mortality from vessel strikes over the five-year period. One marine mammal species, the North Atlantic right whale (*Eubalaena glacialis*), has critical habitat designated under the Endangered Species Act in the AFTT Study Area (described below).

Information on the status, distribution, abundance, and vocalizations of marine mammal species in the AFTT Study Area may be found in Chapter 4 Affected Species Status and Distribution of the Navy's rulemaking and LOA application. Additional information on the general biology and ecology of marine mammals are included in the AFTT DEIS/OEIS. In addition, NMFS annually publishes Stock Assessment Reports (SARs) for all marine mammals in U.S. Exclusive Economic Zone (EEZ) waters, including stocks that occur within the AFTT

Study Area—U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessment Reports (Hayes et *al.,* 2017) (see *https://www.fisheries.noaa.gov/resource/document/us-atlantic-and-gulf-mexico-marine-mammal-stock-assessments-2016*).

The species carried forward for analysis are those likely to be found in the AFTT Study Area based on the most recent data available, and do not include stocks or species that may have once inhabited or transited the area but have not been sighted in recent years and therefore are extremely unlikely to occur in the AFTT Study Area (*e.g.,* species which were extirpated because of factors such as nineteenth and twentieth century commercial exploitation).

The species not carried forward for analysis are the bowhead whale, beluga whale, and narwhal as these would be considered extralimital species. Bowhead whales are likely to be found only in the Labrador Current open ocean area, but in 2012 and 2014, the same bowhead whale was observed in Cape Cod Bay, which represents the southernmost record of this species in the western North Atlantic. In June 2014, a beluga whale was observed in several bays and inlets of Rhode Island and Massachusetts (Swaintek, 2014). This sighting likely represents an extralimital beluga whale occurrence in the Northeast United States Continental Shelf Large Marine Ecosystem. There is no stock of narwhal that occurs in the U.S. EEZ in the Atlantic Ocean; however, populations from Hudson Strait and Davis Strait may extend into the AFTT Study Area at its northwest extreme. However, narwhals prefer cold Arctic waters those wintering in Hudson Strait occur in smaller numbers. For these reasons, the likelihood of any Navy activities encountering and having any effect on any of these three species is so slight as to be unlikely; therefore, these species do not require further analysis.

TABLE 12—MARINE MAMMALS WITH THE POTENTIAL TO OCCUR WITHIN THE AFTT STUDY AREA

Common name	Scientific name [1]	Stock [2]	ESA/MMPA status [3]	Stock abundance [4] best/minimum population	Occurrence in AFTT study area [5]		
					Open ocean	Large marine ecosystems	Inland waters
Order Cetacea							
Suborder Mysticeti (baleen whales)							
Family Balaenidae (right whales)							
Bowhead whale	*Balaena mysticetus*.	Eastern Canada-West Greenland.	Endangered, strategic, depleted.	7,660 (4,500–11,100) [6].	Labrador Current	Newfoundland-Labrador Shelf, West Greenland Shelf, Northeast U.S. Continental Shelf.	NA.
North Atlantic right whale.	*Eubalaena glacialis*.	Western	Endangered, strategic, depleted.	440 (0)/440	Gulf Stream, Labrador Current, North Atlantic Gyre.	Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf, Gulf of Mexico (extralimital).	NA.
Family Balaenopteridae (rorquals)							
Blue whale	*Balaenoptera musculus*.	Western North Atlantic (Gulf of St. Lawrence).	Endangered, strategic, depleted.	Unknown/440 [11]	Gulf Stream, North Atlantic Gyre, Labrador Current.	Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf, Southeast U.S. Continental Shelf, Caribbean Sea, and Gulf of Mexico (strandings only).	NA.
Bryde's whale	*Balaenoptera brydei/edeni*.	Northern Gulf of Mexico.	Proposed Endangered, Strategic.	33 (1.07)/16	Gulf Stream, North Atlantic Gyre.	Gulf of Mexico	NA.
Fin whale	*Balaenoptera physalus*.	Western North Atlantic.	Endangered, strategic, depleted.	1,618 (0.33)/1,234	Gulf Stream, North Atlantic Gyre, Labrador Current.	Caribbean Sea, Gulf of Mexico, Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf.	NA.
		West Greenland	Endangered, strategic, depleted.	4,468 (1,343–14,871) [9].	Labrador Current	West Greenland Shelf.	NA.

TABLE 12—MARINE MAMMALS WITH THE POTENTIAL TO OCCUR WITHIN THE AFTT STUDY AREA—Continued

Common name	Scientific name [1]	Stock [2]	ESA/MMPA status [3]	Stock abundance [4] best/minimum population	Occurrence in AFTT study area [5]		
					Open ocean	Large marine ecosystems	Inland waters
		Gulf of St. Lawrence.	Endangered, strategic, depleted.	328 (306–350) [10]	....	Newfoundland-Labrador Shelf, Scotian Shelf.	NA.
Humpback whale ..	*Megaptera novaeangliae*.	Gulf of Maine	Strategic	823 (0)/823	Gulf Stream, North Atlantic Gyre, Labrador Current.	Gulf of Mexico, Caribbean Sea, Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf.	NA.
Minke whale	*Balaenoptera acutorostrata*.	Canadian Eastern Coastal.	NA	2,591 (0.81)/1,425	Gulf Stream, North Atlantic Gyre, Labrador Current.	Caribbean Sea, Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf.	NA.
		West Greenland [7]	NA	16,609 (7,172–38,461)/NA [7].	Labrador Current	West Greenland Shelf.	NA.
Sei whale	*Balaenoptera borealis*.	Nova Scotia	Endangered, strategic, depleted.	357 (0.52)/236	Gulf Stream, North Atlantic Gyre.	Gulf of Mexico, Caribbean Sea, Southeast Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf.	NA.
		Labrador Sea	Endangered, strategic, depleted.	Unknown [8]	Labrador Current	Newfoundland-Labrador Shelf, West Greenland Shelf.	NA.
Family Physeteridae (sperm whale)							
Suborder Odontoceti (toothed whales)							
Sperm whale	*Physeter macrocephalus*.	North Atlantic	Endangered, strategic, depleted.	2,288 (0.28)/1,815	Gulf Stream, North Atlantic Gyre, Labrador Current.	Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf, Caribbean Sea.	NA.
		Northern Gulf of Mexico.	Endangered, strategic, depleted.	763 (0.38)/560	NA	Gulf of Mexico	NA.
		Puerto Rico and U.S. Virgin Islands.	Endangered, strategic, depleted.	Unknown	North Atlantic Gyre.	Caribbean Sea	NA.
Family Kogiidae (sperm whales)							
Pygmy and dwarf sperm whales.	*Kogia breviceps* and *Kogia sima*.	Western North Atlantic.	NA	3,785 (0.47)/2,598 [12].	Gulf Stream, North Atlantic Gyre.	Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf, Caribbean Sea.	NA.
		Northern Gulf of Mexico.	NA	186 (1.04)/90 [12] ...	NA	Gulf of Mexico, Caribbean Sea.	NA.
Family Monodontidae (beluga whale and narwhal)							
Beluga whale	*Delphinapterus leucas*.	Eastern High Arctic/Baffin Bay [13].	NA	21,213 (10,985–32,619) [13].	Labrador Current	West Greenland Shelf.	NA.
		West Greenland [14]	NA	10,595 (4.904–24,650) [14].	NA	West Greenland Shelf.	NA.

TABLE 12—MARINE MAMMALS WITH THE POTENTIAL TO OCCUR WITHIN THE AFTT STUDY AREA—Continued

Common name	Scientific name [1]	Stock [2]	ESA/MMPA status [3]	Stock abundance [4] best/minimum population	Occurrence in AFTT study area [5]		
					Open ocean	Large marine ecosystems	Inland waters
Narwhal	*Monodon monoceros*.	NA [15]	NA	NA [15]	NA	Newfoundland-Labrador Shelf, West Greenland Shelf.	NA.
Family Ziphiidae (beaked whales)							
Blainville's beaked whale.	*Mesoplodon densirostris*.	Western North Atlantic [16].	NA	7,092 (0.54)/4,632 [17].	Gulf Stream, North Atlantic Gyre, Labrador Current.	Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf.	NA.
		Northern Gulf of Mexico.	NA	149 (0.91)/77 [18]	NA	Gulf of Mexico, Caribbean Sea.	NA.
Cuvier's beaked whale.	*Ziphius cavirostris*	Western North Atlantic [16].	NA	6,532 (0.32)/5,021	Gulf Stream, North Atlantic Gyre.	Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf.	NA.
		Northern Gulf of Mexico [16].	NA	74 (1.04)/36	NA	Gulf of Mexico, Caribbean Sea.	NA.
		Puerto Rico and U.S. Virgin Islands.	Strategic	Unknown	NA	Caribbean Sea	NA.
Gervais' beaked whale.	*Mesoplodon europaeus*.	Western North Atlantic [16].	NA	7,092 (0.54)/4,632 [17].	Gulf Stream, North Atlantic Gyre.	Southeast U.S. Continental Shelf, Northeast United States Continental Shelf.	NA.
		Northern Gulf of Mexico [16].	NA	149 (0.91)/77 [18]	Gulf Stream, North Atlantic Gyre.	Gulf of Mexico, Caribbean Sea.	NA.
Northern bottlenose whale.	*Hyperoodon ampullatus*.	Western North Atlantic.	NA	Unknown	Gulf Stream, North Atlantic Gyre, Labrador Current.	Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf.	NA.
Sowerby's beaked whale.	*Mesoplodon bidens*.	Western North Atlantic [16].	NA	7,092 (0.54)/4,632 [17].	Gulf Stream, North Atlantic Gyre.	Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf.	NA.
True's beaked whale.	*Mesoplodon mirus*	Western North Atlantic [16].	NA	7,092 (0.54)/4,632 [17].	Gulf Stream, North Atlantic Gyre.	Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf.	NA.
Family Delphinidae (dolphins)							
Atlantic spotted dolphin.	*Stenella frontalis*	Western North Atlantic [16].	NA	44,715 (0.43)/31,610.	Gulf Stream	Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf.	NA.
		Northern Gulf of Mexico.	NA	Unknown	NA	Gulf of Mexico, Caribbean Sea.	NA.
		Puerto Rico and U.S. Virgin Islands.	Strategic	Unknown	NA	Caribbean Sea	NA.
Atlantic white-sided dolphin.	*Lagenorhynchus acutus*.	Western North Atlantic.	NA	48,819 (0.61)/30,403.	Gulf Steam, Labrador Current.	Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf.	NA.

TABLE 12—MARINE MAMMALS WITH THE POTENTIAL TO OCCUR WITHIN THE AFTT STUDY AREA—Continued

Common name	Scientific name [1]	Stock [2]	ESA/MMPA status [3]	Stock abundance [4] best/minimum population	Occurrence in AFTT study area [5]		
					Open ocean	Large marine ecosystems	Inland waters
Clymene dolphin	*Stenella clymene*	Western North Atlantic [16].	NA	Unknown	Gulf Stream	Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf.	NA.
		Northern Gulf of Mexico [16].	NA	129 (1.0)/64	NA	Gulf of Mexico, Caribbean Sea.	NA.
Common bottlenose dolphin.	*Tursiops truncatus*	Western North Atlantic Offshore [19].	Strategic, depleted.	77,532 (0.40)/ 56,053.	Gulf Stream, North Atlantic Gyre.	Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf, Scotian Shelf.	NA.
		Western North Atlantic Northern Migratory Coastal [20].	NA	11,548 (0.36)/ 8,620.	NA	Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf.	Long Island Sound, Sandy Hook Bay, Lower Chesapeake Bay, James River, Elizabeth River.
		Western North Atlantic Southern Migratory Coastal [20].	Strategic, depleted.	9,173 (0.46)/6,326	NA	Southeast U.S. Continental Shelf.	Lower Chesapeake Bay, James River, Elizabeth River, Beaufort Inlet, Cape Fear River, Kings Bay, St. Johns River.
		Western North Atlantic South Carolina/Georgia Coastal [20].	Strategic, depleted.	4,377 (0.43)/3,097	NA	Southeast U.S. Continental Shelf.	Kings Bay, St. Johns River.
		Northern North Carolina Estuarine System [20].	Strategic	823 (0.06)/782	NA	Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf.	Beaufort Inlet, Cape Fear River.
		Southern North Carolina Estuarine System [20].	Strategic	Unknown	NA	Southeast U.S. Continental Shelf.	Beaufort Inlet, Cape Fear River
		Northern South Carolina Estuarine System [20].	Strategic	Unknown	NA	Southeast U.S. Continental Shelf.	NA.
		Charleston Estuarine System [20].	Strategic	Unknown	NA	Southeast U.S. Continental Shelf.	NA.
Common bottlenose dolphin (continued).	*Tursiops truncatus*	Northern Georgia/ Southern South Carolina Estuarine System [20].	Strategic	Unknown	NA	Southeast U.S. Continental Shelf.	NA.
		Central Georgia Estuarine System [20].	Strategic	192 (0.04)/185	NA	Southeast U.S. Continental Shelf.	NA.
		Southern Georgia Estuarine System [20].	Strategic	194 (0.05)/185	NA	Southeast U.S. Continental Shelf.	Kings Bay, St. Johns River.
		Western North Atlantic Northern Florida Coastal [20].	Strategic, depleted.	1,219 (0.67)/730	NA	Southeast U.S. Continental Shelf.	Kings Bay, St. Johns River.
		Jacksonville Estuarine System [20].	Strategic	Unknown	NA	Southeast U.S. Continental Shelf.	Kings Bay, St. Johns River.
		Western North Atlantic Central Florida Coastal [20].	Strategic, depleted.	4,895 (0.71)/2,851	NA	Southeast U.S. Continental Shelf.	Port Canaveral.
		Indian River Lagoon Estuarine System [20].	Strategic	Unknown	NA	Southeast U.S. Continental Shelf.	Port Canaveral.
		Biscayne Bay [16]	Strategic	Unknown	NA	Southeast U.S. Continental Shelf.	NA.
		Florida Bay [16]	NA	Unknown	NA	Gulf of Mexico	NA.
		Northern Gulf of Mexico Continental Shelf [20].	NA	51,192 (0.10)/ 46,926.	NA	Gulf of Mexico	NA.

TABLE 12—MARINE MAMMALS WITH THE POTENTIAL TO OCCUR WITHIN THE AFTT STUDY AREA—Continued

Common name	Scientific name [1]	Stock [2]	ESA/MMPA status [3]	Stock abundance [4] best/minimum population	Occurrence in AFTT study area [5]		
					Open ocean	Large marine ecosystems	Inland waters
		Gulf of Mexico Eastern Coastal [20].	NA	12,388 (0.13)/11,110.	NA	Gulf of Mexico	NA.
		Gulf of Mexico Northern Coastal [20].	NA	7,185 (0.21)/6,044	NA	Gulf of Mexico	St. Andrew Bay, Pascagoula River.
		Gulf of Mexico Western Coastal [20].	NA	20,161 (0.17)/17,491.	NA	Gulf of Mexico	Corpus Christi Bay, Galveston Bay.
		Northern Gulf of Mexico Oceanic [20].	NA	5,806 (0.39)/4,230	NA	Gulf of Mexico	NA.
		Northern Gulf of Mexico Bay, Sound, and Estuaries [21].	Strategic	Unknown	NA	Gulf of Mexico	St. Andrew Bay, Pascagoula River, Sabine Lake, Corpus Christi Bay, and Galveston Bay.
		Barataria Bay Estuarine System [20].	Strategic	Unknown	NA	Gulf of Mexico	NA.
		Mississippi Sound, Lake Borgne, Bay Boudreau [20].	Strategic	901 (0.63)/551	NA	Gulf of Mexico	NA.
		St. Joseph Bay [20]	Strategic	152 (0.08)/Unknown.	NA	Gulf of Mexico	NA.
		Choctawhatchee Bay [20].	Strategic	179 (0.04)/Unknown.	NA	Gulf of Mexico	NA.
		Puerto Rico and U.S. Virgin Islands.	Strategic	Unknown	NA	Caribbean Sea	NA.
False killer whale	*Pseudorca crassidens.*	Western North Atlantic [22].	Strategic	442 (1.06)/212	NA	Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf.	NA.
		Northern Gulf of Mexico [16].	NA	Unknown	NA	Gulf of Mexico, Caribbean Sea.	NA.
Fraser's dolphin	*Lagenodelphis hosei.*	Western North Atlantic [23].	NA	Unknown	Gulf Stream	Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf.	NA.
		Northern Gulf of Mexico [16].	NA	Unknown	NA	Gulf of Mexico, Caribbean Sea.	NA.
Killer Whale	*Orcinus orca*	Western North Atlantic [22].	NA	Unknown	Gulf Stream, North Atlantic Gyre, Labrador Current.	Southeast U.S. Continental Shelf, Northeast United States Continental Shelf, Scotian Shelf, Newfoundland—Labrador Shelf.	NA.
		Northern Gulf of Mexico [16].	NA	28 (1.02)/14	NA	Gulf of Mexico, Caribbean Sea.	NA.
Long-finned pilot whale.	*Globicephala melas.*	Western North Atlantic.	Strategic	5,636 (0.63)/3,464	Gulf Stream	Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf.	NA.
Melon-headed Whale.	*Peponocephala electra.*	Western North Atlantic [23].	NA	Unknown	Gulf Stream, North Atlantic Gyre.	Southeast U.S. Continental Shelf.	NA.
		Northern Gulf of Mexico [16].	NA	2,235 (0.75)/1,274	NA	Gulf of Mexico, Caribbean Sea.	NA.
Pantropical spotted-dolphin.	*Stenella attenuate*	Western North Atlantic [16].	NA	3,333 (0.91)/1,733	Gulf Stream	Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf.	NA.
		Northern Gulf of Mexico [22].	NA	50,880 (0.27)/40,699.	NA	Gulf of Mexico, Caribbean Sea.	NA.
Pygmy Killer Whales.	*Feresa attenuata*	Western North Atlantic [16].	NA	Unknown	Gulf Stream, North Atlantic Gyre.	Southeast U.S. Continental Shelf.	NA.

TABLE 12—MARINE MAMMALS WITH THE POTENTIAL TO OCCUR WITHIN THE AFTT STUDY AREA—Continued

Common name	Scientific name [1]	Stock [2]	ESA/MMPA status [3]	Stock abundance [4] best/minimum population	Occurrence in AFTT study area [5]		
					Open ocean	Large marine ecosystems	Inland waters
		Northern Gulf of Mexico [16].	NA	152 (1.02)/75	NA	Gulf of Mexico, Caribbean Sea.	NA.
Risso's dolphin	*Grampus griseus*	Western North Atlantic.	NA	18,250 (0.46)/ 12,619.	Gulf Stream, North Atlantic Gyre.	Southeast U.S. Continental Shelf, Northeast United States Continental Shelf, Scotian Shelf, Newfoundland—Labrador Shelf.	NA.
		Northern Gulf of Mexico.	NA	2,442 (0.57)/1,563	NA	Gulf of Mexico, Caribbean Sea.	NA.
Rough-toothed dolphin.	*Steno bredanensis*.	Western North Atlantic [16].	NA	271 (1.00)/134	Gulf Stream, North Atlantic Gyre.	Caribbean Sea Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf.	NA.
		Northern Gulf of Mexico.	NA	624 (0.99)/311	NA	Gulf of Mexico, Caribbean Sea.	NA.
Short-finned pilot whale.	*Globicephala macrorhynchus*.	Western North Atlantic.	Strategic	21,515 (0.37)/ 15,913.	NA	Northeast Continental Shelf, Southeast U.S. Continental Shelf.	NA.
		Northern Gulf of Mexico [22].	NA	2,415 (0.66)/1,456	NA	Gulf of Mexico, Caribbean Sea.	NA.
		Puerto Rico and U.S. Virgin Islands.	Strategic	Unknown	NA	Caribbean Sea	NA.
Spinner dolphin	*Stenella longirostris*.	Western North Atlantic [16].	NA	Unknown	Gulf Stream, North Atlantic Gyre.	Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf.	NA.
		Northern Gulf of Mexico [16].	NA	11,441 (0.83)/ 6,221.	NA	Gulf of Mexico, Caribbean Sea.	NA.
		Puerto Rico and U.S. Virgin Islands.	Strategic	Unknown	NA	Caribbean Sea	NA.
Striped dolphin	*Stenella coeruleoalba*.	Western North Atlantic [16].	NA	54,807 (0.30)/ 42,804.	Gulf Stream	Northeast U.S. Continental Shelf, Scotian Shelf.	NA.
		Northern Gulf of Mexico [16].	NA	1,849 (0.77)/1,041	NA	Gulf of Mexico, Caribbean Sea.	NA.
Short-beaked common dolphin.	*Delphinus delphis*	Western North Atlantic.	NA	70,184 (0.28)/ 55,690.	Gulf Stream	Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf.	NA.
White-beaked dolphin.	*Lagenorhynchus albirostris*.	Western North Atlantic [23].	NA	2,003 (0.94)/1,023	Labrador Current	Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf.	NA.
Family Phocoenidae (porpoises)							
Harbor porpoise	*Phocoena*	Gulf of Maine/Bay of Fundy.	NA	79,883 (0.32)/ 61,415.	NA	Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf.	Narragansett Bay, Rhode Island Sound, Block Island Sound, Buzzards Bay, Vineyard Sound, Long Island Sound, Piscataqua River, Thames River, Kennebec River.

TABLE 12—MARINE MAMMALS WITH THE POTENTIAL TO OCCUR WITHIN THE AFTT STUDY AREA—Continued

Common name	Scientific name [1]	Stock [2]	ESA/MMPA status [3]	Stock abundance [4] best/minimum population	Occurrence in AFTT study area [5]		
					Open ocean	Large marine ecosystems	Inland waters
		Gulf of St. Lawrence [24].	NA	Unknown [24]	Labrador Current	Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf.	NA.
		Newfoundland [25]	NA	Unknown [25]	Labrador Current	Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf.	NA.
		Greenland [26]	NA	Unknown [26]	Labrador Current	Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf, West Greenland Shelf.	NA.
Order Carnivora							
Suborder Pinnipedia							
Family Phocidae (true seals)							
Gray seal	*Halichoerus grypus*.	Western North Atlantic.	NA	Unknown	NA	Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf.	Narragansett Bay, Rhode Island Sound, Block Island Sound, Buzzards Bay, Vineyard Sound, Long Island Sound, Piscataqua River, Thames River, Kennebeck River.
Harbor seal	*Phoca vitulina*	Western North Atlantic.	NA	75,834 (0.15)/ 66,884.	NA	Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf.	Chesapeake Bay, Narragansett Bay, Rhode Island Sound, Block Island Sound, Buzzards Bay, Vineyard Sound, Long Island Sound, Piscataqua River, Thames River, Kennebeck River.
Harp seal	*Pagophilus groenlandicus*.	Western North Atlantic.	NA	Unknown	NA	Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf.	NA.
Hooded seal	*Cystophora cristata*.	Western North Atlantic.	NA	Unknown	NA	Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf, West Greenland Shelf.	Narragansett Bay, Rhode Island Sound, Block Island Sound, Buzzards Bay, Vineyard Sound, Long Island Sound, Piscataqua River, Thames River, Kennebec River.

Notes: CV: Coefficient of variation; ESA: Endangered Species Act; MMPA: Marine Mammal Protection Act; NA: Not applicable.
[1] Taxonomy follows (Committee on Taxonomy, 2016).
[2] Stock designations for the U.S. EEZ and abundance estimates are from Atlantic and Gulf of Mexico Stock Assessment Reports prepared by NMFS (*Hayes et al.,* 2017), unless specifically noted.

[3] Populations or stocks defined by the MMPA as "strategic" for one of the following reasons: (1) The level of direct human-caused mortality exceeds the potential biological removal level; (2) based on the best available scientific information, numbers are declining and species are likely to be listed as threatened species under the ESA within the foreseeable future; (3) species are listed as threatened or endangered under the ESA; (4) species are designated as depleted under the MMPA.

[4] Stock abundance, CV, and minimum population are numbers provided by the Stock Assessment Reports (*Hayes et al.,* 2017). The stock abundance is an estimate of the number of animals within the stock. The CV is a statistical metric used as an indicator of the uncertainty in the abundance estimate. The minimum population estimate is either a direct count (*e.g.,* pinnipeds on land) or the lower 20th percentile of a statistical abundance estimate.

[5] Occurrence in the AFTT Study Area includes open ocean areas—Labrador Current, North Atlantic Gyre, Gulf Stream, and coastal/shelf waters of seven large marine ecosystems—West Greenland Shelf, Newfoundland-Labrador Shelf, Scotian Shelf, and Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, Caribbean Sea, Gulf of Mexico, and inland waters of Kennebec River, Piscataqua River, Thames River, Narragansett Bay, Rhode Island Sound, Block Island Sound, Buzzards Bay, Vineyard Sound, Long Island Sound, Sandy Hook Bay, Lower Chesapeake Bay, James River, Elizabeth River, Beaufort Inlet, Cape Fear River, Kings Bay, St. Johns River, Port Canaveral, St. Andrew Bay, Pascagoula River, Sabine Lake, Corpus Christi Bay, and Galveston Bay.

[6] The bowhead whale population off the west coast of Greenland is not managed by NMFS and, therefore, does not have an associated Stock Assessment Report. Abundance and 95 percent highest density interval were presented in (Frasier *et al.,* 2015).

[7] The West Greenland stock of minke whales is not managed by NMFS and, therefore, does not have an associated Stock Assessment Report. Abundance and 95 percent confidence interval were presented in (Heide-Jørgensen *et al.,* 2010).

[8] The Labrador Sea stock of sei whales is not managed by NMFS and, therefore, does not have an associated Stock Assessment Report. Information was obtained in (Prieto *et al.,* 2014).

[9] The West Greenland stock of fin whales is not managed by NMFS and, therefore, does not have an associated Stock Assessment Report. Abundance and 95 percent confidence interval were presented in (Heide-Jørgensen *et al.,* 2010).

[10] The Gulf of St. Lawrence stock of fin whales is not managed by NMFS and, therefore, does not have an associated Stock Assessment Report. Abundance and 95 percent confidence interval were presented in (Ramp *et al.,* 2014).

[11] Photo identification catalogue count of 440 recognizable blue whale individuals from the Gulf of St. Lawrence is considered a minimum population estimate for the western North Atlantic stock (Waring *et al.,* 2010).

[12] Estimates include both the pygmy and dwarf sperm whales in the western North Atlantic (Waring *et al.,* 2014) and the northern Gulf of Mexico (Waring *et al.,* 2013).

[13] Beluga whales in the Atlantic are not managed by NMFS and have no associated Stock Assessment Report. Abundance and 95 percent confidence interval for the Eastern High Arctic/Baffin Bay stock were presented in (Innes e*t al.,* 2002).

[14] Beluga whales in the Atlantic are not managed by NMFS and have no associated Stock Assessment Report. Abundance and 95 percent confidence interval for the West Greenland stock were presented in (Heide-Jørgensen *et al.,* 2009).

[15] NA = Not applicable. Narwhals in the Atlantic are not managed by NMFS and have no associated Stock Assessment Report.

[16] Estimates for these western North Atlantic stocks are from Waring *et al.* (2014) and the northern Gulf of Mexico stock are from (Waring *et al.,* 2013) as applicable.

[17] Estimate includes undifferentiated Mesoplodon species.

[18] Estimate includes Gervais' and Blainville's beaked whales.

[19] Estimate may include sightings of the coastal form.

[20] Estimates for these Gulf of Mexico stocks are from Waring et al. (2016).

[21] NMFS is in the process of writing individual stock assessment reports for each of the 32 bay, sound, and estuary stocks.

[22] Estimates for these stocks are from Waring *et al.,* (2015).

[23] Estimates for these western North Atlantic stocks are from (Waring *et al.,* 2007).

[24] Harbor porpoise in the Gulf of St. Lawrence are not managed by NMFS and have no associated Stock Assessment Report.

[25] Harbor porpoise in Newfoundland are not managed by NMFS and have no associated Stock Assessment Report.

[26] Harbor porpoise in Greenland are not managed by NMFS and have no associated Stock Assessment Report.

Important Marine Mammal Habitat

ESA Critical Habitat for North Atlantic Right Whale

The only ESA-listed marine mammal with designated critical habitat within the AFTT Study Area is the North Atlantic right whale (NARW). On February 26, 2016, NMFS issued a final rule (81 FR 4837) to replace the critical habitat for NARW with two new areas. The areas now designated as critical habitat contain approximately 29,763 nmi^2 of marine habitat in the Gulf of Maine and Georges Bank region (Unit 1), essential for NARW foraging and off the Southeast U.S. coast (Unit 2), including the coast of North Carolina, South Carolina, Georgia, and Florida, which are key areas essential for calving. These two ESA-designated critical habitats were established to replace three smaller previously ESA-designated critical habitats (Cape Cod Bay/Massachusetts Bay/Stellwagen Bank, Great South Channel, and the coastal waters of Georgia and Florida in the southeastern United States) that had been designated by NMFS in 1994 (59 FR 28805; June 3, 1994). Two additional areas in Canadian waters, Grand Manan Basin and Roseway Basin, were identified and designated as critical habitat under Canada's endangered species law (Section 58 (5) of the Species at Risk Act (SARA), S. C. 2002, c. 29) and identified in Final Recovery Strategy for the North Atlantic right whale, posted June 2009 on the SARA Public Registry.

Unit 1 encompasses the Gulf of Maine and Georges Bank region including the large embayments of Cape Cod Bay and Massachusetts Bay and deep underwater basins, as well as state waters, except for inshore areas, bays, harbors, and inlets, from Maine through Massachusetts in addition to Federal waters, all of which are key areas. Unit 1 includes the large embayments of Cape Cod Bay and Massachusetts Bay but does not include inshore areas, bays, harbors and inlets. It also does not include waters landward of the 72 COLREGS lines (33 CFR part 80). A large portion of the critical habitat of Unit 1 lies within the coastal waters of the Boston OPAREA (see Figure 4.1–1 of the Navy's rulemaking and LOA application).

Unit 2 consists of all marine waters from Cape Fear, North Carolina, southward to approximately 27 nmi below Cape Canaveral, Florida, within the area bounded on the west by the shoreline and the 72 COLREGS lines, and on the east by rhumb lines connecting the specific points described below. The physical features correlated with the distribution of NARW in the southern critical habitat area provide an optimum environment for calving in the waters of Brunswick County, North Carolina; Horry, Georgetown, Charleston, Colleton, Beaufort, and Jasper Counties, South Carolina; Chatham, Bryan, Liberty, McIntosh, Glynn, and Camden Counties, Georgia; and Nassau, Duval, St. John's, Flagler, Volusia, and Brevard Counties, Florida. For example, the bathymetry of the inner and nearshore middle shelf area minimizes the effect of strong winds and offshore waves, limiting the formation of large waves and rough water. The average temperature of critical habitat waters is cooler during the time right whales are present due to a lack of influence by the Gulf Stream and cool freshwater runoff from coastal areas. The water temperatures may provide an optimal balance between offshore waters that are too warm for nursing mothers to tolerate, yet not too cool for calves that may only have minimal fatty insulation. Reproductive females and calves are expected to be concentrated in the critical habitat from December through April. A majority of the critical habitat of Unit 2 lies within the coastal waters of the Jacksonville OPAREA and the Charleston OPAREA (see Figure 4.1–1 of the Navy's rulemaking and LOA application).

Important Habitat for Sperm Whales

Sperm whales aggregate at the mouth of the Mississippi River and along the continental slope in or near cyclonic cold-core eddies (counterclockwise water movements in the northern hemisphere with a cold center) or anticyclone eddies (clockwise water movements in the northern hemisphere) (Davis *et al.,* 2007). Habitat models for sperm whale occurrence indicate a high probability of suitable habitat along the shelf break off the Mississippi delta, Desoto Canyon, and western Florida (Best e*t al.,* 2012; Weller *et al.,* 2000). Due to the nutrient-rich freshwater plume from the Mississippi Delta the continental slope waters south of the Mississippi River Delta and the Mississippi Canyon play an important ecological role for sperm whales (Davis *et al.,* 2002; Weller *et al.,* 2000). Sightings during extensive surveys in this area consisted of mixed-sex groups of females, immature males, and mother-calf pairs as well as groups of bachelor males (Jochens *et al.,* 2008; Weller *et al.,* 2000). Female sperm whales have displayed a high level of site fidelity and year round utilization off the Mississippi River Delta compared to males (Jochens *et al.,* 2008) suggesting this area may also support year-round feeding, breeding, and nursery areas (Baumgartner *et al.,* 2001; NMFS, 2010), although the seasonality of breeding in Gulf of Mexico sperm whales is not known (Jochens e*t al.,* 2008).

Biologically Important Areas

Biologically Important Areas (BIAs) include areas of known importance for reproduction, feeding, or migration, or areas where small and resident populations are known to occur (LeBrecque *et al.,* 2015a and 2015b). Unlike Critical Habitat, these areas are not formally designated pursuant to any statute or law, but are a compilation of the best available science intended to inform impact and mitigation analyses.

On the East Coast, 19 of the 24 identified BIAs fall within or overlap with the AFTT Study area—10 feeding (2 for minke whale, 1 for sei whale, 3 for fin whale, 3 for NARW, and 1 for humpback), 1 migration (NARW), 2 reproduction (NARW), 6 small and resident population (1 for harbor porpoise and 5 for bottlenose dolphin). Figures 11.2–1 through11.2–2 of the Navy's rulemaking and LOA application illustrate how these BIAs overlap with Navy OPAREAs on the East Coast. In the Gulf of Mexico, 4 of the 12 identified BIAs for small and resident populations overlap the AFTT study area (1 for Bryde's whale and 3 for Bottlenose dolphin). Figures 11.2–3 of the Navy's rulemaking and LOA application illustrate how these BIAs overlap with Navy OPAREAs in the Gulf of Mexico.

Large Whales Feeding BIAs—East Coast Within the AFTT Study Area

Two minke whale feeding BIAs are located in the northeast Atlantic from March through November in waters less than 200 m in the southern and southwestern section of the Gulf of Maine including Georges Bank, the Great South Channel, Cape Cod Bay and Massachusetts Bay, Stellwagen Bank, Cape Anne, and Jeffreys Ledge (LaBrecque *et al.* (2015a, 2015b)) LaBrecque *et al.* (2015b) delineated a feeding area for sei whales in the northeast Atlantic between the 25-meter contour off coastal Maine and Massachusetts to the 200-meter contour in central Gulf of Maine, including the northern shelf break area of Georges Bank. The feeding area also includes the southern shelf break area of Georges Bank from 100 to 2,000 m and the Great South Channel. Feeding activity is concentrated from May through November with a peak in July and August. LaBrecque *et al.* (2015b) identified three feeding areas for fin whales in the North Atlantic within the AFTT Study Area: (1) June to October in the northern Gulf of Maine; (2) year-round in the southern Gulf of Maine, and (3) March to October east of Montauk Point. LaBrecque *et al.* (2015b) delineated a humpback whale feeding area in the Gulf of Maine, Stellwagen Bank, and Great South Channel.

NARW BIAs—East Coast Within the AFTT Study Area

LaBrecque *et al.* (2015b) identified three seasonal NARW feeding areas BIAs located in or near the AFTT Study Area (1) February to April on Cape Cod Bay and Massachusetts Bay (2) April to June in the Great South Channel and on the northern edge of Georges Bank, and (3) June to July and October to December on Jeffreys Ledge in the western Gulf of Maine. A mating BIA was identified in the central Gulf of Maine (from November through January), a calving BIA in the southeast Atlantic (from mid-November to late April) and the migratory corridor area BIA along the U.S. East Coast between the NARW southern calving grounds and northern feeding areas (see Figure 11.2–1 and 11.2–2 of the Navy's rulemaking and LOA application for how these BIAs overlap with Navy OPAREAs).

Harbor Porpoise BIA—East Coast Within the AFTT Study Area

LaBrecque *et al.* (2015b) identified a small and resident population BIA for harbor porpoise in the Gulf of Maine (see Figure 11.2–1 of the Navy's rulemaking and LOA application). From July to September, harbor porpoises are concentrated in waters less than 150 m deep in the northern Gulf of Maine and southern Bay of Fundy. During fall (October to December) and spring (April to June), harbor porpoises are widely dispersed from New Jersey to Maine, with lower densities farther north and south (LaBrecque *et al.,* 2015b).

Bottlenose Dolphin BIAs—East Coast Within the AFTT Study Area

LaBrecque *et al.* (2015b) identified nine small and resident bottlenose dolphin population areas within estuarine areas along the east coast of the U.S. (see Figure 11.2–2 of the Navy's rulemaking and LOA application). These areas include estuarine and nearshore areas extending from Pamlico Sound, North Carolina down to Florida Bay, Florida (LaBrecque *et al.,* 2015b). The Northern North Carolina Estuarine System, Southern North Carolina Estuarine System, and Charleston Estuarine System populations partially overlap with nearshore portions of the Navy Cherry Point Range Complex and Jacksonville Estuarine System Populations partially overlaps with nearshore portions of the Jacksonville Range Complex. The Southern Georgia Estuarine System Population area also overlaps with the Jacksonville Range Complex, specifically within Naval Submarine Base Kings Bay, Kings Bay, Georgia and includes estuarine and intercoastal waterways from Altamaha Sound, to the Cumberland River (LaBrecque *et al.,* 2015b). The remaining four BIAs are outside but adjacent to the AFTT Study Area boundaries.

Bottlenose Dolphin BIAs—Gulf of Mexico Within the AFTT Study Area

LaBrecque *et al.* (2015) also described 11 year-round BIAs for small and resident estuarine stocks of bottlenose dolphin that primarily inhabit inshore waters of bays, sounds, and estuaries (BSE) in the Gulf of Mexico (see Figure 11.2–3 in the Navy's rulemaking and LOA application). Of the 11 BIAs identified for the BSE bottlenose dolphins in the Gulf of Mexico, three overlap with the Gulf of Mexico Range Complex (Aranas Pass Area, Texas; Mississippi Sound Area, Mississippi; and St. Joseph Bay Area, Florida), while eight are located adjacent to the AFTT Study Area boundaries.

Bryde's Whale BIA—Gulf of Mexico Within the AFTT Study Area

The Gulf of Mexico Bryde's whale is a very small population that is genetically distinct from other Bryde's whales and not genetically diverse within the Gulf of Mexico (Rosel and Wilcox, 2014). Further, the species is typically observed only within a narrowly circumscribed area within the eastern Gulf of Mexico. Therefore, this area is described as a year-round BIA by LaBrecque *et al.* (2015). Although survey effort has covered all oceanic waters of the U.S. Gulf of Mexico, whales were observed only between approximately the 100- and 300-m isobaths in the eastern Gulf of Mexico from the head of the De Soto Canyon (south of Pensacola, Florida) to northwest of Tampa Bay, Florida (Maze-Foley and Mullin, 2006; Waring *et al.,* 2016; Rosel and Wilcox, 2014; Rosel *et al.,* 2016). Rosel *et al.* (2016) expanded this description by stating that, due to the depth of some sightings, the area is more appropriately defined to the 400-m isobath and westward to Mobile Bay, Alabama, in order to provide some buffer around the deeper sightings and to include all sightings in the northeastern Gulf of Mexico.

National Marine Sanctuaries

Under Title III of the Marine Protection, Research, and Sanctuaries Act of 1972 (also known as the National Marine Sanctuaries Act (NMSA)), NOAA can establish as national marine sanctuaries (NMS) areas of the marine environment with special conservation, recreational, ecological, historical, cultural, archaeological, scientific, educational, or aesthetic qualities. Sanctuary regulations prohibit destroying, causing the loss of, or injuring any sanctuary resource managed under the law or regulations for that sanctuary (15 CFR part 922). NMS are managed on a site-specific basis, and each sanctuary has site-specific regulations. Most, but not all sanctuaries have site-specific regulatory exemptions from the prohibitions for certain military activities. Additionally, section 304(d) of the NMSA requires Federal agencies to consult with the NOAA Office of National Marine Sanctuaries whenever their Proposed Activity are likely to destroy, cause the loss of, or injure a sanctuary resource.

Three NMS are in the vicinity of or overlap with the AFTT Study Area including the Gerry E. Studds Stellwagen Bank National Marine Sanctuary (Stellwagen Bank NMS), Gray's Reef National Marine Sanctuary (Gray's Reef NMS), and Florida Keys National Marine Sanctuary (Florida Keys NMS). Stellwagen Bank NMS sits at the mouth of Massachusetts Bay, just three miles south of Cape Ann, three miles north of Cape Cod and 25 mi due east of Boston and provides feeding and nursery grounds for marine mammals including NARW, humpback, sei, and fin whales. The Stellwagen Bank NMS is within critical habitat for the NARW for foraging (Unit 1). Gray's Reef NMS is 19 mi east of Sapelo Island Georgia, in the South Atlantic Bight (the offshore area between Cape Hatteras, North Carolina and Cape Canaveral, Florida) and is within the designated critical habitat for NARW calving in the southeast (Unit 2). Florida Keys NMS protects 2,900 nmi ^{2} of waters surrounding the Florida Keys, from south of Miami westward to encompass the Dry Tortugas, excluding Dry Tortugas National Park and supports a resident group of bottlenose dolphin (Florida Bay Population BIA). Two additional sanctuaries, Flower Gardens NMS in the Gulf of Mexico and Monitor NMS off of North Carolina, were determined by the Navy as unnecessary to consult on based on the lack of impacts to sanctuary resources for section 304(d) under NMSA and therefore not discussed further.

Unusual Mortality Events (UME)

A UME is defined under Section 410(6) of the MMPA as a stranding that is unexpected; involves a significant die-off of any marine mammal population; and demands immediate response. From 1991 to the present, there have been 34 formally recognized UMEs affecting marine mammals along the Atlantic Coast and the Gulf of Mexico involving species under NMFS's jurisdiction. The NARW, humpback whale, and minke whale UMEs on the Atlantic Coast are still active and involve ongoing investigations and the impacts to Barataria Bay bottlenose dolphins from the expired UME associated with the Deepwater Horizon (DWH) oil spill in the Gulf of Mexico are thought to be persistent and continue to inform population analyses. The other UMEs expired several years ago and little is known about how the effects of those events might be appropriately applied to an impact assessment several years later. The three UMEs that could inform the current analysis are discussed below.

NARW UME

Since June 7, 2017, elevated mortalities of NARW have occurred. A total of 16 confirmed dead stranded NARW (12 in Canada; 4 in the United States), and five live whale entanglements in Canada have been documented to date predominantly in the Gulf of St. Lawrence region of Canada and around the Cape Cod area of Massachusetts. An additional whale stranded in the United States in April 2017 prior to the start of the UME bringing the annual 2017 total to 17 confirmed dead stranded whales (12 in Canada; 5 in the United States) as of December 5, 2017. Historically (2006–2016), the annual average for dead strandings in Canada and the United States combined is 3.8 whales per year. This event was declared a UME and is under investigation. Full necropsy examinations have been conducted on 11 of the 17 whales and final results from the examinations are pending. Necropsy results from six of the Canadian whales suggest mortalities of four whales were compatible with blunt trauma likely caused by vessel collision and one mortality confirmed from chronic entanglement in fishing gear. The sixth whale was too decomposed to determine the cause of mortality, but some observations in this animal suggested blunt trauma. A seventh necropsy has been performed, but the results are not currently available (Daoust *et al.,* 2017). Daoust *et al.* (2017) also concluded there were no oil and gas seismic surveys authorized in the months prior to or during the period over which these mortalities occurred, as well as no blasting or major marine development projects. All of the NARW that stranded in the United States that are part of the UME have been significantly decomposed at the time of stranding, and investigations have been limited. Sonar has not been investigated for the mortalities in the United States.

As part of the UME investigation process, an independent team of scientists (Investigative Team) was assembled to coordinate with the Working Group on Marine Mammal Unusual Mortality Events to review the data collected, sample future whales that strand and to determine the next steps for the investigation. For more information on this UME, please refer to *https://www.fisheries.noaa.gov/national/marine-life-distress/2017-2018-north-atlantic-right-whale-unusual-mortality-event.*

Humpback Whale UME Along the Atlantic Coast

Since January 2016, elevated mortalities of humpback whales along the Atlantic coast from Maine through North Carolina have occurred. As of December 1, 2017 a total of 58 humpback strandings have occurred (26 and 32 whales in 2016 and 2017, respectively). As of April 2017, partial or full necropsy examinations were conducted on 20 cases, or approximately half of the 42 strandings (at that time). Of the 20 whales examined, 10 had evidence of blunt force trauma or pre-mortem propeller wounds indicative of vessel strike, which is over six times above the 16-year average of 1.5 whales showing signs of vessel strike in this region. Vessel strikes were documented for stranded humpback whales in Virginia (3), New York (3), Delaware (2), Massachusetts (1) and New Hampshire (1). NOAA, in coordination with our stranding network partners, continues to investigate the recent mortalities, environmental conditions, and population monitoring to better understand the recent humpback whale mortalities. At this time, vessel parameters (including size) are not known for each vessel-whale collision that lead to the death of the whales. Therefore, NOAA considers all sizes of vessels to be risks for whale species in highly trafficked areas. This investigation is ongoing. Please refer to *http://www.nmfs.noaa.gov/pr/health/mmume/2017humpbackatlanticume.html* for more information on this UME.

Minke Whale UME Along the Atlantic Coast

Since January 2017, elevated mortalities of minke whale along the Atlantic coast from Maine through South Carolina have occurred. As of February 16, 2018, a total of 30 strandings have occurred (28 and 2 whales in 2017 and 2018, respectively). As of February 16, 2018 full or partial necropsy examinations were conducted on over 60 percent of the whales. Preliminary findings in several of the whales have shown evidence of human interactions, primarily fisheries interactions, or infectious disease. These findings are not consistent across all of the whales examined, so more research is needed. This investigation is ongoing. Please refer to *https://www.fisheries.noaa.gov/national/marine-life-distress/2017-2018-minke-whale-unusual-mortality-event-along-atlantic-coast* for more information on this UME.

Cetacean UME in the Northern Gulf of Mexico and Persistent Impacts on Barataria Bay Bottlenose Dolphins

The cetacean UME in the northern Gulf of Mexico UME occurred from March 2010 through July 2014. The event included all cetaceans stranded during this time in Alabama, Mississippi, and Louisiana and all cetaceans other than bottlenose dolphins stranded in the Florida Panhandle (Franklin County through Escambia County), with a total of 1,141 cetaceans stranded or reported dead offshore. For reference, the same area experienced a normal average of 75 strandings per year from 2002–09 (Litz *et al.,* 2014). The majority of stranded animals were bottlenose dolphins, though at least ten additional species were reported as well. Since not all cetaceans that die wash ashore where they may be found, the number reported stranded is likely a fraction of the total number of cetaceans that died during the UME. There was also an increase in strandings of stillborn and newborn dolphins (Colegrove *et al.,* 2016).

Increased dolphin strandings occurred in northern Louisiana and Mississippi before the DWH oil spill (March–mid–April 2010). Some previous Gulf of Mexico cetacean UMEs had included environmental influences (*e.g.,* low salinity due to heavy rainfall and associated runoff of land-based pesticides, low temperatures) as possible contributing factors (Litz *et al.,* 2014). Low air and water temperatures occurred in the spring of 2010 throughout the Gulf of Mexico prior to and during the start of the UME, and a portion of the pre-spill atypical strandings occurred in Lake Pontchartrain, Louisiana, concurrent with lower than average salinity (Mullin *et al.,* 2015). Therefore, a large part of the increased dolphin strandings during this time may have been due to a combination of cold temperatures and low salinity (Litz *et al.,* 2014).

The UME investigation and the DWH Natural Resource Damage Assessment (described below) determined that the DWH oil spill is the most likely explanation of the persistent, elevated stranding numbers in the northern Gulf of Mexico after the spill that began on April 20, 2010. The evidence to date supports that exposure to hydrocarbons released during the DWH oil spill was the most likely explanation of adrenal and lung disease in dolphins, which contributed to increased deaths of dolphins living within the oil spill footprint and increased fetal loss. The longest and most prolonged stranding cluster of the UME was in Barataria Bay, Louisiana in 2010–11, followed by Mississippi and Alabama in 2011, consistent with timing and spatial distribution of oil, while the number of deaths was not elevated for areas which were not as heavily oiled.

In order to assess the health of free-ranging (not stranded) dolphin capture-release health assessments were conducted in Barataria Bay, during which physical examinations, including weighing and morphometric measurements, were conducted, routine biological samples (*e.g.,* blood, tissue) were obtained, and animals were examined with ultrasound. Veterinarians then reviewed the findings and determined an overall prognosis for each animal (*e.g.,* favorable outcome expected, outcome uncertain, unfavorable outcome expected). Almost half of the examined animals were given a guarded or worse prognosis, and 17 percent were not expected to survive (Schwacke *et al.,* 2014a). Comparison of Barataria Bay dolphins to a reference population found significantly increased adrenal disease, lung disease, and poor health. In addition to the health assessments, histological evaluations of samples from dead stranded animals from within and outside the UME area found that UME animals were more likely to have lung and adrenal lesions and to have primary bacterial pneumonia, which caused or contributed significantly to death (Schwacke *et al.,* 2014a, 2014b; Venn-Watson *et al.,* 2015b).

The prevalence of brucellosis and morbillivirus infections was low and biotoxin levels were low or below the detection limit, meaning that these were not likely primary causes of the UME (Venn-Watson *et al.,* 2015b; Fauquier *et al.,* 2017). Subsequent study found that persistent organic pollutants (*e.g.,* polychlorinated biphenyls), which are associated with endocrine disruption and immune suppression when present in high levels, are likely not a primary contributor to the poor health conditions and increased mortality observed in these Gulf of Mexico populations (Balmer *et al.,* 2015). The chronic adrenal gland and lung diseases identified in stranded UME dolphins are consistent with exposure to petroleum compounds (Venn-Watson *et al.,* 2015b). Colegrove *et al.* (2016) found that the increase in perinatal strandings resulted from late-term pregnancy failures and development of *in utero* infections likely caused by chronic illnesses in mothers who were exposed to oil.

While the number of dolphin mortalities in the area decreased after the peak from March 2010–July 2014, it does not follow that the effects of the oil spill on these populations have ended. Researchers still saw evidence of chronic lung disease and adrenal impairment four years after the spill (in July 2014) and saw evidence of failed pregnancies in 2015 (Smith *et al.,* 2017). These follow-up studies found a yearly mortality rate for Barataria Bay dolphins of roughly 13 percent (as compared to annual mortality rates of 5 percent or less that have been previously reported for other dolphin populations), and found that only 20 percent of pregnant dolphins produced viable calves (compared with 83 percent in a reference population) (Lane *et al.,* 2015; McDonald *et al.,* 2017). Research into the long-term health effects of the spill on marine mammal populations is ongoing. For more information on the UME, please visit *www.nmfs.noaa.gov/pr/health/mmume/cetacean_gulfofmexico.htm.*

Marine Mammal Hearing

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

- Low-frequency cetaceans (mysticetes): Generalized hearing is estimated to occur between approximately 7 Hz and 35 kHz, with best hearing estimated to be from 100 Hz to 8 kHz;
- Mid-frequency cetaceans (larger toothed whales, beaked whales, and most delphinids): Generalized hearing is estimated to occur between approximately 150 Hz and 160 kHz, with best hearing from 10 kHz to less than 100 kHz;
- High-frequency cetaceans (porpoises, river dolphins, and members of the genera Kogia and Cephalorhynchus; including two members of the genus Lagenorhynchus, on the basis of recent echolocation data and genetic data): Generalized hearing is estimated to occur between approximately 275 Hz and 160 kHz.
- Pinnipeds in water; Phocidae (true seals): Generalized hearing is estimated to occur between approximately 50 Hz to 86 kHz, with best hearing between 1–50 kHz;
- Pinnipeds in water; Otariidae (eared seals): Generalized hearing is estimated to occur between 60 Hz and 39 kHz, with best hearing between 2–48 kHz.

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

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

Potential Effects of Specified Activities on Marine Mammals and Their Habitat

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

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

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

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

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

Potential Effects of Underwater Sound

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

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

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

Acoustic Sources

Direct Physiological Effects

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

Threshold Shift (Noise-Induced Loss of Hearing)

When animals exhibit reduced hearing sensitivity within their auditory range (*i.e.,* sounds must be louder for an animal to detect them) following exposure to a sufficiently intense sound or a less intense sound for a sufficient duration, it is referred to as a noise-induced threshold shift (TS). An animal can experience a temporary threshold shift (TTS) and/or permanent threshold shift (PTS). TTS can last from minutes or hours to days (*i.e.,* there is recovery back to baseline/pre-exposure levels), can occur within a specific frequency range (*i.e.,* an animal might only have a temporary loss of hearing sensitivity within a limited frequency band of its auditory range), and can be of varying amounts (for example, an animal's hearing sensitivity might be reduced by only 6 dB or reduced by 30 dB). Repeated sound exposure that leads to TTS could cause PTS. In severe cases of PTS, there can be total or partial deafness, while in most cases the animal has an impaired ability to hear sounds in specific frequency ranges (Kryter, 1985). When PTS occurs, there is physical damage to the sound receptors in the ear (*i.e.,* tissue damage), whereas TTS represents primarily tissue fatigue and is reversible (Southall *et al.,* 2007). PTS is permanent (*i.e.,* there is incomplete recovery back to baseline/pre-exposure levels), but also can occur in a specific frequency range and amount as mentioned above for TTS. In addition, other investigators have suggested that TTS is within the normal bounds of physiological variability and tolerance and does not represent physical injury (*e.g.,* Ward, 1997). Therefore, NMFS does not consider TTS to constitute auditory injury.

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

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

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

Marine mammal hearing plays a critical role in communication with conspecifics and in interpretation of environmental cues for purposes such as predator avoidance and prey capture. Depending on the degree (elevation of threshold in dB), duration (*i.e.,* recovery time), and frequency range of TTS, and the context in which it is experienced, TTS can have effects on marine mammals ranging from discountable to serious similar to those discussed in auditory masking, below. For example, a marine mammal may be able to readily compensate for a brief, relatively small amount of TTS in a non-critical frequency range that takes place during a time when the animal is traveling through the open ocean, where ambient noise is lower and there are not as many competing sounds present. Alternatively, a larger amount and longer duration of TTS sustained during a time when communication is critical for successful mother/calf interactions could have more serious impacts if it were in the same frequency band as the necessary vocalizations and of a severity that impeded communication. The fact that animals exposed to high levels of sound that would be expected to result in this physiological response would also be expected to have behavioral responses of a comparatively more severe or sustained nature is potentially more significant than simple existence of a TTS. However, it is important to note that TTS could occur due to longer exposures to sound at lower levels so that a behavioral response may not be elicited.

Depending on the degree and frequency range, the effects of PTS on an animal could also range in severity, although it is considered generally more serious than TTS because it is a permanent condition. Of note, reduced hearing sensitivity as a simple function of aging has been observed in marine mammals, as well as humans and other taxa (Southall *et al.,* 2007), so we can infer that strategies exist for coping with this condition to some degree, though likely not without some cost to the animal.

Acoustically Mediated Bubble Growth and Other Pressure-Related Injury

One theoretical cause of injury to marine mammals is rectified diffusion (Crum and Mao, 1996), the process of increasing the size of a bubble by exposing it to a sound field. This process could be facilitated if the environment in which the ensonified bubbles exist is supersaturated with gas. Repetitive diving by marine mammals can cause the blood and some tissues to accumulate gas to a greater degree than is supported by the surrounding environmental pressure (Ridgway and Howard, 1979). The deeper and longer dives of some marine mammals (for example, beaked whales) are theoretically predicted to induce greater supersaturation (Houser *et al.,* 2001b). If rectified diffusion were possible in marine mammals exposed to high-level sound, conditions of tissue supersaturation could theoretically speed the rate and increase the size of bubble growth. Subsequent effects due to tissue trauma and emboli would presumably mirror those observed in humans suffering from decompression sickness.

It is unlikely that the short duration (in combination with the source levels) of sonar pings would be long enough to drive bubble growth to any substantial size, if such a phenomenon occurs. However, an alternative but related hypothesis has also been suggested: Stable bubbles could be destabilized by high-level sound exposures such that bubble growth then occurs through static diffusion of gas out of the tissues. In such a scenario the marine mammal would need to be in a gas-supersaturated state for a long enough period of time for bubbles to become of a problematic size. Recent research with *ex vivo* supersaturated bovine tissues suggested that, for a 37 kHz signal, a sound exposure of approximately 215 dB referenced to (re) 1 μPa would be required before microbubbles became destabilized and grew (Crum *et al.,* 2005). Assuming spherical spreading loss and a nominal sonar source level of 235 dB re 1 μPa at 1 m, a whale would need to be within 10 m (33 ft) of the sonar dome to be exposed to such sound levels. Furthermore, tissues in the study were supersaturated by exposing them to pressures of 400–700 kilopascals for periods of hours and then releasing them to ambient pressures. Assuming the equilibration of gases with the tissues occurred when the tissues were exposed to the high pressures, levels of supersaturation in the tissues could have been as high as 400–700 percent. These levels of tissue supersaturation are substantially higher than model predictions for marine mammals (Houser *et al.,* 2001; Saunders *et al.,* 2008). It is improbable that this mechanism is responsible for stranding events or traumas associated with beaked whale strandings. Both the degree of supersaturation and exposure levels observed to cause microbubble destabilization are unlikely to occur, either alone or in concert.

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

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

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

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

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

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

Acoustic Masking

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

In humans, significant masking of tonal signals occurs as a result of exposure to noise in a narrow band of similar frequencies. As the sound level increases, though, the detection of frequencies above those of the masking stimulus decreases also. This principle is expected to apply to marine mammals as well because of common biomechanical cochlear properties across taxa.

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

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

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

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

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

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

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

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

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

Impaired Communication

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

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

Stress Response

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

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

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

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

Relationships between these physiological mechanisms, animal behavior, and the costs of stress responses have also been documented fairly well through controlled experiments; because this physiology exists in every vertebrate that has been studied, it is not surprising that stress responses and their costs have been documented in both laboratory and free-living animals (for examples see, Holberton *et al.,* 1996; Hood *et al.,* 1998; Jessop *et al.,* 2003; Krausman *et al.,* 2004; Lankford *et al.,* 2005; Reneerkens *et al.,* 2002; Thompson and Hamer, 2000).

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

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

Behavioral Response/Disturbance

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

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

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

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

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

Flight Response

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

Response to Predator

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

Alteration of Diving or Movement

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

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

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). Visual tracking, passive acoustic monitoring, and movement recording tags were used to quantify sperm whale behavior prior to, during, and following exposure to airgun arrays at received levels in the range 140–160 dB at distances of 7–13 km, following a phase-in of sound intensity and full array exposures at 1–13 km (Madsen *et al.,* 2006a; Miller *et al.,* 2009). Sperm whales did not exhibit horizontal avoidance behavior at the surface. However, foraging behavior may have been affected. The sperm whales exhibited 19 percent less vocal (buzz) rate during full exposure relative to post exposure, and the whale that was approached most closely had an extended resting period and did not resume foraging until the airguns had ceased firing. 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 (Miller *et al.,* 2009). These data raise concerns that airgun surveys may impact foraging behavior in sperm whales, although more data are required to understand whether the differences were due to exposure or natural variation in sperm whale behavior (Miller *et al.,* 2009).

Balaenopterid whales exposed to moderate low-frequency signals similar to the ATOC sound source demonstrated no variation in foraging activity (Croll *et al.,* 2001), whereas five out of six North Atlantic right whales exposed to an acoustic alarm interrupted their foraging dives (Nowacek *et al.,* 2004). Although the received SPLs were similar in the latter two studies, the frequency, duration, and temporal pattern of signal presentation were different. These factors, as well as differences in species sensitivity, are likely contributing factors to the differential response. Blue whales exposed to simulated mid-frequency sonar in the Southern California Bight were less likely to produce low frequency calls usually associated with feeding behavior (Melcón *et al.,* 2012). However, Melcón *et al.* (2012) were unable to determine if suppression of low frequency calls reflected a change in their feeding performance or abandonment of foraging behavior and indicated that implications of the documented responses are unknown. Further, it is not known whether the lower rates of calling actually indicated a reduction in feeding behavior or social contact since the study used data from remotely deployed, passive acoustic monitoring buoys. In contrast, blue whales increased their likelihood of calling when ship noise was present, and decreased their likelihood of calling in the presence of explosive noise, although this result was not statistically significant (Melcón *et al.,* 2012). Additionally, the likelihood of an animal calling decreased with the increased received level of mid-frequency sonar, beginning at a SPL of approximately 110–120 dB re 1 μPa (Melcón *et al.,* 2012). Results from the 2010–2011 field season of an ongoing behavioral response study in Southern California waters indicated that, in some cases and at low received levels, tagged blue whales responded to mid-frequency sonar but that those responses were mild and there was a quick return to their baseline activity (Southall *et al.,* 2011; Southall *et al.,* 2012b). 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 some deep feeding whales being more significantly affected (*i.e.,* generalized avoidance; cessation of feeding; increased swimming speeds; or directed travel away from the source) compared to surface feeding individuals that typically showed no change in behavior. Some non-feeding whales also seemed to be affected by exposure. The authors indicate that disruption of feeding and displacement could impact individual fitness and health. However, for this to be true, we would have to assume that an individual whale could not compensate for this lost feeding opportunity by either immediately feeding at another location, by feeding shortly after cessation of acoustic exposure, or by feeding at a later time. There is no indication this is the case, particularly since unconsumed prey would likely still be available in the environment in most cases following the cessation of acoustic exposure.

Breathing

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

Social Relationships

Social interactions between mammals can be affected by noise via the disruption of communication signals or by the displacement of individuals. Disruption of social relationships therefore depends on the disruption of other behaviors (*e.g.,* caused avoidance, masking, etc.). Sperm whales responded to military sonar, apparently from a submarine, by dispersing from social aggregations, moving away from the sound source, remaining relatively silent, and becoming difficult to approach (Watkins *et al.,* 1985). In contrast, sperm whales in the Mediterranean that were exposed to submarine sonar continued calling (J. Gordon pers. comm. cited in Richardson *et al.,* 1995). Long-finned pilot whales exposed to three types of disturbance—playbacks of killer whale sounds, naval sonar exposure, and tagging all resulted in increased group sizes (Visser *et al.,* 2016). In response to sonar, pilot whales also spent more time at the surface with other members of the group (Visser *et al.,* 2016). However, social disruptions must be considered in context of the relationships that are affected. While some disruptions may not have deleterious effects, others, such as long-term or repeated disruptions of mother/calf pairs or interruption of mating behaviors, have the potential to affect the growth and survival or reproductive effort/success of individuals.

Vocalizations (Also See Masking Section)

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

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

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

Seismic pulses at average received levels of 131 dB re 1 micropascal squared per second (μPa2-s) caused blue whales to increase call production (Di Iorio and Clark, 2010). In contrast, McDonald *et al.* (1995) tracked a blue whale with seafloor seismometers and reported that it stopped vocalizing and changed its travel direction at a range of 10 km from the seismic vessel (estimated received level 143 dB re 1 μPa peak-to-peak). Blackwell *et al.* (2013) found that bowhead whale call rates dropped significantly at onset of airgun use at sites with a median distance of 41–45 km from the survey.

Blackwell *et al.* (2015) expanded this analysis to show that whales actually increased calling rates as soon as airgun signals were detectable before ultimately decreasing calling rates at higher received levels (*i.e.,* 10-minute cSEL of ~127 dB). Overall, these results suggest that bowhead whales may adjust their vocal output in an effort to compensate for noise before ceasing vocalization effort and ultimately deflecting from the acoustic source (Blackwell *et al.,* 2013, 2015). Captive bottlenose dolphins sometimes vocalized after an exposure to impulse sound from a seismic watergun (Finneran *et al.,* 2010a). These studies demonstrate that even low levels of noise received far from the noise source can induce behavioral responses.

Avoidance

Avoidance is the displacement of an individual from an area as a result of the presence of a sound. Richardson *et al.* (1995) noted that avoidance reactions are the most obvious manifestations of disturbance in marine mammals. Avoidance is qualitatively different from the flight response, but also differs in the magnitude of the response (*i.e.,* directed movement, rate of travel, etc.). Oftentimes avoidance is temporary, and animals return to the area once the noise has ceased. However, longer term displacement is possible and can lead to changes in abundance or distribution patterns of the species in the affected region if they do not become acclimated to the presence of the sound (Blackwell *et al.,* 2004; Bejder *et al.,* 2006; Teilmann *et al.,* 2006). Acute avoidance responses have been observed in captive porpoises and pinnipeds exposed to a number of different sound sources (Kastelein *et al.,* 2001; Finneran *et al.,* 2003; Kastelein *et al.,* 2006a; Kastelein *et al.,* 2006b). Short-term avoidance of seismic surveys, low frequency emissions, and acoustic deterrents have also been noted in wild populations of odontocetes (Bowles *et al.,* 1994; Goold, 1996; 1998; Stone *et al.,* 2000; Morton and Symonds, 2002) and to some extent in mysticetes (Gailey *et al.,* 2007), while longer term or repetitive/chronic displacement for some dolphin groups and for manatees has been suggested to be due to the presence of chronic vessel noise (Haviland-Howell *et al.,* 2007; Miksis-Olds *et al.,* 2007). Gray whales have been reported deflecting from customary migratory paths in order to avoid noise from airgun surveys (Malme *et al.,* 1984). Humpback whales showed avoidance behavior in the presence of an active airgun array during observational studies and controlled exposure experiments in western Australia (McCauley *et al.,* 2000a).

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

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

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

Kvadsheim *et al.* (2007) conducted a controlled exposure experiment in which killer whales fitted with D-tags were exposed to mid-frequency active sonar (Source A: A 1.0 second upsweep 209 dB @1–2 kHz every 10 seconds for 10 minutes; Source B: With a 1.0 second upsweep 197 dB @6–7 kHz every 10 seconds for 10 minutes). When exposed to Source A, a tagged whale and the group it was traveling with did not appear to avoid the source. When exposed to Source B, the tagged whales along with other whales that had been carousel feeding, where killer whales cooperatively herd fish schools into a tight ball towards the surface and feed on the fish which have been stunned by tailslaps and subsurface feeding (Simila, 1997), ceased feeding during the approach of the sonar and moved rapidly away from the source. When exposed to Source B, Kvadsheim 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 killer whales were consistent with the results of other studies.

Southall *et al.* (2007) reviewed the available literature on marine mammal hearing and physiological and behavioral responses to human-made sound with the goal of proposing exposure criteria for certain effects. This peer-reviewed compilation of literature is very valuable, though Southall *et al.* (2007) note that not all data are equal, some have poor statistical power, insufficient controls, and/or limited information on received levels, background noise, and other potentially important contextual variables. Such data were reviewed and sometimes used for qualitative illustration, but no quantitative criteria were recommended for behavioral responses. All of the studies considered, however, contain an estimate of the received sound level when the animal exhibited the indicated response.

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

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

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

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

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

In 2007, the first in a series of behavioral response studies (BRS) on deep diving odontocetes conducted by NMFS, Navy, and other scientists showed one Blainville's beaked whale responding to an MFAS playback. Tyack *et al.* (2011) indicates that the playback began when the tagged beaked whale was vocalizing at depth (at the deepest part of a typical feeding dive), following a previous control with no sound exposure. The whale appeared to stop clicking significantly earlier than usual, when exposed to MF signals in the 130–140 dB (rms) received level range. After a few more minutes of the playback, when the received level reached a maximum of 140–150 dB, the whale ascended on the slow side of normal ascent rates with a longer than normal ascent, at which point the exposure was terminated. The results are from a single experiment and a greater sample size is needed before robust and definitive conclusions can be drawn. Tyack *et al.* (2011) also indicates that Blainville's beaked whales appear to be sensitive to noise at levels well below expected TTS (~160 dB re1µPa). This sensitivity was manifested by an adaptive movement away from a sound source. This response was observed irrespective of whether the signal transmitted was within the band width of MFAS, which suggests that beaked whales may not respond to the specific sound signatures. Instead, they may be sensitive to any pulsed sound from a point source in this frequency range of the MF active sonar transmission. The response to such stimuli appears to involve the beaked whale increasing the distance between it and the sound source. Overall the results from the 2007–2008 study conducted showed a change in diving behavior of the Blainville's beaked whale to playback of MFAS and predator sounds (Boyd *et al.,* 2008; Southall *et al.* 2009; Tyack *et al.,* 2011).

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

Reaction to mid-frequency sounds included premature cessation of clicking and termination of a foraging dive, and a slower ascent rate to the surface. Results from a similar behavioral response study in southern California waters have been presented for the 2010–2011 field season (Southall *et al.* 2011; DeRuiter *et al.,* 2013b). DeRuiter *et al.* (2013b) presented results from two Cuvier's beaked whales that were tagged and exposed to simulated MFAS during the 2010 and 2011 field seasons of the southern California behavioral response study. The 2011 whale was also incidentally exposed to MFAS from a distant naval exercise. Received levels from the MFAS signals from the controlled and incidental exposures were calculated as 84–144 and 78–106 dB re 1 µPa 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. Specifically, this result suggests that caution is needed when using marine mammal response data collected from smaller, nearer sound sources to predict at what received levels animals may respond to larger sound sources that are significantly farther away—as the distance of the source appears to be an important contextual variable and animals may be less responsive to sources at notably greater distances. Cuvier's beaked whale responses suggested particular sensitivity to sound exposure as consistent with results for Blainville's beaked whale. Similarly, beaked whales exposed to sonar during British training exercises stopped foraging (DSTL, 2007), and preliminary results of controlled playback of sonar may indicate feeding/foraging disruption of killer whales and sperm whales (Miller *et al.,* 2011).

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

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

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

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

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

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

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

Orientation

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

Continued Pre-disturbance Behavior and Habituation

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

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

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

Explosive Sources

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

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

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

Further Potential Effects of Behavioral Disturbance on Marine Mammal Fitness

The different ways that marine mammals respond to sound are sometimes indicators of the ultimate effect that exposure to a given stimulus will have on the well-being (survival, reproduction, etc.) of an animal. There are few quantitative marine mammal data relating the exposure of marine mammals to sound to effects on reproduction or survival, though data exists for terrestrial species to which we can draw comparisons for marine mammals. Several authors have reported that disturbance stimuli may cause animals to abandon nesting and foraging sites (Sutherland and Crockford, 1993); may cause animals to increase their activity levels and suffer premature deaths or reduced reproductive success when their energy expenditures exceed their energy budgets (Daan *et al.,* 1996; Feare, 1976; Mullner *et al.,* 2004); or may cause animals to experience higher predation rates when they adopt risk-prone foraging or migratory strategies (Frid and Dill, 2002). Each of these studies addressed the consequences of animals shifting from one behavioral state (*e.g.,* resting or foraging) to another behavioral state (*e.g.,* avoidance or escape behavior) because of human disturbance or disturbance stimuli.

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

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

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

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

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

Vigilance is normally an adaptive behavior that helps animals determine the presence or absence of predators, assess their distance from conspecifics, or to attend cues from prey (Bednekoff and Lima, 1998; Treves, 2000). Despite those benefits, however, vigilance has a cost of time; when animals focus their attention on specific environmental cues, they are not attending to other activities such as foraging. These costs have been documented best in foraging animals, where vigilance has been shown to substantially reduce feeding rates (Saino, 1994; Beauchamp and Livoreil, 1997; Fritz *et al.,* 2002). Animals will spend more time being vigilant, which may translate to less time foraging or resting, when disturbance stimuli approach them more directly, remain at closer distances, have a greater group size (*e.g.,* multiple surface vessels), or when they co-occur with times that an animal perceives increased risk *(e.g.,* when they are giving birth or accompanied by a calf). Most of the published literature, however, suggests that direct approaches will increase the amount of time animals will dedicate to being vigilant. An example of this concept with terrestrial species involved bighorn sheep and Dall's sheep, which dedicated more time being vigilant, and less time resting or foraging, when aircraft made direct approaches over them (Frid, 2001; Stockwell *et al.,* 1991). Vigilance has also been documented in pinnipeds at haul out sites where resting may be disturbed when seals become alerted and/or flush into the water due to a variety of disturbances, which may be anthropogenic (noise and/or visual stimuli) or due to other natural causes such as other pinnipeds (Richardson *et al.,* 1995; Southall *et al.,* 2007; VanBlaricom, 2010; and Lozano and Hente, 2014).

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

The primary mechanism by which increased vigilance and disturbance appear to affect the fitness of individual animals is by disrupting an animal's time budget and, as a result, reducing the time they might spend foraging and resting (which increases an animal's activity rate and energy demand while decreasing their caloric intake/energy). Ridgway *et al.* (2006) reported that increased vigilance in bottlenose dolphins exposed to sound over a five-day period in open-air, open-water enclosures in San Diego Bay did not cause any sleep deprivation or stress effects such as changes in cortisol or epinephrine levels. An example of this concept with terrestrial species involved a study of grizzly bears (*Ursus horribilis*) reported that bears disturbed by hikers reduced their energy intake by an average of 12 kilocalories/min (50.2 × 103kiloJoules/min), and spent energy fleeing or acting aggressively toward hikers (White *et al.,* 1999).

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

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

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

Stranding and Mortality

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

Marine 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).

Several sources have published lists of mass stranding events of cetaceans in an attempt to identify relationships between those stranding events and military active sonar (Hildebrand, 2004; IWC, 2005; Taylor *et al.,* 2004). For example, based on a review of mass stranding events around the world between consisting of two or more individuals of Cuvier's beaked whales records between the International Whaling Commission (2005) show that a quarter (9 of 41) were associated with concurrent naval patrol, explosion, maneuvers, or MFAS. However, one stranding event was contemporaneous with and reasonably associated spatially with the use of seismic airguns. This event occurred in the Gulf of California, coincident with seismic reflection profiling by the R/V Maurice Ewing operated by Columbia University's Lamont-Doherty Earth Observatory and involved two Cuvier's beaked whales (Hildebrand, 2004). The vessel had been firing an array of 20 airguns with a total volume of 8,500 in3 (Hildebrand, 2004; Taylor *et al.,* 2004).

Most of the stranding events reviewed by the IWC involved beaked whales. A mass stranding of Cuvier's beaked whales in the eastern Mediterranean Sea occurred in 1996 (Frantzis, 1998) and mass stranding events involving Gervais' beaked whales, Blainville's beaked whales, and Cuvier's beaked whales occurred off the coast of the Canary Islands in the late 1980s (Simmonds and Lopez-Jurado, 1991). The stranding events that occurred in the Canary Islands and Kyparissiakos Gulf in the late 1990s and the Bahamas in 2000 have been the most intensively-studied mass stranding events and have been associated with naval maneuvers involving the use of tactical sonar.

Strandings Associated With Impulsive Sound

Silver Strand

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

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

Kyle of Durness, Scotland

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

Strandings Associated With Active Sonar

Over the past 21 years, there have been five stranding events coincident with military MF active sonar use in which exposure to sonar is believed to have been a contributing factor: Greece (1996); the Bahamas (2000); Madeira (2000); Canary Islands (2002); and Spain (2006). NMFS refers the reader to DoN (2013) for a report on these strandings associated with Navy sonar activities; Cox *et al.* (2006) for a summary of common features shared by the strandings events in Greece (1996), Bahamas (2000), Madeira (2000), and Canary Islands (2002); and Fernandez *et al.,* (2005) for an additional summary of the Canary Islands 2002 stranding event. Additionally, in 2004, during the Rim of the Pacific (RIMPAC) exercises, between 150 and 200 usually pelagic melon-headed whales occupied the shallow waters of Hanalei Bay, Kauai, Hawaii for over 28 hours. NMFS determined that MFAS was a plausible, if not likely, contributing factor in what may have been a confluence of events that led to the Hanalei Bay stranding. A number of other stranding events coincident with the operation of MFAS, including the death of beaked whales or other species (minke whales, dwarf sperm whales, pilot whales), have been reported; however, the majority have not been investigated to the degree necessary to determine the cause of the stranding and only one of these stranding events, the Bahamas (2000), was associated with exercises conducted by the U.S. Navy. Most recently, the Independent Scientific Review Panel investigating potential contributing factors to a 2008 mass stranding of melon-headed whales in Antsohihy, Madagascar released its final report suggesting that the stranding was likely initially triggered by an industry seismic survey. This report suggests that the operation of a commercial high-powered 12 kHz multi-beam echosounder during an industry seismic survey was a plausible and likely initial trigger that caused a large group of melon-headed whales to leave their typical habitat and then ultimately strand as a result of secondary factors such as malnourishment and dehydration. The report indicates that the risk of this particular convergence of factors and ultimate outcome is likely very low, but recommends that the potential be considered in environmental planning. 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 will abide by the Notification and Reporting Plan, which sets out notification, reporting, and other requirements when dead, injured, or stranding whales are detected in certain circumstances.

Greece (1996)

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

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

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

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

Bahamas (2000)

NMFS and the Navy prepared a joint report addressing the multi-species stranding in the Bahamas in 2000, which took place within 24 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, Portugal (2000)

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

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

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

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

Canary Islands, Spain (2002)

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

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

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

Hanalei Bay (2004)

On July 3 and 4, 2004, approximately 150 to 200 melon-headed whales occupied the shallow waters of the Hanalei Bay, 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 nine hours total from 1:15 p.m. to 12:30 a.m.) as they approached from the south. The potential for these transmissions to have triggered the whales' movement into Hanalei Bay was investigated. Analyses with the information available indicated that animals to the south and east of Kaua'i could have detected active sonar transmissions on July 2, and reached Hanalei Bay on or before 7 a.m. on July 3. However, data limitations regarding the position of the whales prior to their arrival in the Bay, the magnitude of sonar exposure, behavioral responses of melon-headed whales to acoustic stimuli, and other possible relevant factors preclude a conclusive finding regarding the role of sonar in triggering this event. Propagation modeling suggests that transmissions from sonar use during the July 3 exercise in the PMRF warning area may have been detectable at the mouth of the Bay. If the animals responded negatively to these signals, it may have contributed to their continued presence in the Bay. The U.S. Navy ceased all active sonar transmissions during exercises in this range on the afternoon of July 3. Subsequent to the cessation of sonar use, the animals were herded out of the Bay.

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

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

Spain (2006)

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

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

Behaviorally Mediated Responses to MFAS That May Lead to Stranding

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

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

Because many species of marine mammals make repetitive and prolonged dives to great depths, it has long been assumed that marine mammals have evolved physiological mechanisms to protect against the effects of rapid and repeated decompressions. Although several investigators have identified physiological adaptations that may protect marine mammals against nitrogen gas supersaturation (alveolar collapse and elective circulation; Kooyman *et al.,* 1972; Ridgway and Howard, 1979), Ridgway and Howard (1979) reported that bottlenose dolphins that were trained to dive repeatedly had muscle tissues that were substantially supersaturated with nitrogen gas. Houser *et al.* (2001) used these data to model the accumulation of nitrogen gas within the muscle tissue of other marine mammal species and concluded that cetaceans that dive deep and have slow ascent or descent speeds would have tissues that are more supersaturated with nitrogen gas than other marine mammals. Based on these data, Cox *et al.* (2006) hypothesized that a critical dive sequence might make beaked whales more prone to stranding in response to acoustic exposures. The sequence began with (1) very deep (to depths as deep as two 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 rates of ascent from normal dive behaviors are unlikely to result in supersaturation to the extent that bubble formation would be expected. Tyack *et al.* (2006) suggested that emboli observed in animals exposed to mid-frequency range sonar (Jepson *et al.,* 2003; Fernandez *et al.,* 2005; Fernández *et al.,* 2012) could stem from a behavioral response that involves repeated dives shallower than the depth of lung collapse. Given that nitrogen gas accumulation is a passive process (*i.e.,* nitrogen is metabolically inert), a bottlenose dolphin was trained to repetitively dive a profile predicted to elevate nitrogen saturation to the point that nitrogen bubble formation was predicted to occur. However, inspection of the vascular system of the dolphin via ultrasound did not demonstrate the formation of asymptomatic nitrogen gas bubbles (Houser *et al.,* 2007). Baird *et al.* (2008), in a beaked whale tagging study off Hawaii, showed that deep dives are equally common during day or night, but ''bounce dives'' are typically a daytime behavior, possibly associated with visual predator avoidance. This may indicate that ''bounce dives'' are associated with something other than behavioral regulation of dissolved nitrogen levels, which would be necessary day and night.

If marine mammals respond to a Navy vessel that is transmitting active sonar in the same way that they might respond to a predator, their probability of flight responses could increase when they perceive that Navy vessels are approaching them directly, because a direct approach may convey detection and intent to capture (Burger and Gochfeld, 1981, 1990; Cooper, 1997, 1998). The probability of flight responses could also increase as received levels of active sonar increase (and the ship is, therefore, closer) and as ship speeds increase (that is, as approach speeds increase). For example, the probability of flight responses in Dall's sheep (*Ovis dalli dalli*) (Frid 2001a, b), ringed seals (*Phoca hispida*) (Born *et al.,* 1999), Pacific brant (*Branta bernic nigricans*) and Canada geese (*B. Canadensis*) increased as a helicopter or fixed-wing aircraft approached groups of these animals more directly (Ward *et al.,* 1999). Bald eagles (*Haliaeetus leucocephalus*) perched on trees alongside a river were also more likely to flee from a paddle raft when their perches were closer to the river or were closer to the ground (Steidl and Anthony, 1996).

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

Strandings on the Atlantic Coast and the Gulf of Mexico

Stranding events, specifically UMEs that occurred on the Atlantic Coast and the Gulf of Mexico (inclusive of the AFTT Study Area) were previously discussed in the Description of Marine Mammals section.

Potential Effects of Vessel Strike

Vessel collisions with marine mammals, also referred to as vessel strikes or ship strikes, can result in death or serious injury of the animal. Wounds resulting from ship strike may include massive trauma, hemorrhaging, broken bones, or propeller lacerations (Knowlton and Kraus, 2001). An animal at the surface could be struck directly by a vessel, a surfacing animal could hit the bottom of a vessel, or an animal just below the surface could be cut by a vessel's propeller. Superficial strikes may not kill or result in the death of the animal. These interactions are typically associated with large whales, which are occasionally found draped across the bulbous bow of large commercial ships upon arrival in port. Although smaller cetaceans are more maneuverable in relation to large vessels than are large whales, they may also be susceptible to strike. The severity of injuries typically depends on the size and speed of the vessel (Knowlton and Kraus, 2001; Laist *et al.,* 2001; Vanderlaan and Taggart, 2007; Conn and Silber, 2013). Impact forces increase with speed, as does the probability of a strike at a given distance (Silber *et al.,* 2010; Gende *et al.,* 2011).

The most vulnerable marine mammals are those that spend extended periods of time at the surface in order to restore oxygen levels within their tissues after deep dives (*e.g.,* the sperm whale). In addition, some baleen whales, such as the NARW, 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. In an effort to reduce the number and severity of strikes of the endangered NARW, NMFS implemented speed restrictions in 2008 (73 FR 60173; October 10, 2008). These restrictions require that vessels greater than or equal to 65 ft (19.8 m) in length travel at less than or equal to 10 knots (kn) near key port entrances and in certain areas of right whale aggregation along the U.S. eastern seaboard. Conn and Silber (2013) estimated that these restrictions reduced total ship strike mortality risk levels by 80 to 90 percent. 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 or serious injury (Knowlton and Kraus, 2001; Laist *et al.,* 2001; Jensen and Silber, 2003; Pace and Silber, 2005; Vanderlaan and Taggart, 2007). In assessing records in which vessel speed was known, Laist *et al.* (2001) found a direct relationship between the occurrence of a whale strike and the speed of the vessel involved in the collision. The authors concluded that most deaths occurred when a vessel was traveling in excess of 13 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).

In a separate study, Vanderlaan and Taggart (2007) analyzed the probability of lethal mortality of large whales at a given speed, showing that the greatest rate of change in the probability of a lethal injury to a large whale as a function of vessel speed occurs between

8.6 and 15 kn. The chances of a lethal injury decline from approximately 80 percent at 15 kn to approximately 20 percent at 8.6 kn. At speeds below 11.8 kn, the chances of lethal injury drop below 50 percent, while the probability asymptotically increases toward 100 percent above 15 kn.

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

Over a period of 18 years from 1995 to 2012 there have been a total of 19 Navy vessel strikes in the AFTT Study Area. Eight of the strikes resulted in a confirmed death; but in 11 of the 19 strikes, the fate of the animal was unknown. It is possible that some of the 11 reported strikes resulted in recoverable injury or were not marine mammals at all, but another large marine species (*e.g.,* basking shark). However, it is prudent to consider that all of the strikes could have resulted in the death of a marine mammal. The maximum number of strikes in any given year was three strikes, which occurred in 2001 and 2004. The highest average number of strikes over any five year period was two strikes per year from 2001 to 2005. The average number of strikes for the entire 18-year period is 1.055 strikes per year. From 2009–2016 there has been a total of three whale strikes reported in the AFTT Study Area.

Between 2007 and 2009, the Navy developed and distributed additional training, mitigation, and reporting tools to Navy operators to improve marine mammal protection and to ensure compliance with permit requirements. In 2007, the Navy implemented Marine Species Awareness Training designed to improve effectiveness of visual observation for marine resources including marine mammals. In subsequent years, the Navy issued refined policy guidance on ship strikes in order to collect the most accurate and detailed data possible in response to a possible incident.

Marine Mammal Habitat

The Navy's proposed training and testing activities could potentially affect marine mammal habitat through the introduction of impacts to the prey species of marine mammals, acoustic habitat (sound in the water column), water quality, and important habitat for marine mammals. Each of these components was considered in the AFTT 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 AFTT DEIS/OEIS, NMFS has determined that the proposed training and training activities would not have adverse or long-term impacts on marine mammal habitat.

Effects to Prey

Sound may affect marine mammals through impacts on the abundance, behavior, or distribution of prey species (*e.g.,* crustaceans, cephalopods, fish, zooplankton). Marine mammal prey varies by species, season, and location and, for some, is not well documented. Here, we describe studies regarding the effects of noise on known marine mammal prey.

Fish utilize the soundscape and components of sound in their environment to perform important functions such as foraging, predator avoidance, mating, and spawning (*e.g.,* Zelick *et al.,* 1999; Fay, 2009). Depending on their hearing anatomy and peripheral sensory structures, which vary among species, fishes hear sounds using pressure and particle motion sensitivity capabilities and detect the motion of surrounding water (Fay *et al.,* 2008). The potential effects of airgun noise on fishes depends on the overlapping frequency range, distance from the sound source, water depth of exposure, and species-specific hearing sensitivity, anatomy, and physiology. Key impacts to fishes may include behavioral responses, hearing damage, barotrauma (pressure-related injuries), and mortality.

Fish react to sounds which are especially strong and/or intermittent low-frequency sounds, and behavioral responses such as flight or avoidance are the most likely effects. Short duration, sharp sounds can cause overt or subtle changes in fish behavior and local distribution. The reaction of fish to acoustic sources depends on the physiological state of the fish, past exposures, motivation (*e.g.,* feeding, spawning, migration), and other environmental factors. Hastings and Popper (2005) identified several studies that suggest fish may relocate to avoid certain areas of sound energy. Changes in behavior of fish have been observed as a result of sound produced by explosives, with effect intensified in areas of hard substrate (Wright, 1982). Stunning from pressure waves could also temporarily immobilize fish, making them more susceptible to predation. Fish not killed or driven from a location by an explosion might change their behavior, feeding pattern, or distribution. The abundances of various fish and invertebrates near the detonation point for explosives could be altered for a few hours before animals from surrounding areas repopulate the area; however, these populations would likely be replenished as waters near the detonation point are mixed with adjacent waters. Repeated exposure of individual fish to sounds from underwater explosions is not likely and most acoustic effects are expected to be short-term and localized. Long-term consequences for fish populations would not be expected. Several studies have demonstrated that airgun sounds might affect the distribution and behavior of some fishes, potentially impacting foraging opportunities or increasing energetic costs (*e.g.,* Fewtrell and McCauley, 2012; Pearson *et al.,* 1992; Skalski *et al.,* 1992; Santulli *et al.,* 1999; Paxton *et al.,* 2017).

Some studies have shown no or slight reaction to airgun sounds (*e.g.,* Pena *et al.,* 2013; Wardle *et al.,* 2001; Jorgenson and Gyselman, 2009; Cott *et al.,* 2012). More commonly, though, the impacts of noise on fish are temporary. Investigators reported significant, short-term declines in commercial fishing catch rate of gadid fishes during and for up to five days after survey operations, but the catch rate subsequently returned to normal (Engas *et al.,* 1996; Engas and Lokkeborg, 2002); other studies have reported similar findings (Hassel *et al.,* 2004). However, even temporary effects to fish distribution patterns can impact their ability to carry out important life-history functions (Paxton *et al.,* 2017).

SPLs of sufficient strength have been known to cause injury to fish and fish mortality and, in some studies, fish auditory systems have been damaged by airgun noise (McCauley *et al.,* 2003; Popper *et al.,* 2005; Song *et al.,* 2008). However, in most fish species, hair cells in the ear continuously regenerate and loss of auditory function likely is restored when damaged cells are replaced with new cells. Halvorsen et al. (2012a) showed that a TTS of 4–6 dB was recoverable within 24 hours for one species. Impacts would be most severe when the individual fish is close to the source and when the duration of exposure is long. No mortality occurred to fish in any of these studies.

Injury caused by barotrauma can range from slight to severe and can cause death, and is most likely for fish with swim bladders. Barotrauma injuries have been documented during controlled exposure to impact pile driving (an impulsive noise source, as are explosives and airguns) (Halvorsen *et al.,* 2012b; Casper *et al.,* 2013). For seismic surveys, the sound source is constantly moving, and most fish would likely avoid the sound source prior to receiving sound of sufficient intensity to cause physiological or anatomical damage.

It is uncertain whether some permanent hearing loss over a part of a fish's hearing range would have long-term consequences for that individual. It is possible for fish to be injured or killed by an explosion. Physical effects from pressure waves generated by underwater sounds (*e.g.,* underwater explosions) could potentially affect fish within proximity of training or testing activities. The shock wave from an underwater explosion is lethal to fish at close range, causing massive organ and tissue damage and internal bleeding (Keevin & Hempen, 1997). At greater distance from the detonation point, the extent of mortality or injury depends on a number of factors including fish size, body shape, orientation, and species (Keevin & Hempen, 1997; Wright, 1982). At the same distance from the source, larger fish are generally less susceptible to death or injury, elongated forms that are round in cross-section are less at risk than deep-bodied forms, and fish oriented sideways to the blast suffer the greatest impact (Edds-Walton & Finneran, 2006; O'Keeffe, 1984; O'Keeffe & Young, 1984; Wiley *et al.,* 1981; Yelverton *et al.,* 1975). Species with swim bladders have higher mortality than those without them (Continental Shelf Associates Inc., 2004; Goertner *et al.,* 1994).

Invertebrates appear to be able to detect sounds (Pumphrey, 1950; Frings and Frings, 1967) and are most sensitive to low-frequency sounds (Packard *et al.,* 1990; Budelmann and Williamson, 1994; Lovell *et al.,* 2005; Mooney *et al.,* 2010). Available data suggest that cephalopods are capable of sensing the particle motion of sounds and detect low frequencies up to 1–1.5 kHz, depending on the species, and so are likely to detect airgun noise (Kaifu *et al.,* 2008; Hu *et al.,* 2009; Mooney *et al.,* 2010; Samson *et al.,* 2014). Cephalopods have a specialized sensory organ inside the head called a statocyst that may help an animal determine its position in space (orientation) and maintain balance (Budelmann, 1992). Packard et al. (1990) showed that cephalopods were sensitive to particle motion, not sound pressure, and Mooney et al. (2010) demonstrated that squid statocysts act as an accelerometer through which particle motion of the sound field can be detected. Auditory injuries (lesions occurring on the statocyst sensory hair cells) have been reported upon controlled exposure to low-frequency sounds, suggesting that cephalopods are particularly sensitive to low-frequency sound (Andre *et al.,* 2011; Sole *et al.,* 2013). Behavioral responses, such as inking and jetting, have also been reported upon exposure to low-frequency sound (McCauley *et al.,* 2000b; Samson *et al.,* 2014).

Impacts to benthic communities from impulsive sound generated by active acoustic sound sources are not well documented. There are no published data that indicate whether threshold shift injuries or effects of auditory masking occur in benthic invertebrates, and there are little data to suggest whether sounds from seismic surveys would have any substantial impact on invertebrate behavior (Hawkins *et al.,* 2014), though some studies have indicated showed no short-term or long-term effects of airgun exposure (*e.g.,* Andriguetto-Filho *et al.,* 2005; Payne *et al.,* 2007; 2008; Boudreau *et al.,* 2009). Exposure to airgun signals was found to significantly increase mortality in scallops, in addition to causing significant changes in behavioral patterns during exposure (Day *et al.,* 2017). However, the authors state that the observed levels of mortality were not beyond naturally occurring rates.

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

Prey species exposed to sound might move away from the sound source, experience TTS, experience masking of biologically relevant sounds, or show no obvious direct effects. Mortality from decompression injuries is possible in close proximity to a sound, but only limited data on mortality in response to airgun noise exposure are available (Hawkins *et al.,* 2014). The most likely impacts for most prey species in a given area would be temporary avoidance of the area. Surveys using towed airgun arrays move through an area relatively quickly, limiting exposure to multiple impulsive sounds. In all cases, sound levels would return to ambient once a survey ends and the noise source is shut down and, when exposure to sound ends, behavioral and/or physiological responses are expected to end relatively quickly (McCauley *et al.,* 2000b). The duration of fish avoidance of a given area after survey effort stops is unknown, but a rapid return to normal recruitment, distribution, and behavior is anticipated. While the potential for disruption of spawning aggregations or schools of important prey species can be meaningful on a local scale, the mobile and temporary nature of most surveys and the likelihood of temporary avoidance behavior suggest that impacts would be minor.

Acoustic Habitat

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

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

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

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

Water Quality

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

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

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

Important Marine Mammal Habitat

The only ESA-listed marine mammal with designated critical habitat within the AFTT Study Area is the NARW. This critical habitat was discussed in the Description of Marine Mammals section. BIAs were also discussed in the Description of Marine Mammals section.

Estimated Take of Marine Mammals

This section indicates the number of takes that NMFS is proposing to authorize which are based on the amount of take that NMFS anticipates could, or are likely to occur depending on the type of take and the methods used to estimate it, as described in detail below. NMFS coordinated closely with the Navy in the development of their incidental take application, and with one exception, preliminarily agrees that the methods the Navy has put forth described herein to estimate take (including the model, thresholds, and density estimates), and the resulting numbers proposed for authorization, are appropriate and based on the best available science. Where we did not concur with the Navy's analysis and proposed take numbers (*i.e.,* large whale mortality from ship strike), NMFS has explicitly described our rationale and proposed what we consider an appropriate number of takes.

Takes are predominantly in the form of harassment, but a small number of mortalities are also proposed. For this military readiness activity, the MMPA defines ''harassment'' as: (i) Any act that injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild (Level A Harassment); or (ii) Any act that disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns, including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering, to a point where such behavioral patterns are abandoned or significantly altered (Level B Harassment).

Authorized takes would primarily be by Level B harassment, as use of the acoustic and explosive sources (*i.e.,* sonar, airguns, piledriving, explosives) is likely to result in behavioral disruption or TTS for marine mammals. There is also the potential for Level A harassment, in the form of auditory injury and/or tissue damage (latter for explosives only) to result from exposure to the sound sources utilized in training and testing activities. Lastly, a limited number of serious injuries or mortalities could occur for four species of mid-frequency cetaceans during ship shock trials and three serious injuries or mortalities total (over the 5-yr period) of mysticetes and sperm whales through vessel collisions. Although we analyze the impacts of these potential serious injuries or mortalities that are proposed for authorization, the proposed mitigation and monitoring measures are expected to minimize the likelihood that ship strike or these high level explosive exposures (and the associated serious injury or mortality) occur.

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

Acoustic Thresholds

Using the best available science NMFS, in coordination with the Navy, has established acoustic thresholds that identify the received level of underwater sound above which exposed marine mammals would reasonably expected to be experience a disruption in behavior, or to incur TTS (equated to Level B harassment) or PTS of some degree (equated to Level A harassment). Thresholds have also been developed to identify the pressure levels above which animals may incur different types of tissue damage from exposure to pressure waves from explosive detonation.

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

Non-Impulsive and Impulsive

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

These thresholds (Tables 13–14) were developed by compiling and synthesizing the best available science and soliciting input multiple times from both the public and peer reviewers to inform the final product, and are provided in the table below. The references, analysis, and methodology used in the development of the thresholds are described in NMFS 2016 Technical Guidance, which may be accessed at: *http://www.nmfs.noaa.gov/pr/acoustics/guidelines.htm.*

TABLE 13—ACOUSTIC THRESHOLDS IDENTIFYING THE ONSET OF TTS AND PTS FOR NON-IMPULSIVE SOUND SOURCES BY FUNCTIONAL HEARING GROUP

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

Note: SEL thresholds in dB re 1 μPa²s.

Based on the best available science, the Navy (in coordination with NMFS) used the acoustic and pressure thresholds indicated in Table 14 to predict the onset of TTS, PTS, tissue damage, and mortality for explosives (impulsive) and other impulsive sound sources.

TABLE 14—ONSET OF TTS, PTS, TISSUE DAMAGE, AND MORTALITY THRESHOLDS FOR MARINE MAMMALS FOR EXPLOSIVES AND OTHER IMPULSIVE SOURCES

Functional hearing group	Species	Weighted onset TTS	Weighted onset PTS	Mean onset slight GI tract injury	Mean onset slight lung injury	Mean onset mortality
Low-frequency cetaceans.	All mysticetes	168 dB SEL or 213 dB Peak SPL.	183 dB SEL or 219 dB Peak SPL.	237 dB SPL (unweighted).	Equation 1	Equation 2.
Mid-frequency cetaceans.	Most delphinids, medium and large toothed whales.	170 dB SEL or 224 dB Peak SPL.	185 dB SEL or 230 dB Peak SPL.	237 dB SPL (unweighted).		
High-frequency cetaceans.	Porpoises and Kogia spp	140 dB SEL or 196 dB Peak SPL.	155 dB SEL or 202 dB Peak SPL.	237 dB SPL (unweighted).		
Phocidae	Harbor, Gray, Bearded, Harp, Hooded, and Ringed seals.	170 dB SEL or 212 dB Peak SPL.	185 dB SEL or 218 dB Peak SPL.	237 dB SPL (unweighted).		

Notes:

Equation 1: $47.5M^{1/3} (1 + [D_{Rm}/10.1])^{1/6}$ Pa-sec.

Equation 2: $103M^{1/3} (1 + [D_{Rm}/10.1])^{1/6}$ Pa-sec.

M = mass of the animals in kg.

D_{Rm} = depth of the receiver (animal) in meters.

SPL = sound pressure level.

Impulsive—Airguns and Impact Pile Driving

Impact pile driving produces impulsive noise; therefore, the criteria used to assess the onset of TTS and PTS are identical to those used for airguns, as well as explosives (see Table 14 above) (see Hearing Loss from Airguns in Section 6.4.3.1, Methods for Analyzing Impacts from Airguns in the Navy's rulemaking and LOA application). Refer to the *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Impacts to Marine Mammals and Sea Turtles technical report* (U.S. Department of the Navy, 2017d) for detailed information on how the criteria and thresholds were derived.

Non-Impulsive—Sonar and Vibratory Pile Driving/Removal

Vibratory pile removal (that will be used during the Elevated Causeway System) creates continuous non-impulsive noise at low source levels for a short duration. Therefore, the criteria used to assess the onset of TTS and PTS due to exposure to sonars (non-impulsive, see Table 13 above) are also used to assess auditory impacts to marine mammals from vibratory pile driving (see Hearing Loss from Sonar and Other Transducers in Section 6.4.2.1, Methods for Analyzing Impacts from Sonars and Other Transducers in the Navy's rulemaking and LOA application). Refer to the *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Impacts to Marine Mammals and Sea Turtles technical report* (U.S. Department of the Navy, 2017d) for detailed information on how the criteria and thresholds were derived. Non-auditory injury (*i.e.,* other than PTS) and mortality from sonar and other transducers is so unlikely as to be discountable under normal conditions and is therefore not considered further in this analysis.

Behavioral Harassment

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

Airguns and Pile Driving

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

The existing NMFS Level B harassment thresholds were also applied to estimate behavioral effects from impact and vibratory pile driving (Table 15).

TABLE 15—PILE DRIVING LEVEL B THRESHOLDS USED IN THIS ANALYSIS TO PREDICT BEHAVIORAL RESPONSES FROM MARINE MAMMALS

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

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

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

Sonar

As noted, the Navy coordinated with NMFS to propose behavioral harassment thresholds specific to their military readiness activities utilizing active sonar. The way the criteria were derived is discussed in detail in *the Criteria and Thresholds for U.S. Navy Acoustic and Explosive Impacts to Marine Mammals and Sea Turtles Technical Report* (U.S. Department of the Navy, 2017d).

In the Navy acoustic impact analyses during Phase II, the likelihood of behavioral effects to sonar and other transducers was based on a probabilistic function (termed a behavioral response function—BRF), that related the likelihood (*i.e.,* probability) of a behavioral response to the received SPL. The BRF was used to estimate the percentage of an exposed population that is likely to exhibit altered behaviors or behavioral disturbance at a given received SPL. This BRF relied on the assumption that sound poses a negligible risk to marine mammals if they are exposed to SPL below a certain ''basement'' value. Above the basement exposure SPL, the probability of a response increased with increasing SPL. Two BRFs were used in Navy acoustic impact analyses: BRF1 for mysticetes and BRF2 for other species. BRFs were not used for harbor porpoises and beaked whales during Phase II analyses. Instead, step functions at SPLs of 120 dB re 1 μPa and 140 dB re 1 μPa were used for harbor porpoises and beaked whales, respectively, as thresholds to predict behavioral disturbance.

Developing the new behavioral criteria for Phase III involved multiple steps: All available behavioral response studies conducted both in the field and on captive animals were examined in order to understand the breadth of behavioral responses of marine mammals to sonar and other transducers. Marine mammal species were placed into behavioral criteria groups based on their known or suspected behavioral sensitivities to sound. In most cases these divisions were driven by taxonomic classifications (*e.g.,* mysticetes, pinnipeds). The data from the behavioral studies were analyzed by looking for significant responses, or lack thereof, for each experimental session. The Navy used cutoffs distances beyond which the potential of significant behavioral responses (and therefore Level B harassment) is considered to be unlikely (see Table 16 below). For animals within the cutoff distance, a behavioral response function based on a received SPL as presented in Section 3.1.0 of the Navy's rulemaking and LOA application was used to predict the probability of a potential significant behavioral response. For training and testing events that contain multiple platforms or tactical sonar sources that exceed 215 dB re 1 μPa @ 1 m, this cutoff distance is substantially increased (*i.e.,* doubled) from values derived from the literature. The use of multiple platforms and intense sound sources are factors that probably increase responsiveness in marine mammals overall. There are currently few behavioral observations under these circumstances; therefore, the Navy conservatively predicted significant behavioral responses at further ranges for these more intense activities.

TABLE 16—CUTOFF DISTANCES FOR MODERATE SOURCE LEVEL, SINGLE PLATFORM TRAINING AND TESTING EVENTS AND FOR ALL OTHER EVENTS WITH MULTIPLE PLATFORMS OR SONAR WITH SOURCE LEVELS AT OR EXCEEDING 215 dB RE 1 μPA @1 M

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

Notes: dB re 1 μPa @1 m: decibels referenced to 1 micropascal at 1 meter; km: kilometer; SL: source level.

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) 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, approximately 120 dB re 1 μPa. Therefore, a SPL of 120 dB re 1 μPa was used in the analysis as a threshold for predicting behavioral responses in harbor porpoises.

The range to received sound levels in 6-dB steps from five representative sonar bins and the percentage of animals that may exhibit a potentially significant behavioral response under each behavioral response function (or step function in the case of the harbor porpoise) are shown in Table 17 through Table 21. Cells are shaded if the mean range value for the specified received level exceeds the distance cutoff range for a particular hearing group and therefore are not included in the estimated take. Table 17 illustrates the potentially significant behavioral response for LFAS.

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Table 17. Ranges to a Potentially Significant Behavioral Response for Sonar Bin LF5 over a Representative Range of Environments within the AFTT Study Area.

Received Level (dB re 1 µPa)	*Mean Range (m) with minimum to maximum values in parentheses*	*Probability of Behavioral Response*				
		Odontocetes	*Mysticetes*	*Pinnipeds*	*Beaked Whales*	*Harbor Porpoises*
196	0 (0—0)	100%	100%	100%	100%	100%
190	0 (0—0)	100%	98%	99%	100%	100%
184	0 (0—0)	99%	88%	98%	100%	100%
178	1 (0—1)	97%	59%	92%	100%	100%
172	2 (1—2)	91%	30%	76%	99%	100%
166	4 (1—6)	78%	20%	48%	97%	100%
160	10 (1—13)	58%	18%	27%	93%	100%
154	21 (1—25)	40%	17%	18%	83%	100%
148	46 (1—60)	29%	16%	16%	66%	100%
142	104 (1—140)	25%	13%	15%	45%	100%
136	242 (120—430)	23%	9%	15%	28%	100%
130	573 (320—1,275)	20%	5%	15%	18%	100%
124	1,268 (550—2,775)	17%	2%	14%	14%	100%
118	2,733 (800—6,525)	12%	1%	13%	12%	0%
112	5,820 (1,025—18,275)	6%	0%	9%	11%	0%
106	13,341 (1,275—54,525)	3%	0%	5%	11%	0%
100	31,026 (2,025—100,000*)	1%	0%	2%	8%	0%

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

Notes: Cells are shaded if the mean range value for the specified received level exceeds the distance cutoff range for a particular hearing group. Any impacts within the cutoff range for a criteria group are included in the estimated impacts. Cut-off ranges in this table are for activities with high source levels and/or multiple platforms (see Table 17 for behavioral cut-off distances).

dB re 1 µPa2 - s: decibels referenced to 1 micropascal squared second; m: meters

Table 18. Ranges to a Potentially Significant Behavioral Response for Sonar Bin MF1 over a Representative Range of Environments within the AFTT Study Area.

Received Level (dB re 1 µPa)	*Mean Range (m) with minimum to maximum values in parentheses*	*Probability of Behavioral Response*				
		Odontocetes	*Mysticetes*	*Pinnipeds*	*Beaked Whales*	*Harbor Porpoises*
196	109 (100—150)	100%	100%	100%	100%	100%
190	257 (220—370)	100%	98%	99%	100%	100%
184	573 (400—1,000)	99%	88%	98%	100%	100%
178	1,235 (725—3,525)	97%	59%	92%	100%	100%
172	3,007 (875—9,775)	91%	30%	76%	99%	100%
166	6,511 (925—19,525)	78%	20%	48%	97%	100%
160	11,644 (975—36,275)	58%	18%	27%	93%	100%
154	18,012 (975—60,775)	40%	17%	18%	83%	100%
148	26,037 (1,000—77,525)	29%	16%	16%	66%	100%
142	33,377 (1,000—100,000*)	25%	13%	15%	45%	100%
136	41,099 (1,025—100,000*)	23%	9%	15%	28%	100%
130	46,618 (3,275—100,000*)	20%	5%	15%	18%	100%
124	50,173 (3,525—100,000*)	17%	2%	14%	14%	100%
118	52,982 (3,775—100,000*)	12%	1%	13%	12%	0%
112	56,337 (4,275—100,000*)	6%	0%	9%	11%	0%
106	60,505 (4,275—100,000*)	3%	0%	5%	11%	0%
100	62,833 (4,525—100,000*)	1%	0%	2%	8%	0%

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

Notes: Cells are shaded if the mean range value for the specified received level exceeds the distance cutoff range for a particular hearing group. Any impacts within the cutoff range for a criteria group are included in the estimated impacts. Cut-off ranges in this table are for activities with high source levels and/or multiple platforms (see Table 17 for behavioral cut-off distances). dB re 1 µPa2 - s: decibels referenced to 1 micropascal squared second; m: meters

Table 19. Ranges to a Potentially Significant Behavioral Response for Sonar Bin MF4 over a Representative Range of Environments within the AFTT Study Area.

Received Level (dB re 1 µPa)	*Mean Range (m) with minimum to maximum values in parentheses*	*Probability of Behavioral Response*				
		Odontocetes	*Mysticetes*	*Pinnipeds*	*Beaked Whales*	*Harbor Porpoises*
196	8 (1—10)	100%	100%	100%	100%	100%
190	17 (1—21)	100%	98%	99%	100%	100%
184	35 (1—40)	99%	88%	98%	100%	100%
178	71 (1—95)	97%	59%	92%	100%	100%
172	156 (110—410)	91%	30%	76%	99%	100%
166	431 (280—1,275)	78%	20%	48%	97%	100%
160	948 (490—3,525)	58%	18%	27%	93%	100%
154	1,937 (750—10,025)	40%	17%	18%	83%	100%
148	3,725 (1,025—20,525)	29%	16%	16%	66%	100%
142	7,084 (1,525—38,525)	25%	13%	15%	45%	100%
136	11,325 (1,775—56,275)	23%	9%	15%	28%	100%
130	16,884 (1,775—74,275)	20%	5%	15%	18%	100%
124	24,033 (2,275—80,775)	17%	2%	14%	14%	100%
118	31,950 (2,275—100,000*)	12%	1%	13%	12%	0%
112	37,663 (2,525—100,000*)	6%	0%	9%	11%	0%
106	41,436 (2,775—100,000*)	3%	0%	5%	11%	0%
100	44,352 (2,775—100,000*)	1%	0%	2%	8%	0%

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

Notes: Cells are shaded if the mean range value for the specified received level exceeds the distance cutoff range for a particular hearing group. Any impacts within the cutoff range for a criteria group are included in the estimated impacts. Cut-off ranges in this table are for activities with high source levels and/or multiple platforms (see Table 17 for behavioral cut-off distances). dB re 1 µPa2 - s: decibels referenced to 1 micropascal squared second; m: meters

Table 20. Ranges to a Potentially Significant Behavioral Response for Sonar Bin MF5 over a Representative Range of Environments within the AFTT Study Area.

Received Level (dB re 1 µPa)	*Mean Range (m) with minimum to maximum values in parentheses*	*Probability of Behavioral Response*				
		Odontocetes	*Mysticetes*	*Pinnipeds*	*Beaked Whales*	*Harbor Porpoises*
196	0 (0—0)	100%	100%	100%	100%	100%
190	2 (1—3)	100%	98%	99%	100%	100%
184	4 (1—9)	99%	88%	98%	100%	100%
178	14 (1—18)	97%	59%	92%	100%	100%
172	29 (1—35)	91%	30%	76%	99%	100%
166	61 (1—80)	78%	20%	48%	97%	100%
160	141 (1—400)	58%	18%	27%	93%	100%
154	346 (1—1,000)	40%	17%	18%	83%	100%
148	762 (420—2,525)	29%	16%	16%	66%	100%
142	1,561 (675—5,525)	25%	13%	15%	45%	100%
136	2,947 (1,025—10,775)	23%	9%	15%	28%	100%
130	5,035 (1,025—17,275)	20%	5%	15%	18%	100%
124	7,409 (1,275—22,525)	17%	2%	14%	14%	100%
118	10,340 (1,525—29,525)	12%	1%	13%	12%	0%
112	13,229 (1,525—38,025)	6%	0%	9%	11%	0%
106	16,487 (1,525—46,025)	3%	0%	5%	11%	0%
100	20,510 (1,775—60,525)	1%	0%	2%	8%	0%

Note: Cells are shaded if the mean range value for the specified received level exceeds the distance cutoff range for a particular hearing group. Any impacts within the cutoff range for a criteria group are included in the estimated impacts. Cut-off ranges in this table are for activities with high source levels and/or multiple platforms (see Table 17 for behavioral cut-off distances). dB re 1 µPa2 - s: decibels referenced to 1 micropascal squared second; m: meter

Table 21 illustrates the potentially significant behavioral response for HFAS.

Table 21. Ranges to a Potentially Significant Behavioral Response for Sonar Bin HF4 over a Representative Range of Environments within the AFTT Study Area.

Received Level (dB re 1 µPa)	*Mean Range (m) with minimum to maximum values in parentheses*	*Probability of Behavioral Response*				
		Odontocetes	*Mysticetes*	*Pinnipeds*	*Beaked Whales*	*Harbor Porpoises*
196	3 (1—6)	100%	100%	100%	100%	100%
190	8 (1—14)	100%	98%	99%	100%	100%
184	18 (1—35)	99%	88%	98%	100%	100%
178	37 (1—100)	97%	59%	92%	100%	100%
172	78 (1—300)	91%	30%	76%	99%	100%
166	167 (1—725)	78%	20%	48%	97%	100%
160	322 (25—1,525)	58%	18%	27%	93%	100%
154	555 (45—3,775)	40%	17%	18%	83%	100%
148	867 (70—6,775)	29%	16%	16%	66%	100%
142	1,233 (150—12,775)	25%	13%	15%	45%	100%
136	1,695 (260—20,025)	23%	9%	15%	28%	100%
130	2,210 (470—29,275)	20%	5%	15%	18%	100%
124	2,792 (650—40,775)	17%	2%	14%	14%	100%
118	3,421 (950—49,775)	12%	1%	13%	12%	0%
112	4,109 (1,025—49,775)	6%	0%	9%	11%	0%
106	4,798 (1,275—49,775)	3%	0%	5%	11%	0%
100	5,540 (1,275—49,775)	1%	0%	2%	8%	0%

Notes: dB re 1 µPa2 - s: decibels referenced to 1 micropascal squared second; m: meters

Explosives

Phase III explosive criteria for behavioral thresholds for marine mammals is the hearing groups TTS threshold minus 5 dB (see Table 22 and Table 14 for the TTS thresholds for explosives) for events that contain multiple impulses from explosives underwater. This was the same approach as taken in Phase II for explosive analysis.

TABLE 22—PHASE III BEHAVIORAL THRESHOLDS FOR EXPLOSIVES FOR MARINE MAMMALS

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

Note: Weighted SEL thresholds in dB re 1 µPa2s underwater.

Navy's Acoustic Effects Model

Sonar and Other Transducers and Explosives

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

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

Assumptions in the Navy model intentionally err on the side of overestimation when there are unknowns. Naval activities are modeled as though they would occur regardless of proximity to marine mammals, meaning that no mitigation is considered (*i.e.,* no power down or shut down modeled) and without any avoidance of the activity by the animal. The final step of the quantitative analysis of acoustic effects is to consider the implementation of mitigation and the possibility that marine mammals would avoid continued or repeated sound exposures.

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

Airguns and Pile Driving

The Navy's quantitative analysis estimates the sound and energy received by marine mammals distributed in the area around planned Navy activities involving airguns. See the technical report titled *Quantitative Analysis for Estimating Acoustic and Explosive Impacts to Marine Mammals and Sea Turtles* (U.S. Department of the Navy, 2017a) for additional details. Underwater noise effects from pile driving and vibratory pile extraction were modeled using actual measures of impact pile driving and vibratory removal during construction of an Elevated Causeway System (Illingworth and Rodkin, 2015, 2016). A conservative estimate of spreading loss of sound in shallow coastal waters (*i.e.,* transmission loss = 16.5*Log10 [radius]) was applied based on spreading loss observed in actual measurements. Inputs used in the model are provided in Section 1.4.1.3 (Pile Driving) of the Navy's rulemaking and LOA application, including source levels; the number of strikes required to drive a pile and the duration of vibratory removal per pile; the number of piles driven or removed per day; and the number of days of pile driving and removal.

Range to Effects

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

Sonar

The range to received sound levels in 6-dB steps from five representative sonar bins and the percentage of the total number of animals that may exhibit a significant behavioral response (and therefore Level B harassment) under each behavioral response function (or step function in the case of the harbor porpoise) are shown in Table 17 through Table 21 above, respectively. See Section 6.4.2.1 (Methods for Analyzing Impacts from Sonars and Other Transducers) of the Navy's rulemaking and LOA application for additional details on the derivation and use of the behavioral response functions, thresholds, and the cutoff distances.

The ranges to the PTS for five representative sonar systems for an exposure of 30 seconds is shown in Table 23 relative to the marine mammal's functional hearing group. This period (30 seconds) was chosen based on examining the maximum amount of time a marine mammal would realistically be exposed to levels that could cause the onset of PTS based on platform (*e.g.,* ship) speed and a nominal animal swim speed of approximately 1.5 meters per second. The ranges provided in the table include the average range to PTS, as well as the range from the minimum to the maximum distance at which PTS is possible for each hearing group.

TABLE 23—RANGE TO PERMANENT THRESHOLD SHIFT FOR FIVE REPRESENTATIVE SONAR SYSTEMS

Functional hearing group	Approximate PTS (30 seconds) ranges (meters) [1]				
	Sonar bin LF5 (low frequency sources <180 dB source 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 sono-buoy)	Sonar bin HF4 (*e.g.*, SQS–20 mine hunting sonar)
Low-frequency Cetaceans	0 (0–0)	66 (65–80)	15 (15–18)	0 (0–0)	0 (0–0)
Mid-frequency Cetaceans	0 (0–0)	16 (16–16)	3 (3–3)	0 (0–0)	1 (0–2)
High-frequency Cetaceans	0 (0–0)	192 (170–270)	31 (30–40)	9 (8–13)	34 (20–85)
Phocid Seals	0 (0–0)	46 (45–55)	11 (11–13)	0 (0–0)	0 (0–0)

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

Notes: ASW: anti-submarine warfare; HF: High frequency; LF: Low frequency; MF: Mid-frequency; PTS: Permanent threshold shift; NA: Not applicable because there is no overlap between species and sound source.

The tables below illustrate the range to TTS for 1, 30, 60, and 120 seconds from five representative sonar systems (see Table 24 through Table 28).

TABLE 24—RANGES TO TEMPORARY THRESHOLD SHIFT FOR SONAR BIN LF5 OVER A REPRESENTATIVE RANGE OF ENVIRONMENTS WITHIN THE STUDY AREA

Functional hearing group	Approximate TTS ranges (meters) [1]			
	Sonar bin LF5 (low frequency sources <180 dB source level)			
	1 second	30 seconds	60 seconds	120 seconds
Low-frequency Cetaceans	4 (0–5)	4 (0–5)	4 (0–5)	4 (0–5)
Mid-frequency Cetaceans	222 (200–310)	222 (200–310)	331 (280–525)	424 (340–800)
High-frequency Cetaceans	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)

TABLE 24—RANGES TO TEMPORARY THRESHOLD SHIFT FOR SONAR BIN LF5 OVER A REPRESENTATIVE RANGE OF ENVIRONMENTS WITHIN THE STUDY AREA—Continued

Functional hearing group	Approximate TTS ranges (meters) [1]			
	Sonar bin LF5 (low frequency sources <180 dB source level)			
	1 second	30 seconds	60 seconds	120 seconds
Phocid Seals	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)

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

Notes: Ranges for 1-sec and 30-sec periods are identical for Bin MF1 because this system nominally pings every 50 seconds, therefore these periods encompass only a single ping. PTS: Permanent threshold shift; TTS: Temporary threshold shift.

TABLE 25—RANGES TO TEMPORARY THRESHOLD SHIFT FOR SONAR BIN MF1 OVER A REPRESENTATIVE RANGE OF ENVIRONMENTS WITHIN THE STUDY AREA

Functional hearing group	Approximate TTS ranges (meters) [1]			
	Sonar bin MF1 (*e.g.*, SQS–53 ASW hull mounted sonar)			
	1 second	30 seconds	60 seconds	120 seconds
Low-frequency Cetaceans	1,111 (650–2,775)	1,111 (650–2,775)	1,655 (800–3,775)	2,160 (900–6,525)
Mid-frequency Cetaceans	222 (200–310)	222 (200–310)	331 (280–525)	424 (340–800)
High-frequency Cetaceans	3,001 (1275–8,275)	3,001 (1275–8,275)	4,803 (1525–13,525)	6,016 (1525–16,775)
Phocid Seals	784 (575–1,275)	784 (575–1,275)	1,211 (850–3,025)	1,505 (1025–3,775)

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

Notes: Ranges for 1-sec and 30-sec periods are identical for Bin MF1 because this system nominally pings every 50 seconds, therefore these periods encompass only a single ping. ASW: Anti-submarine warfare; MF: Mid-frequency; PTS: Permanent threshold shift; TTS: Temporary threshold shift.

TABLE 26—RANGES TO TEMPORARY THRESHOLD SHIFT FOR SONAR BIN MF4 OVER A REPRESENTATIVE RANGE OF ENVIRONMENTS WITHIN THE STUDY AREA

Functional hearing group	Approximate TTS ranges (meters) [1]			
	Sonar bin MF4 (*e.g.*, AQS–22 ASW dipping sonar)			
	1 second	30 seconds	60 seconds	120 seconds
Low-frequency Cetaceans	89 (85–120)	175 (160–280)	262 (220–575)	429 (330–875)
Mid-frequency Cetaceans	22 (22–25)	36 (35–45)	51 (45–60)	72 (70–95)
High-frequency Cetaceans	270 (220–575)	546 (410–1,025)	729 (525–1,525)	1,107 (600–2,275)
Phocid Seals	67 (65–90)	119 (110–180)	171 (150–260)	296 (240–700)

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

Notes: ASW: Anti-submarine warfare; MF: Mid-frequency; PTS: Permanent threshold shift; TTS: Temporary threshold shift.

TABLE 27—RANGES TO TEMPORARY THRESHOLD SHIFT FOR SONAR BIN MF5 OVER A REPRESENTATIVE RANGE OF ENVIRONMENTS WITHIN THE STUDY AREA

Functional hearing group	Approximate TTS ranges (meters) [1]			
	Sonar bin MF5 (*e.g.*, SSQ–62 ASW sonobuoy)			
	1 second	30 seconds	60 seconds	120 seconds
Low-frequency Cetaceans	11 (0–14)	11 (0–14)	16 (0–20)	23 (0–25)
Mid-frequency Cetaceans	5 (0–10)	5 (0–10)	12 (0–15)	17 (0–22)
High-frequency Cetaceans	122 (110–320)	122 (110–320)	187 (150–525)	286 (210–750)

TABLE 27—RANGES TO TEMPORARY THRESHOLD SHIFT FOR SONAR BIN MF5 OVER A REPRESENTATIVE RANGE OF ENVIRONMENTS WITHIN THE STUDY AREA—Continued

Functional hearing group	Approximate TTS ranges (meters) [1]			
	Sonar bin MF5 (*e.g.*, SSQ–62 ASW sonobuoy)			
	1 second	30 seconds	60 seconds	120 seconds
Phocid Seals	9 (8–13)	9 (8–13)	15 (14–18)	22 (21–25)

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

Notes: ASW: Anti-submarine warfare; MF: Mid-frequency; PTS: Permanent threshold shift; TTS: Temporary threshold shift.

TABLE 28—RANGES TO TEMPORARY THRESHOLD SHIFT FOR SONAR BIN HF4 OVER A REPRESENTATIVE RANGE OF ENVIRONMENTS WITHIN THE STUDY AREA

Functional hearing group	Approximate TTS ranges (meters) [1]			
	Sonar bin HF4 (*e.g.*, SQS–20 mine hunting sonar)			
	1 second	30 seconds	60 seconds	120 seconds
Low-frequency Cetaceans	1 (0–3)	3 (0–5)	5 (0–7)	7 (0–12)
Mid-frequency Cetaceans	10 (7–17)	19 (11–35)	27 (17–60)	39 (22–100)
High-frequency Cetaceans	242 (100–975)	395 (170–1,775)	524 (230–2,775)	655 (300–4,275)
Phocid Seals	2 (0–5)	5 (0–8)	8 (5–13)	12 (8–20)

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

Notes: HF: High frequency; PTS: Permanent threshold shift; TTS: Temporary threshold shift.

Explosives

The following section provides the range (distance) over which specific physiological or behavioral effects are expected to occur based on the explosive criteria (see Chapter 6.5.2.1.1 of the Navy's rulemaking and LOA application and *Criteria and Thresholds Used to Estimate Impacts to Marine Mammals from Explosives*) and the explosive propagation calculations from the Navy Acoustic Effects Model (see Chapter 6.5.2.1.3, Navy Acoustic Effects Model of the Navy's rulemaking and LOA application). The range to effects are shown for a range of explosive bins, from E1 (up to 0.25 lb net explosive weight) to E17 (up to 58,000 lb net explosive weight) (Tables 29 through 34). Ranges are determined by modeling the distance that noise from an explosion will need to propagate to reach exposure level thresholds specific to a hearing group that will cause behavioral response, TTS, PTS, and non-auditory injury. Ranges are provided for a representative source depth and cluster size for each bin. For events with multiple explosions, sound from successive explosions can be expected to accumulate and increase the range to the onset of an impact based on SEL thresholds. Ranges to non-injury and mortality are shown in Table 33 and 34, respectively. Range to effects is important information in not only predicting impacts from explosives, but also in verifying the accuracy of model results against real-world situations and determining adequate mitigation ranges to avoid higher level effects, especially physiological effects to marine mammals. For additional information on how ranges to impacts from explosions were estimated, see the technical report *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing* (U.S. Navy, 2017b).

Table 29. shows the minimum, average, and maximum ranges to onset of auditory and behavioral effects for high-frequency cetaceans based on the developed thresholds.

TABLE 29—SEL-BASED RANGES TO ONSET PTS, ONSET TTS, AND BEHAVIORAL REACTION FOR HIGH-FREQUENCY CETACEANS

Range to effects for explosives: high frequency cetaceans [1]					
Bin	Source depth (m)	Cluster size	PTS	TTS	Behavioral
E1	0.1	1	446 (180–975)	1,512 (525–3,775)	2,591 (800–6,775)
		20	1,289 (440–3,025)	4,527 (1,275–10,775)	6,650 (1,525–16,525)
E2	0.1	1	503 (200–1,025)	1,865 (600–3,775)	3,559 (1,025–6,775)
		2	623 (250–1,275)	2,606 (750–5,275)	4,743 (1,275–8,525)
E3	18.25	1	865 (525–2,525)	3,707 (1,025–6,775)	5,879 (1,775–10,025)
		50	4,484 (1,275–7,775)	10,610 (2,275–19,775)	13,817 (2,275–27,025)
E4	15	1	1,576 (1,025–2,275)	6,588 (4,525–8,775)	9,744 (7,275–13,025)

TABLE 29—SEL-BASED RANGES TO ONSET PTS, ONSET TTS, AND BEHAVIORAL REACTION FOR HIGH-FREQUENCY CETACEANS—Continued

Range to effects for explosives: high frequency cetaceans [1]					
Bin	Source depth (m)	Cluster size	PTS	TTS	Behavioral
		5	3,314 (2,275–4,525)	10,312 (7,525–14,775)	14,200 (9,775–20,025)
	19.8	2	1,262 (975–2,025)	4,708 (1,775–7,525)	6,618 (2,025–11,525)
	198	2	1,355 (875–2,775)	4,900 (2,525–8,275)	6,686 (3,025–11,275)
E5	0.1	25	3,342 (925–8,025)	8,880 (1,275–20,525)	11,832 (1,525–25,025)
E6	0.1	1	1,204 (550–3,275)	4,507 (1,275–10,775)	6,755 (1,525–16,525)
	30	1	2,442 (1,525–5,025)	7,631 (4,525–10,775)	10,503 (4,775–15,025)
E7	15	1	3,317 (2,525–4,525)	10,122 (7,775–13,275)	13,872 (9,775–17,775)
E8	0.1	1	1,883 (675–4,525)	6,404 (1,525–14,525)	9,001 (1,525–19,775)
	45.75	1	2,442 (1,025–5,525)	7,079 (2,025–12,275)	9,462 (2,275–17,025)
	305	1	3,008 (2,025–4,025)	9,008 (6,025–10,775)	12,032 (8,525–14,525)
E9	0.1	1	2,210 (800–4,775)	6,088 (1,525–13,275)	8,299 (1,525–19,025)
E10	0.1	1	2,960 (875–7,275)	8,424 (1,525–19,275)	11,380 (1,525–24,275)
E11	18.5	1	4,827 (1,525–8,775)	11,231 (2,525–20,025)	14,667 (2,525–26,775)
	45.75	1	3,893 (1,525–7,525)	9,320 (2,275–17,025)	12,118 (2,525–21,525)
E12	0.1	1	3,046 (1,275–6,775)	7,722 (1,525–18,775)	10,218 (2,025–22,525)
E16	61	1	5,190 (2,275–9,775)	7,851 (3,525–19,525)	9,643 (3,775–25,775)
E17	61	1	6,173 (2,525–12,025)	11,071 (3,775–29,275)	13,574 (4,025–37,775)

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

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

TABLE 30—SEL-BASED RANGES TO ONSET PTS, ONSET TTS, AND BEHAVIORAL REACTION FOR MID-FREQUENCY CETACEANS

Range to effects for explosives: mid-frequency cetaceans [1]					
Bin	Source depth (m)	Cluster size	PTS	TTS	Behavioral
E1	0.1	1	26 (25–50)	139 (95–370)	218 (120–550)
		20	113 (80–290)	539 (210–1,025)	754 (270–1,525)
E2	0.1	1	35 (30–45)	184 (100–300)	276 (130–490)
		2	51 (40–70)	251 (120–430)	365 (160–700)
E3	18.25	1	40 (35–45)	236 (190–800)	388 (280–1,275)
		50	304 (230–1,025)	1,615 (750–3,275)	2,424 (925–5,025)
E4	15	1	74 (60–100)	522 (440–750)	813 (650–1,025)
		5	192 (140–260)	1,055 (875–1,525)	1,631 (1,275–2,525)
	19.8	2	69 (65–70)	380 (330–470)	665 (550–750)
	198	2	48 (0–55)	307 (260–380)	504 (430–700)
E5	0.1	25	391 (170–850)	1,292 (470–3,275)	1,820 (575–5,025)
E6	0.1	1	116 (90–290)	536 (310–1,025)	742 (380–1,525)
	30	1	110 (85–310)	862 (600–2,275)	1,281 (975–3,275)
E7	15	1	201 (190–220)	1,067 (1,025–1,275)	1,601 (1,275–2,025)
E8	0.1	1	204 (150–500)	802 (400–1,525)	1,064 (470–2,275)
	45.75	1	133 (120–200)	828 (525–2,025)	1,273 (775–2,775)
	305	1	58 (0–110)	656 (550–750)	1,019 (900–1,025)
E9	0.1	1	241 (200–370)	946 (450–1,525)	1,279 (500–2,275)
E10	0.1	1	339 (230–750)	1,125 (490–2,525)	1,558 (550–4,775)
E11	18.5	1	361 (230–750)	1,744 (800–3,775)	2,597 (925–5,025)
	45.75	1	289 (230–825)	1,544 (800–3,275)	2,298 (925–5,025)
E12	0.1	1	382 (270–550)	1,312 (525–2,775)	1,767 (600–4,275)
E16	61	1	885 (650–1,775)	3,056 (1,275–5,025)	3,689 (1,525–6,525)
E17	61	1	1,398 (925–2,275)	3,738 (1,525–6,775)	4,835 (1,775–9,275)

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

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

TABLE 31—SEL-BASED RANGES TO ONSET PTS, ONSET TTS, AND BEHAVIORAL REACTION FOR LOW-FREQUENCY CETACEANS

Range to effects for explosives: low-frequency cetaceans [1]					
Bin	Source depth (m)	Cluster size	PTS	TTS	Behavioral
E1	0.1	1	54 (45–80)	259 (130–390)	137 (90–210)
		20	211 (110–320)	787 (340–1,525)	487 (210–775)
E2	0.1	1	64 (55–75)	264 (150–400)	154 (100–220)
		2	87 (70–110)	339 (190–500)	203 (120–300)
E3	18.25	1	211 (190–390)	1,182 (600–2,525)	588 (410–1,275)
		50	1,450 (675–3,275)	8,920 (1,525–24,275)	4,671 (1,025–10,775)
E4	15	1	424 (380–550)	3,308 (2,275–4,775)	1,426 (1,025–2,275)
		5	1,091 (950–1,525)	6,261 (3,775–9,525)	3,661 (2,525–5,275)
	19.8	2	375 (350–400)	1,770 (1,275–3,025)	1,003 (725–1,275)
	198	2	308 (280–380)	2,275 (1,275–3,525)	1,092 (850–2,275)
E5	0.1	25	701 (300–1,525)	4,827 (750–29,275)	1,962 (575–22,525)
E6	0.1	1	280 (150–450)	1,018 (460–7,275)	601 (300–1,525)
	30	1	824 (525–1,275)	4,431 (2,025–7,775)	2,334 (1,275–4,275)
E7	15	1	1,928 (1,775–2,275)	8,803 (6,025–14,275)	4,942 (3,525–6,525)
E8	0.1	1	486 (220–1,000)	3,059 (575–20,525)	1,087 (440–7,775)
	45.75	1	1,233 (675–3,025)	7,447 (1,275–19,025)	3,633 (1,000–9,025)
	305	1	937 (875–975)	6,540 (3,025–12,025)	3,888 (2,025–6,525)
E9	0.1	1	655 (310–1,275)	2,900 (650–31,025)	1,364 (500–8,525)
E10	0.1	1	786 (340–7,275)	7,546 (725–49,025)	3,289 (550–26,525)
E11	18.5	1	3,705 (925–8,775)	16,488 (2,275–40,275)	9,489 (1,775–22,775)
	45.75	1	3,133 (925–8,275)	16,365 (1,775–50,275)	8,701 (1,275–23,775)
E12	0.1	1	985 (400–6,025)	7,096 (800–72,775)	2,658 (625–46,525)
E16	61	1	10,155 (2,025–21,525)	35,790 (18,025–69,775)	25,946 (14,025–58,775)
E17	61	1	17,464 (8,275–39,525)	47,402 (21,025–93,275)	34,095 (16,275–86,275)

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

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

TABLE 32—SEL-BASED RANGES TO ONSET PTS, ONSET TTS, AND BEHAVIORAL REACTION FOR PHOCIDS

Range to effects for explosives: phocids [1]					
Bin	Source depth (m)	Cluster size	PTS	TTS	Behavioral
E1	0.1	1	50 (45–85)	242 (120–470)	360 (160–650)
		20	197 (110–380)	792 (300–1,275)	1,066 (410–2,275)
E2	0.1	1	65 (55–85)	267 (140–430)	378 (190–675)
		2	85 (65–100)	345 (180–575)	476 (230–875)
E3	18.25	1	121 (110–220)	689 (500–1,525)	1,074 (725–2,525)
		50	859 (600–2,025)	4,880 (1,525–10,525)	7,064 (1,775–16,275)
E4	15	1	213 (190–260)	1,246 (1,025–1,775)	2,006 (1,525–3,025)
		5	505 (450–600)	2,933 (2,275–4,275)	4,529 (3,275–6,775)
	19.8	2	214 (210–220)	1,083 (900–2,025)	1,559 (1,025–2,525)
	198	2	156 (150–180)	1,141 (825–2,275)	2,076 (1,275–3,525)
E5	0.1	25	615 (250–1,025)	2,209 (850–9,775)	3,488 (1,025–15,275)
E6	0.1	1	210 (160–380)	796 (480–1,275)	1,040 (600–3,275)
	30	1	359 (280–625)	1,821 (1,275–2,775)	2,786 (1,775–4,275)
E7	15	1	557 (525–650)	3,435 (2,775–4,525)	5,095 (3,775–6,775)
E8	0.1	1	346 (230–600)	1,136 (625–4,025)	1,708 (850–6,025)
	45.75	1	469 (380–1,025)	2,555 (1,275–6,025)	3,804 (1,525–9,775)
	305	1	322 (310–330)	3,222 (1,775–4,525)	4,186 (2,275–5,775)
E9	0.1	1	441 (330–575)	1,466 (825–5,775)	2,142 (950–9,775)
E10	0.1	1	539 (350–900)	1,914 (875–8,525)	3,137 (1,025–15,025)
E11	18.5	1	1,026 (700–2,025)	5,796 (1,525–12,775)	8,525 (1,775–19,775)
	45.75	1	993 (675–2,275)	4,835 (1,525–13,525)	7,337 (1,775–18,775)
E12	0.1	1	651 (420–900)	2,249 (950–11,025)	3,349 (1,275–16,025)
E16	61	1	2,935 (1,775–5,025)	6,451 (2,275–16,275)	10,619 (3,275–24,025)
E17	61	1	3,583 (1,775–7,525)	12,031 (3,275–29,275)	18,396 (7,275–41,025)

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

Table 33 below shows the average and ranges due to varying propagation conditions to non-auditory injury as a function of explosive bin (*i.e.,* net explosive weight). Ranges to gastrointestinal tract injury typically exceed ranges to slight lung injury; therefore, the maximum range to effect is not mass-dependent. Animals within these water volumes would be expected to receive minor injuries at the outer ranges, increasing to more substantial injuries, and finally mortality as an animal approaches the detonation point.

TABLE 33—RANGES [1] TO 50% NON-AUDITORY INJURY RISK FOR ALL MARINE MAMMAL HEARING GROUPS

Bin	Range (m)
E1	22 (22–35)
E2	25 (25–30)
E3	46 (35–75)
E4	63 (0–130)
E5	75 (55–130)
E6	97 (65–390)
E7	232 (200–270)
E8	170 (0–490)
E9	215 (100–430)
E10	251 (110–700)
E11	604 (400–2,525)
E12	436 (130–1,025)
E16	1,844 (925–3,025)
E17	3,649 (1,000–14,025)

[1] Distances in meters (m). Average distance is shown with the minimum and maximum distances due to varying propagation environments in parentheses. Modeled ranges based on peak pressure for a single explosion generally exceed the modeled ranges based on impulse (related to animal mass and depth).

Ranges to mortality, based on animal mass, are shown in Table 34 below.

TABLE 34—RANGES [1] TO 50% MORTALITY RISK FOR ALL MARINE MAMMAL HEARING GROUPS AS A FUNCTION OF ANIMAL MASS

Bin	Representative animal mass (kg)					
	10	250	1,000	5,000	25,000	72,000
E1	4 (3–5)	1 (0–3)	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)
E2	5 (5–7)	3 (0–5)	0 (0–2)	0 (0–0)	0 (0–0)	0 (0–0)
E3	11 (9–15)	6 (3–11)	3 (2–4)	0 (0–2)	0 (0–0)	0 (0–0)
E4	20 (0–45)	11 (0–30)	5 (0–13)	3 (0–6)	1 (0–2)	0 (0–2)
E5	18 (14–50)	10 (5–35)	5 (3–11)	3 (2–6)	0 (0–3)	0 (0–2)
E6	26 (17–75)	14 (0–55)	7 (0–20)	4 (3–10)	2 (0–4)	1 (0–3)
E7	100 (75–130)	49 (25–95)	21 (17–30)	13 (11–15)	7 (6–7)	5 (4–6)
E8	69 (0–140)	36 (0–100)	16 (0–30)	12 (0–17)	6 (0–8)	5 (0–7)
E9	58 (40–200)	26 (17–55)	14 (11–18)	9 (8–11)	5 (4–5)	4 (3–5)
E10	107 (40–320)	39 (19–220)	18 (14–35)	12 (10–21)	6 (6–9)	5 (4–6)
E11	299 (230–675)	163 (90–490)	74 (55–150)	45 (35–85)	24 (21–40)	19 (15–30)
E12	194 (60–460)	82 (25–340)	22 (18–30)	15 (12–17)	8 (7–9)	6 (5–7)
E16	1,083 (925–1,525)	782 (500–1,025)	423 (350–550)	275 (230–300)	144 (130–150)	105 (90–120)
E17	1,731 (925–2,525)	1,222 (700–2,275)	857 (575–1,025)	586 (470–825)	318 (290–340)	244 (210–280)

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

Airguns

Table 35 and Table 36 present the approximate ranges in meters to PTS, TTS, and potential behavioral reactions for airguns for 10 and 100 pulses, respectively. Ranges are specific to the AFTT Study Area and also to each marine mammal hearing group, dependent upon their criteria and the specific locations where animals from the hearing groups and the airgun activities could overlap. Small air guns (12–60 in.[3]) would be fired pierside at the Naval Undersea Warfare Center Division, Newport Testing Range, and at off-shore locations typically in the Northeast, Virginia Capes, and Gulf of Mexico Range Complexes. Single, small air guns lack the peak pressures that could cause non-auditory injury (see Finneran *et al.,* (2015)).

TABLE 35—RANGE TO EFFECTS FROM AIRGUNS FOR 10 PULSES

Hearing group	Range to effects for airguns [1] for 10 pulses (m)				
	PTS (SEL)	PTS (Peak SPL)	TTS (SEL)	TTS (Peak SPL)	Behavioral [2]
High-Frequency Cetacean	0 (0–0)	15 (15–15)	0 (0–0)	25 (25–25)	700 (250–1,025)
Low-Frequency Cetacean	13 (12–13)	2 (2–2)	72 (70–80)	4 (4–4)	685 (170–1,025)
Mid-Frequency Cetacean	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)	680 (160–2,275)
Phocids	0 (0–0)	2 (2–2)	3 (3–3)	4 (4–4)	708 (220–1,025)

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

TABLE 36—RANGE TO EFFECTS FROM AIRGUNS FOR 100 PULSES

Hearing group	Range to effects for airguns [1] for 100 pulses (m)				
	PTS (SEL)	PTS (Peak SPL)	TTS (SEL)	TTS (Peak SPL)	Behavioral [2]
High-Frequency Cetacean	4 (4–4)	40 (40–40)	48 (45–50)	66 (65–70)	2,546 (1,025–5,525)
Low-Frequency Cetacean	122 (120–130)	3 (3–3)	871 (600–1,275)	13 (12–13)	2,546 (1,025–5,525)
Mid-Frequency Cetacean	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)	2,546 (1,025–5,525)
Phocids	3 (2–3)	3 (3–3)	25 (25–25)	14 (14–15)	2,546 (1,025–5,525)

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

Pile Driving

Table 37 and Table 38 present the approximate ranges in meters to PTS, TTS, and potential behavioral reactions for impact pile driving and vibratory pile removal, respectively. Non-auditory injury is not predicted for pile driving activities.

TABLE 37—AVERAGE RANGES TO EFFECTS FROM IMPACT PILE DRIVING

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

Notes: PTS: permanent threshold shift; TTS: temporary threshold shift.

TABLE 38—AVERAGE RANGES TO EFFECTS FROM VIBRATORY PILE EXTRACTION

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

Notes: PTS: permanent threshold shift; TTS: temporary threshold shift.

Serious Injury or Mortality From Ship Strikes

There have been three recorded Navy vessel strikes of marine mammals in the AFTT Study Area to from 2009 through 2017 (nine years). There are incidents in which a vessel struck animal has remained unidentified to species and the Navy cannot quantifiably predict that the possible takes from vessel strike will be of any particular species. Therefore, the Navy requested mortal takes of three large whales over the course of the five-year rule, and no more than two of any species of humpback whale, fin whale, sei whale, minke whale, blue whale, or sperm whale (either GOM or North Atlantic). NMFS concurs that the request for mortal takes of three large whales (of any species listed in previous sentence) over the five-year period of the rule is reasonable based on the available strike data and the Navy's analysis (see their updated ship strike analysis on NMFS website *https://www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-military-readiness-activities*), but does not agree that two mortal takes of any one species is likely. When the probability of hitting more than one individual of the same species within the five-year period is considered in combination with the available data indicating the proportional historical strikes of different species and the probability of hitting the same species twice, the likelihood of hitting the same species of whale twice in five years is very low (under to well under 10 percent). Therefore, we find that it is unlikely that the same species would be struck twice during the five-year regulatory period and are proposing to authorize up to three mortal takes of no more than one from any of the species of large whales over the five-year period, which means an annual average of 0.2 whales from each species (*i.e.,* 1 take over 5 years divided by 5 to get the annual number).

Marine Mammal Density

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

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

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

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

1. Spatial density models (see Roberts *et al.* (2016)) predict spatial variability of animal presence based on habitat variables (*e.g.,* sea surface temperature, seafloor depth, etc.). This model is developed for areas, species, and, when available, specific timeframes (months or seasons) with sufficient survey data; therefore, this model cannot be used for species with low numbers of sightings. In the AFTT Study Area, this model is available for certain species along the east coast to the offshore extent of available survey data and in the Gulf of Mexico.

2. Design-based density models predict animal density based on survey data. Like spatial density models, they are applied to areas with survey data. Design-based density models may be stratified, in which a density is predicted for each sub-region of a survey area, allowing for better prediction of species distribution across the density model area. In the AFTT Study Area, stratified density models are used for certain species on both the east coast and the Gulf of Mexico. In addition, a few species' stratified density models are applied to areas east of regions with available survey data and cover a substantial portion of the Atlantic Ocean portion of the AFTT Study Area.

3. Extrapolative models are used in areas where there is insufficient or no survey data. These models use a limited set of environmental variables to predict possible species densities based on environmental observations during actual marine mammal surveys (see Mannocci *et al.* (2017)). In the AFTT Study Area, extrapolative models are typically used east of regions with available survey data and cover a substantial portion of the Atlantic Ocean of the AFTT Study Area. Because some unsurveyed areas have oceanographic conditions that are very different from surveyed areas (*e.g.,* the Labrador Sea and North Atlantic gyre) and some species models rely on a very limited data set, the predictions of some species' extrapolative density models and some regions of certain species' extrapolative density models are considered highly speculative. Extrapolative models are not used in the Gulf of Mexico.

4. Existing Relative Environmental Suitability models include a high degree of uncertainty, but are applied when no other model is available.

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

Take Requests

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

- Acoustics (sonar and other transducers; airguns; pile driving/extraction).
- Explosives (explosive shock wave and sound; explosive fragments).
- Physical Disturbance and Strike (vessel strike).

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

The quantitative analysis process used for the AFTT DEIS/OEIS and the Navy's take request in the rulemaking and LOA application to estimate potential exposures to marine mammals resulting from acoustic and explosive stressors is detailed in the technical report titled *Quantitative Analysis for Estimating Acoustic and Explosive Impacts to Marine Mammals and Sea Turtles* (U.S. Department of the Navy, 2017a). The Navy Acoustic Effects Model estimates acoustic and explosive effects without taking mitigation into account; therefore, the model overestimates predicted impacts on marine mammals within mitigation zones. To account for mitigation for marine species in the take estimates, the Navy conducts a post-modeling analysis using applicable literature to conservatively quantify the manner in which mitigation is expected to reduce model-estimated PTS to TTS for exposures to sonar and other transducers, and reduce model-estimated mortality to injury for exposures to explosives. The Navy coordinated with NMFS in the development of this quantitative method to address the effects of mitigation on acoustic exposures and takes, and concurs with the Navy that it is appropriate to incorporate into the take estimates based on the best available science. For additional information on the quantitative analysis process and mitigation measures, refer to Section 6 (Take Estimates for Marine Mammals) and Section 11 (Mitigation Measures) of the Navy's rulemaking and LOA application.

Summary of Proposed Authorized Take From Training and Testing Activities

Based on the methods outlined in the previous sections, Navy's model analysis, the Navy's summarizes the take request for acoustic and explosive sources for training and testing activities annually (based on the maximum number of activities per 12-month period), and the summation over a five-year period, as well as the Navy's take request for individual small and large ship shock trials, and the take that could occur over a five-year period for all ship shock activities. NMFS has reviewed the Navy's data and analysis and preliminary determined that it is complete and accurate and that the takes by harassment proposed for authorization are reasonably expected to occur and that the takes by mortality could occur as in the case of vessel strikes.

Take Reasonably Expected To Occur From Training Activities

Table 39 summarizes the Navy's take request and the amount and type of take that is reasonably likely to occur (Level A and Level B harassment) by species associated with all training activities. Note that Level B take includes both behavioral disruption and TTS. Navy figures 6.4–10 through 6.5–69 in Section 6 of the Navy's rulemaking and LOA application illustrate the comparative amounts of TTS and behavioral disruption for each species, noting that if a "taken" animal was exposed to both TTS and behavioral disruption in the model, it was recorded as a TTS.

TABLE 39—SPECIES AND STOCK-SPECIFIC TAKE PROPOSED FOR AUTHORIZATION FOR ALL TRAINING ACTIVITIES

Species	Stock	Annual		5-Year total	
		Level B	Level A	Level B	Level A
Suborder Mysticeti (baleen whales)					
Family Balaenidae (right whales)					
North Atlantic right whale *	Western North Atlantic	246	0	1,176	0
Family Balaenopteridae (roquals)					
Blue whale *	Western North Atlantic (Gulf of St. Lawrence).	26	0	121	0
Bryde's whale	Northern Gulf of Mexico	0	0	0	0
	NSD †	206	0	961	0
Minke whale	Canadian East Coast	2,425	0	11,262	0
Fin whale *	Western North Atlantic	1,498	3	7,295	13
Humpback whale	Gulf of Maine	232	1	1,116	3
Sei whale *	Nova Scotia	292	0	1,400	0
Suborder Odontoceti (toothed whales)					
Family Physeteridae (sperm whale)					
Sperm whale *	Gulf of Mexico Oceanic	24	0	118	0
	North Atlantic	14,084	0	68,839	0
Family Kogiidae (sperm whales)					
Dwarf sperm whale	Gulf of Mexico Oceanic	14	0	71	0
	Western North Atlantic	8,527	10	39,914	48
Pygmy sperm whale	Northern Gulf of Mexico	14	0	71	0
	Western North Atlantic	8,527	10	39,914	48
Family Ziphiidae (beaked whales)					
Blainville's beaked whale	Northern Gulf of Mexico	35	0	173	0
	Western North Atlantic	12,532	0	61,111	0
Cuvier's beaked whale	Northern Gulf of Mexico	34	0	172	0
	Western North Atlantic	46,401	0	226,286	0
Gervais' beaked whale	Northern Gulf of Mexico	35	0	173	0
	Western North Atlantic	12,532	0	61,111	0
Northern bottlenose whale	Western North Atlantic	1,074	0	5,360	0
Sowersby's beaked whale	Western North Atlantic	12,532	0	61,111	0
True's beaked whale	Western North Atlantic	12,532	0	61,111	0

TABLE 39—SPECIES AND STOCK-SPECIFIC TAKE PROPOSED FOR AUTHORIZATION FOR ALL TRAINING ACTIVITIES—Continued

Species	Stock	Annual		5-Year total	
		Level B	Level A	Level B	Level A
Family Delphinidae (dolphins)					
Atlantic spotted dolphin	Northern Gulf of Mexico	951	0	4,710	0
	Western North Atlantic	117,458	9	570,940	45
Atlantic white-sided dolphin	Western North Atlantic	14,493	1	71,050	3
Bottlenose dolphin	Choctawhatchee Bay	7	0	33	0
	Gulf of Mexico Eastern Coastal	42	0	125	0
	Gulf of Mexico Northern Coastal	218	0	1,088	0
	Gulf of Mexico Western Coastal	4,148	0	12,568	0
	Indian River Lagoon Estuarine System.	283	0	1,414	0
	Jacksonville Estuarine System	84	0	421	0
	Mississippi Sound, Lake Borgne, Bay Boudreau.	0	0	0	0
	Northern Gulf of Mexico Continental Shelf.	1,560	2	7,798	9
	Northern Gulf of Mexico Oceanic	194	0	969	0
	Northern North Carolina Estuarine System.	3,221	0	11,798	0
	Southern North Carolina Estuarine System.	0	0	0	0
	Western North Atlantic Northern Florida Coastal.	906	0	4,323	0
	Western North Atlantic Central Florida Coastal.	5,341	0	25,594	0
	Western North Atlantic Northern Migratory Coastal.	25,188	4	125,183	19
	Western North Atlantic Offshore	308,206	39	1,473,308	193
	Western North Atlantic South Carolina/Georgia Coastal.	4,328	0	20,559	0
	Western North Atlantic Southern Migratory Coastal.	12,493	2	58,061	10
Clymene dolphin	Northern Gulf of Mexico	99	0	495	0
	Western North Atlantic	69,773	3	330,027	13
False killer whale	Northern Gulf of Mexico	41	0	207	0
	Western North Atlantic	8,270	0	39,051	0
Fraser's dolphin	Northern Gulf of Mexico	59	0	296	0
	Western North Atlantic	3,930	0	18,633	0
Killer whale	Northern Gulf of Mexico	1	0	4	0
	Western North Atlantic	78	0	372	0
Long-finned pilot whale	Western North Atlantic	17,040	0	83,050	0
Melon-headed whale	Northern Gulf of Mexico	70	0	352	0
	Western North Atlantic	37,156	1	175,369	3
Pantropical spotted dolphin	Northern Gulf of Mexico	565	0	2,827	0
	Western North Atlantic	145,125	2	686,775	10
Pygmy killer whale	Northern Gulf of Mexico	16	0	82	0
	Western North Atlantic	6,482	0	30,639	0
Risso's dolphin	Northern Gulf of Mexico	39	0	197	0
	Western North Atlantic	21,033	0	100,018	0
Rough-toothed dolphin	Northern Gulf of Mexico	97	0	434	0
	Western North Atlantic	19,568	0	92,313	0
Short-beaked common dolphin	Western North Atlantic	218,145	12	1,046,192	61
Short-finned pilot whale	Northern Gulf of Mexico	36	0	179	0
	Western North Atlantic	31,357	0	150,213	0
Spinner dolphin	Northern Gulf of Mexico	227	0	1,136	0
	Western North Atlantic	73,691	1	347,347	6
Striped dolphin	Northern Gulf of Mexico	67	0	336	0
	Western North Atlantic	91,038	3	451,001	13
White-beaked dolphin	Western North Atlantic	39	0	192	0
Family Phocoenidae (porpoises)					
Harbor porpoise	Gulf of Maine/Bay of Fundy	29,789	161	147,289	802
Suborder Pinnipedia					
Family Phocidae (true seals)					
Gray seal	Western North Atlantic	1,443	0	7,172	0

TABLE 39—SPECIES AND STOCK-SPECIFIC TAKE PROPOSED FOR AUTHORIZATION FOR ALL TRAINING ACTIVITIES—Continued

Species	Stock	Annual		5-Year total	
		Level B	Level A	Level B	Level A
Harbor seal	Western North Atlantic	2,341	0	11,631	0
Harp seal	Western North Atlantic	8,444	1	42,188	4
Hooded seal	Western North Atlantic	128	0	631	0

* ESA-listed species (all stocks) within the AFTT Study Area.
† NSD: No stock designated.

Take Reasonably Expected To Occur From Testing Activities

Table 40 summarizes the Navy's take request and the amount and type of take that is reasonably likely to occur (Level A and Level B harassment) by species associated with all testing activities.

TABLE 40—SPECIES-SPECIFIC TAKE PROPOSED FOR AUTHORIZATION FROM ALL TESTING ACTIVITIES (EXCLUDING SHIP SHOCK TRIALS)

Species	Stock	Annual		5-Year total	
		Level B	Level A	Level B	Level A
Suborder Mysticeti (baleen whales)					
Family Balaenidae (right whales)					
North Atlantic right whale *	Western North Atlantic	339	0	1,667	0
Family Balaenopteridae (roquals)					
Blue whale *	Western North Atlantic (Gulf of St. Lawrence).	20	0	97	0
Bryde's whale	Northern Gulf of Mexico	52	0	254	0
	NSD †	124	0	612	0
Minke whale	Canadian East Coast	1,616	1	7,971	7
Fin whale *	Western North Atlantic	3,868	3	18,781	16
Humpback whale	Gulf of Maine	493	0	2,412	0
Sei whale *	Nova Scotia	502	0	2,431	0
Suborder Odontoceti (toothed whales)					
Family Physeteridae (sperm whale)					
Sperm whale *	Gulf of Mexico Oceanic	1,106	0	5,237	0
	North Atlantic	11,296	0	51,752	0
Family Kogiidae (sperm whales)					
Dwarf sperm whale	Gulf of Mexico Oceanic	728	6	3,424	27
	Western North Atlantic	4,383	14	21,159	65
Pygmy sperm whale	Northern Gulf of Mexico	728	6	3,424	27
	Western North Atlantic	4,383	14	21,159	65
Family Ziphiidae (beaked whales)					
Blainville's beaked whale	Northern Gulf of Mexico	1,392	0	6,710	0
	Western North Atlantic	10,565	0	49,646	0
Cuvier's beaked whale	Northern Gulf of Mexico	1,460	0	6,987	0
	Western North Atlantic	38,780	0	182,228	0
Gervais' beaked whale	Northern Gulf of Mexico	1,392	0	6,710	0
	Western North Atlantic	10,565	0	49,646	0
Northern bottlenose whale	Western North Atlantic	971	0	4,485	0
Sowersby's beaked whale	Western North Atlantic	10,593	0	49,764	0
True's beaked whale	Western North Atlantic	10,593	0	49,764	0
Family Delphinidae (dolphins)					
Atlantic spotted dolphin	Northern Gulf of Mexico	71,883	2	333,793	12
	Western North Atlantic	109,582	11	504,537	50
Atlantic white-sided dolphin	Western North Atlantic	31,780	1	150,063	6
Bottlenose dolphin	Choctawhatchee Bay	966	0	4,421	0

TABLE 40—SPECIES-SPECIFIC TAKE PROPOSED FOR AUTHORIZATION FROM ALL TESTING ACTIVITIES (EXCLUDING SHIP SHOCK TRIALS)—Continued

Species	Stock	Annual		5-Year total	
		Level B	Level A	Level B	Level A
	Gulf of Mexico Eastern Coastal	0	0	0	0
	Gulf of Mexico Northern Coastal	16,258	1	76,439	5
	Gulf of Mexico Western Coastal	3,677	0	18,036	0
	Indian River Lagoon Estuarine System.	3	0	14	0
	Jacksonville Estuarine System	3	0	13	0
	Mississippi Sound, Lake Borgne, Bay Boudreau.	1	0	3	0
	Northern Gulf of Mexico Continental Shelf.	125,941	8	594,921	39
	Northern Gulf of Mexico Oceanic	14,448	1	67,243	5
	Northern North Carolina Estuarine System.	107	0	533	0
	Southern North Carolina Estuarine System.	0	0	0	0
	Western North Atlantic Northern Florida Coastal.	328	0	1,613	0
	Western North Atlantic Central Florida Coastal.	2,273	0	10,950	0
	Western North Atlantic Northern Migratory Coastal.	11,854	3	56,321	14
	Western North Atlantic Offshore	119,880	24	566,572	115
	Western North Atlantic South Carolina/Georgia Coastal.	1,632	0	8,017	0
	Western North Atlantic Southern Migratory Coastal.	4,221	0	20,828	0
Clymene dolphin	Northern Gulf of Mexico	4,164	0	19,919	0
	Western North Atlantic	35,985	2	170,033	7
False killer whale	Northern Gulf of Mexico	1,931	0	9,116	0
	Western North Atlantic	3,766	0	17,716	0
Fraser's dolphin	Northern Gulf of Mexico	1,120	0	5,314	0
	Western North Atlantic	1,293	0	6,069	0
Killer whale	Northern Gulf of Mexico	32	0	150	0
	Western North Atlantic	42	0	188	0
Long-finned pilot whale	Western North Atlantic	20,502	2	94,694	6
Melon-headed whale	Northern Gulf of Mexico	3,058	0	14,544	0
	Western North Atlantic	16,688	1	78,545	4
Pantropical spotted dolphin	Northern Gulf of Mexico	25,929	1	121,468	4
	Western North Atlantic	77,450	4	355,889	17
Pygmy killer whale	Northern Gulf of Mexico	719	0	3,415	0
	Western North Atlantic	2,848	0	13,427	0
Risso's dolphin	Northern Gulf of Mexico	1,649	0	7,817	0
	Western North Atlantic	20,071	1	94,009	6
Rough-toothed dolphin	Northern Gulf of Mexico	3,927	0	18,493	0
	Western North Atlantic	8,766	0	41,492	0
Short-beaked common dolphin	Western North Atlantic	353,012	16	1,675,885	71
Short-finned pilot whale	Northern Gulf of Mexico	1,823	0	8,613	0
	Western North Atlantic	17,002	1	80,576	6
Spinner dolphin	Northern Gulf of Mexico	7,815	0	36,567	0
	Western North Atlantic	33,350	2	157,241	7
Striped dolphin	Northern Gulf of Mexico	2,447	0	11,700	0
	Western North Atlantic	102,047	5	465,392	21
White-beaked dolphin	Western North Atlantic	44	0	213	0
Family Phocoenidae (porpoises)					
Harbor porpoise	Gulf of Maine/Bay of Fundy	135,221	230	627,215	1,093
Suborder Pinnipedia					
Family Phocidae (true seals)					
Gray seal	Western North Atlantic	899	2	4,375	9
Harbor seal	Western North Atlantic	1,496	5	7,095	16
Harp seal	Western North Atlantic	7,791	0	38,273	11
Hooded seal	Western North Atlantic	782	0	3,805	0

* ESA-listed species (all stocks) within the AFTT Study Area.
† NSD: No stock designated.

Take Reasonably Expected To Occur From Ship Shock

Table 41 summarizes the Navy's take request and the maximum amount and type of take that could potentially occur (Level B and Level A harassment, or serious injury/mortality) by species for ship shock trials under testing activities per small and large ship shock events and the summation over a five-year period. The table below displays maximum ship shock impacts to marine mammals by species (in bold text), as well as maximum impacts on individual stocks. The maximum is derived by selecting the highest number of potential impacts across all locations and all seasons for each species/stock. Small Ship Shock trials could take place any season within the deep offshore water of the Virginia Capes Range Complex or in the spring, summer, or fall within the Jacksonville Range Complex and could occur up to three times over a five-year period. The Large Ship Shock trial could take place in the Jacksonville Range Complex during the Spring, Summer, or Fall and during any season within the deep offshore water of the Virginia Capes Range Complex or within the Gulf of Mexico. The Large Ship Shock Trial could occur once over 5 years. For serious injury/mortality takes over the five-year period, an annual average of 0.2 whales from each dolphin species/stock listed below (*i.e.,* 1 take divided by 5 years to get the annual number) or 1.2 dolphins in the case of short-beaked common dolphin (*i.e.,* 6 takes divided by 5 years to get the annual number) is used in further analysis in the ''Negligible Impact Analysis and Determination'' section.

TABLE 41—SPECIES SPECIFIC TAKE PROPOSED FOR AUTHORIZATION FROM SHIP SHOCK TRIALS

Species/stock	Small ship shock			Large ship shock			5-Year total		
	Level B	Level A	Mortality	Level B	Level A	Mortality	Level B	Level A	Mortality
Suborder Mysticeti (baleen whales)									
Family Balaenidae (right whales)									
North Atlantic right whale	**1**	**0**	**0**	**2**	**0**	**0**	**5**	**0**	**0**
Western North Atlantic *	1	0	0	2	0	0	5	0	0
Family Balaenopteridae (roquals)									
Blue whale	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**0**
Western North Atlantic (Gulf of St. Lawrence) *	0	0	0	1	0	0	1	0	0
Bryde's whale	**3**	**0**	**0**	**6**	**1**	**0**	**15**	**1**	**0**
Northern Gulf of Mexico *	0	0	0	3	1	0	3	1	0
NSD †	3	0	0	6	0	0	15	0	0
Minke whale	**19**	**1**	**0**	**39**	**3**	**0**	**96**	**6**	**0**
Canadian East Coast	19	1	0	39	3	0	96	6	0
Fin whale	**131**	**3**	**0**	**234**	**27**	**0**	**627**	**36**	**0**
Western North Atlantic *	131	3	0	234	27	0	627	36	0
Humpback whale	**8**	**0**	**0**	**20**	**2**	**0**	**44**	**2**	**0**
Gulf of Maine	8	0	0	20	2	0	44	2	0
Sei whale	**12**	**1**	**0**	**27**	**4**	**0**	**63**	**7**	**0**
Nova Scotia *	12	1	0	27	4	0	63	7	0
Suborder Odontoceti (toothed whales)									
Family Physeteridae (sperm whale)									
Sperm whale *	**1**	**1**	**0**	**3**	**4**	**0**	**6**	**7**	**0**
Gulf of Mexico Oceanic	0	0	0	2	0	0	2	0	0
North Atlantic	1	1	0	3	4	0	6	7	0
Family Kogiidae (sperm whales)									
Dwarf sperm whale	**46**	**28**	**0**	**91**	**70**	**0**	**229**	**154**	**0**
Gulf of Mexico Oceanic	0	0	0	51	64	0	51	64	0
Western North Atlantic	46	28	0	91	70	0	229	154	0
Pygmy sperm whale	**46**	**28**	**0**	**91**	**70**	**0**	**229**	**154**	**0**
Northern Gulf of Mexico	0	0	0	51	64	0	51	64	0
Western North Atlantic	46	28	0	91	70	0	229	154	0
Family Ziphiidae (beaked whales)									
Blainville's beaked whale	**1**	**0**	**0**	**1**	**1**	**0**	**4**	**1**	**0**
Northern Gulf of Mexico	0	0	0	1	0	0	1	0	0
Western North Atlantic	1	0	0	1	1	0	4	1	0
Cuvier's beaked whale	**2**	**1**	**0**	**2**	**3**	**0**	**4**	**1**	**0**
Northern Gulf of Mexico	0	0	0	1	0	0	1	0	0
Western North Atlantic	2	1	0	2	3	0	8	6	0
Gervais' beaked whale	**1**	**0**	**0**	**1**	**1**	**0**	**8**	**6**	**0**
Northern Gulf of Mexico	0	0	0	1	0	0	1	0	0
Western North Atlantic	1	0	0	1	1	0	4	1	0
Northern bottlenose whale	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Western North Atlantic	0	0	0	0	0	0	0	0	0
Sowerby's beaked whale	**1**	**0**	**0**	**1**	**1**	**0**	**4**	**1**	**0**
Western North Atlantic	1	0	0	1	1	0	4	1	0
True's beaked whale	**1**	**0**	**0**	**1**	**1**	**0**	**4**	**1**	**0**
Western North Atlantic	1	0	0	1	1	0	4	1	0
Family Delphinidae (dolphins)									
Atlantic spotted dolphin	**6**	**4**	**0**	**8**	**12**	**0**	**26**	**24**	**0**

TABLE 41—SPECIES SPECIFIC TAKE PROPOSED FOR AUTHORIZATION FROM SHIP SHOCK TRIALS—Continued

Species/stock	Small ship shock			Large ship shock			5-Year total		
	Level B	Level A	Mortality	Level B	Level A	Mortality	Level B	Level A	Mortality
Northern Gulf of Mexico	0	0	0	2	1	0	2	1	0
Western North Atlantic	6	4	0	8	12	0	26	24	0
Atlantic white-sided dolphin	**1**	**1**	**0**	**3**	**9**	**1**	**6**	**12**	**1**
Western North Atlantic	1	1	0	3	9	1	6	12	1
Bottlenose dolphin	**13**	**10**	**0**	**16**	**24**	**0**	**55**	**54**	**0**
Choctawhatchee Bay	0	0	0	0	0	0	0	0	0
Gulf of Mexico Eastern Coastal	0	0	0	0	0	0	0	0	0
Gulf of Mexico Northern Coastal	0	0	0	1	1	0	1	1	0
Gulf of Mexico Western Coastal	0	0	0	0	0	0	0	0	0
Indian River Lagoon Estuarine System	0	0	0	0	0	0	0	0	0
Jacksonville Estuarine System	0	0	0	0	0	0	0	0	0
Mississippi Sound, Lake Borgne, Bay Boudreau	0	0	0	0	0	0	0	0	0
Northern Gulf of Mexico Continental Shelf	0	0	0	10	6	0	10	6	0
Northern Gulf of Mexico Oceanic	0	0	0	10	9	0	10	9	0
Northern North Carolina Estuarine System	0	0	0	0	0	0	0	0	0
Southern North Carolina Estuarine System	0	0	0	0	0	0	0	0	0
Western North Atlantic Northern Florida Coastal	0	0	0	0	0	0	0	0	0
Western North Atlantic Central Florida Coastal	0	0	0	0	0	0	0	0	0
Western North Atlantic Northern Migratory Coastal	0	0	0	0	0	0	0	0	0
Western North Atlantic Offshore	13	10	0	16	24	0	55	54	0
Western North Atlantic South Carolina/Georgia Coastal	0	0	0	0	0	0	0	0	0
Western North Atlantic Southern Migratory Coastal	0	0	0	0	0	0	0	0	0
Clymene dolphin	**2**	**5**	**0**	**9**	**8**	**0**	**15**	**23**	**0**
Northern Gulf of Mexico	0	0	0	8	6	0	8	6	0
Western North Atlantic	2	5	0	9	8	0	15	23	0
False killer whale	**0**	**0**	**0**	**2**	**1**	**0**	**2**	**1**	**0**
Northern Gulf of Mexico	0	0	0	2	1	0	2	1	0
Western North Atlantic	0	0	0	2	0	0	2	0	0
Fraser's dolphin	**0**	**0**	**0**	**2**	**3**	**0**	**2**	**3**	**0**
Northern Gulf of Mexico	0	0	0	2	3	0	2	3	0
Western North Atlantic	0	0	0	0	0	0	0	0	0
Killer whale	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Northern Gulf of Mexico	0	0	0	0	0	0	0	0	0
Western North Atlantic	0	0	0	0	0	0	0	0	0
Long-finned pilot whale	**2**	**2**	**0**	**5**	**6**	**0**	**11**	**12**	**0**
Western North Atlantic	2	2	0	5	6	0	11	12	0
Melon-headed whale	**1**	**1**	**0**	**5**	**4**	**0**	**8**	**7**	**0**
Northern Gulf of Mexico	0	0	0	4	4	0	4	4	0
Western North Atlantic	1	1	0	5	1	0	8	4	0
Pantropical spotted dolphin	**2**	**3**	**0**	**25**	**20**	**1**	**31**	**29**	**1**
Northern Gulf of Mexico	0	0	0	25	20	1	25	20	1
Western North Atlantic	2	3	0	7	3	0	13	12	0
Pygmy killer whale	**0**	**0**	**0**	**1**	**1**	**0**	**1**	**1**	**0**
Northern Gulf of Mexico	0	0	0	1	1	0	1	1	0
Western North Atlantic	0	0	0	1	0	0	1	0	0
Risso's dolphin	**1**	**1**	**0**	**3**	**1**	**0**	**6**	**4**	**0**
Northern Gulf of Mexico	0	0	0	2	1	0	2	1	0
Western North Atlantic	1	1	0	3	1	0	6	4	0
Rough-toothed dolphin	**1**	**0**	**0**	**3**	**2**	**0**	**6**	**2**	**0**
Northern Gulf of Mexico	0	0	0	2	2	0	2	2	0
Western North Atlantic	0	0	0	0	0	0	0	0	0
Short-beaked common dolphin	**40**	**51**	**1**	**67**	**107**	**3**	**187**	**260**	**6**
Western North Atlantic	40	51	1	67	107	3	187	260	6
Short-finned pilot whale	**2**	**2**	**0**	**4**	**5**	**0**	**10**	**11**	**0**
Northern Gulf of Mexico	0	0	0	2	3	0	2	3	0
Western North Atlantic	2	2	0	4	5	0	10	11	0
Spinner dolphin	**3**	**1**	**0**	**37**	**45**	**1**	**46**	**48**	**1**
Northern Gulf of Mexico	0	0	0	37	45	1	37	45	1
Western North Atlantic	3	1	0	7	3	0	16	6	0
Striped dolphin	**4**	**8**	**0**	**10**	**12**	**0**	**22**	**36**	**0**
Northern Gulf of Mexico	0	0	0	4	3	0	4	3	0
Western North Atlantic	4	8	0	10	12	0	22	36	0
White-beaked dolphin	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Western North Atlantic	0	0	0	0	0	0	0	0	0
Family Phocoenidae (porpoises)									
Harbor porpoise	**43**	**41**	**0**	**120**	**81**	**0**	**249**	**204**	**0**
Gulf of Maine/Bay of Fundy	43	41	0	120	81	0	249	204	0
Suborder Pinnipedia									
Family Phocidae (true seals)									
Gray seal	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Western North Atlantic	0	0	0	0	0	0	0	0	0
Harbor seal	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Western North Atlantic	0	0	0	0	0	0	0	0	0
Harp seal	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

TABLE 41—SPECIES SPECIFIC TAKE PROPOSED FOR AUTHORIZATION FROM SHIP SHOCK TRIALS—Continued

Species/stock	Small ship shock			Large ship shock			5-Year total		
	Level B	Level A	Mortality	Level B	Level A	Mortality	Level B	Level A	Mortality
Western North Atlantic	0	0	0	0	0	0	0	0	0
Hooded seal	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Western North Atlantic	0	0	0	0	0	0	0	0	0

Note: The table displays maximum ship shock impacts to marine mammals by species (in bold text), as well as maximum impacts on individual stocks.
* ESA-listed species' stocks within the AFTT Study Area.
† NSD: No stock designated.

Take From Vessel Strikes

Vessel strike to marine mammals is not associated with any specific training or testing activity but is rather an extremely limited and sporadic, but possible, accidental result of Navy vessel movement within the AFTT Study Area or while in transit. There have been three recorded Navy vessel strikes of large whales (*i.e.,* mysticetes and sperm whales) in the AFTT Study Area to from 2009 through 2017 (nine years). In order to account for the accidental nature of vessel strikes to large whales in general, and the potential risk from any vessel movement within the AFTT Study Area, the Navy requests incidental takes based on the resulting probabilities presented in their analysis as described in detail in Chapter 6 of the Navy's rulemaking and LOA application (and further refine ship strike analysis on NMFS website *https://www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-military-readiness-activities* and coordination with NMFS), as well as the cumulative low history of Navy vessel strikes since 2009 and introduction of the Marine Species Awareness Training and adoption of additional mitigation measures. Most Navy-reported whale strikes have not been identified to the species level, however, small delphinids are neither expected nor authorized to be struck by Navy vessels since: They have not been struck historically by Navy AFTT activities, their smaller size and maneuverability makes a strike from a larger vessel much less likely as illustrated in worldwide ship-strike records, and the majority of the Navy's faster-moving activities are located in offshore areas where smaller delphinid densities are less. Accordingly, NMFS proposes takes of large whales only over the course of the five-year regulations from training and testing activities as discussed below.

The Navy estimated that it may strike, and take by serious injury or mortality, up to three large whales incidental to the Proposed Activity over the course of the five years of the AFTT regulations. Because of the number of incidents in which the struck animal has remained unidentified to species, the Navy cannot quantifiably predict that the potential takes will be of any particular species, and therefore requested incidental take authorization for up to two of any the following species in the five-year period: Humpback whale (Gulf of Maine stock), fin whale (Western North Atlantic stock), minke (Canadian East Coast stock), and sperm whale (North Atlantic stock) and one of any of the following: Sei whale (Nova Scotia stock), blue whale (Western North Atlantic stock), sperm whale (Gulf of Mexico Oceanic stock).

NMFS agrees that the request for mortal takes of three large whales (of any species listed in previous bullet) over the five-year period of the rule is reasonable based on the available strike data (three strikes by Navy over nine years) and the Navy's analysis, but does not agree that two mortal takes of any one species is likely. When the probability of hitting more than one individual of the same species within the five-year period is considered in combination with the available data indicating the proportional historical strikes of different species and the probability of hitting the same species twice, the likelihood of hitting the same species of whale twice in five years is very low (under to well under 10 percent). Therefore, we find that it is unlikely that the same species would be struck twice during the five-year regulatory period and are proposing to authorize up to three mortal takes of no more than one from any of the species of large whales over the five-year period, which means an annual average of 0.2 whales from each species/stock listed above (*i.e.,* 1 take divided by 5 years to get the annual number).

In addition to procedural mitigation, the Navy will implement measures in mitigation areas used by NARW for foraging, calving, and migration (see Section 11, Mitigation Measures of the Navy's rulemaking and LOA application and a full analysis of Mitigation in Chapter 5 of the AFTT DEIS/OEIS). These measures, which go above and beyond those focused on other species (*e.g.,* funding of and communication with sightings systems, implementation of speed reductions during applicable circumstances in certain areas) have helped the Navy avoid striking a NARW during training and testing activities in the past; and therefore, are likely to eliminate the potential for future strikes to occur. In particular, the mitigation pertaining to vessels, including the continued participation in and sponsoring of the Early Warning System, will help Navy vessels avoid NARW during transits and training and testing activities. The Early Warning System is a comprehensive information exchange network dedicated to reducing the risk of vessel strikes to NARW off the southeast United States from all mariners (*i.e.,* Navy and non-Navy vessels). Navy participants include the Fleet Area Control and Surveillance Facility, Jacksonville; Commander, Naval Submarine Forces, Norfolk, Virginia; and Naval Submarine Support Command. The Navy, U.S. Coast Guard, U.S. Army Corps of Engineers, and NMFS collaboratively sponsor daily aerial surveys from December 1 through March 31 (weather permitting) to observe for NARW from the shoreline out to approximately 30–35 nmi offshore. Aerial surveyors relay sightings information to all mariners transiting within the NARW calving habitat (*e.g.,* commercial vessels, recreational boaters, and Navy ships). Refer to Section 11 (Mitigation Measures) of the Navy's rulemaking and LOA application for a full list of these measures.

Regarding the Bryde's whale, due to low numbers, almost exclusively limited to Gulf of Mexico, and limited ship traffic that overlaps with Bryde's whale habitat, Navy does not anticipate any ship strike takes.

Proposed Mitigation Measures

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

In *Conservation Council for Hawaii* v. *National Marine Fisheries Service,* 97 F. Supp.3d 1210, 1229 (D. Haw. Mar. 31, 2015), the Court stated that NMFS ''appear[s] to think [it] satisf[ies] the statutory 'least practicable adverse impact' requirement with a 'negligible impact' finding.'' More recently, expressing similar concerns in a challenge to our last U.S. Navy Operations of Surveillance Towed Array Sensor System Low Frequency Active Sonar (SURTASS LFA) incidental take rule (77 FR 50290), the Ninth Circuit Court of Appeals in *Natural Resources Defense Council (NRDC)* v. *Pritzker,* 828 F.3d 1125, 1134 (9th Cir. 2016), stated, ''[c]ompliance with the 'negligible impact' requirement does not mean there [is] compliance with the 'least practicable adverse impact standard [. . .] .'' As the Ninth Circuit noted in its opinion, however, the Court was interpreting the statute without the benefit of NMFS' formal interpretation. We state here explicitly that NMFS is in full agreement that the ''negligible impact'' and ''least practicable adverse impact'' requirements are distinct, even though both statutory standards refer to species and stocks. With that in mind, we provide further explanation of our interpretation of least practicable adverse impact, and explain what distinguishes it from the negligible impact standard. This discussion is consistent with, and expands upon, previous rules we have issued (such as the Navy Gulf of Alaska rule (82 FR 19530)).

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

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

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

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

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

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

Section 101(a)(5)(A)(i)(II) requires NMFS to issue, in conjunction with its authorization, binding—and enforceable—restrictions (in the form of regulations) setting forth how the activity must be conducted, thus

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

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

ensuring the activity has the ''least practicable adverse impact'' on the affected species or stocks. In situations where mitigation is specifically needed to reach a negligible impact determination, section 101(a)(5)(A)(i)(II) also provides a mechanism for ensuring compliance with the ''negligible impact'' requirement. Finally, we reiterate that the least practicable adverse impact standard also requires consideration of measures for marine mammal habitat, with particular attention to rookeries, mating grounds, and other areas of similar significance, and for subsistence impacts; whereas the negligible impact standard is concerned solely with conclusions about the impact of an activity on annual rates of recruitment and survival.[3]

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

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

Implementation of Least Practicable Adverse Impact Standard

Given this most recent Court decision, we further clarify how we determine whether a measure or set of measures meets the ''least practicable adverse impact'' standard. Our evaluation of potential mitigation measures includes consideration of two primary factors:

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

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

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

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

In the evaluation of specific measures, the details of the specified activity will necessarily inform each of the two primary factors discussed above (expected reduction of impacts and practicability), and will be carefully considered to determine the types of mitigation that are appropriate under the least practicable adverse impact standard. Analysis of how a potential mitigation measure may reduce adverse impacts on a marine mammal stock or species, consideration of personnel safety, practicality of implementation, and consideration of the impact on effectiveness of military readiness activities are not issues that can be meaningfully evaluated through a yes/no lens. The manner in which, and the degree to which, implementation of a measure is expected to reduce impacts, as well as its practicability in terms of these considerations, can vary widely. For example, a time/area restriction could be of very high value for decreasing population-level impacts (*e.g.,* avoiding disturbance of feeding females in an area of established biological importance) or it could be of lower value (*e.g.,* decreased disturbance in an area of high productivity but of less firmly established biological importance). Regarding practicability, a measure might involve operational

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

restrictions in an area or time that impedes the Navy's ability to detect or track enemy submarines (higher impact on mission effectiveness), or it could mean delaying a small in-port training event by 30 minutes to avoid exposure of a marine mammal to injurious levels of sound (lower impact). A responsible evaluation of ''least practicable adverse impact'' will consider the factors along these realistic scales. Accordingly, the greater the likelihood that a measure will contribute to reducing the probability or severity of adverse impacts to the species or stock, the greater the weight that measure(s) is given when considered in combination with practicability to determine the appropriateness of the mitigation measure(s), and vice versa. In the evaluation of specific measures, the details of the specified activity will necessarily inform each of the two primary factors discussed above (expected reduction of impacts and practicability), and will be carefully considered to determine the types of mitigation that are appropriate under the least practicable adverse impact standard. We discuss consideration of these factors in greater detail below.

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

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

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

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

We consider available information indicating the likelihood of any measure to accomplish its objective. If evidence shows that a measure has not typically been effective or successful, then either that measure should be modified or the potential value of the measure to reduce effects is lowered.

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

NMFS reviewed the proposed activities and the suite of proposed mitigation measures as described in the Navy's rulemaking and LOA application and the AFTT DEIS/OEIS to determine if they would result in the least practicable adverse effect on marine mammals. NMFS worked with the Navy in the development of the Navy's initially proposed measures, which are informed by years of experience and monitoring. A complete discussion of the evaluation process used by the Navy to develop, assess, and select mitigation measures, which was informed by input form NMFS, can be found in Chapter 5 (Mitigation) of the AFTT DEIS/OEIS and is summarized below. The Navy proposes to implement mitigation measures to avoid potential impacts from acoustic, explosive, and physical disturbance and strike stressors.

In summary, the Navy proposes a suite of procedural mitigation measures that we expect to result in a reduction in the probability and/or severity of impacts expected to result from acute exposure to acoustic sources or explosives, ship strike, and impacts to marine mammal habitat. Specifically, the Navy uses a combination of delayed starts, powerdowns, and shutdowns to avoid serious injury or mortality, minimize the likelihood or severity of PTS or other injury, and reduce instances of TTS or more severe behavioral disruption. Additional procedural vessel operation mitigation is included to minimize or avoid the likelihood of ship strikes, with an additional focus on right whales. The Navy also proposes to implement time/area restrictions intended to reduce take of marine mammals in areas or times where they are known to engage in important behaviors, such as feeding or calving, where the disruption of those behaviors would be more likely to result in population-level impacts. The Navy assessed the practicability of the measures it proposed in the context of personnel safety, practicality, and their impacts on the Navy's ability to meet their Title 10 requirements and found that the measures were supportable. NMFS has evaluated the mitigation measures the Navy has proposed and the measures will both sufficiently reduce impacts on the affected marine

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

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

The Navy also evaluated several measures in the Navy's AFTT DEIS/OEIS that are not included in the Navy's rulemaking and LOA application for the Proposed Activity, and NMFS concurs that their inclusion was not appropriate to support the least practicable adverse impact standard based on our assessment. In summary, first, commenters sometimes recommend that the Navy reduce their overall amount of training, reduce explosive use, modify their sound sources, completely replace live training with computer simulation, or include time of day restrictions. All of these proposed measures could potentially reduce the number of marine mammals taken, via direct reduction of the activities or amount of sound energy put in the water. However, as the Navy has described in Chapter 5 of the AFTT DEIS/OEIS, they need to train and test in the conditions in which they fight—and these types of modifications fundamentally change the activity in a manner that would not support the purpose and need for the training and testing (*i.e.,* are entirely impracticable) and therefore are not considered further. Second, the Navy evaluated a suite of additional potential procedural mitigation measures, including increased mitigation zones, additional passive acoustic and visual monitoring, and decreased vessel speeds. Some of these measures have the potential to incrementally reduce take to some degree in certain circumstances, though the degree to which this would occur is typically low or uncertain. However, as described in the Navy's analysis, the impracticability of implementation outweighed the potential reduction of impacts to marine mammal species or stocks (see Chapter 5 of AFTT DEIS/OEIS). NMFS reviewed the Navy's evaluation and concurs that the measures proposed by the Navy and discussed above affect the least practicable adverse impact on the marine mammal species or stocks and their habitat and that the addition of these other measures would not meet that standard.

Below are the mitigation measures that NMFS determined will ensure the least practicable adverse impact on all affected species and stocks and their habitat, including the specific considerations for military readiness activities. The following sections summarize the mitigation measures that will be implemented in association with the training and testing activities analyzed in this document. The Navy's mitigation measures are organized into two categories: procedural mitigation and mitigation areas.

Procedural Mitigation

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

TABLE 42—PROCEDURAL MITIGATION FOR ENVIRONMENTAL AWARENESS AND EDUCATION

Procedural mitigation description
Stressor or Activity: • All training and testing activities, as applicable. *Mitigation Zone Size and Mitigation Requirements:* • Appropriate personnel involved in mitigation and training or testing activity reporting under the Proposed Activity will complete one or more modules of the U.S Navy Afloat Environmental Compliance Training Series, as identified in their career path training plan. Modules include: ○ Introduction to the U.S. Navy Afloat Environmental Compliance Training Series. The introductory module provides information on environmental laws (*e.g.,* ESA, MMPA) and the corresponding responsibilities that are relevant to Navy training and testing activities. The material explains why environmental compliance is important in supporting the Navy's commitment to environmental stewardship ○ Marine Species Awareness Training. All bridge watch personnel, Commanding Officers, Executive Officers, maritime patrol aircraft aircrews, anti-submarine warfare and mine warfare rotary-wing aircrews, Lookouts, and equivalent civilian personnel must successfully complete the Marine Species Awareness Training prior to standing watch or serving as a Lookout. The Marine Species Awareness Training provides information on sighting cues, visual observation tools and techniques, and sighting notification procedures. Navy biologists developed Marine Species Awareness Training to improve the effectiveness of visual observations for biological resources, focusing on marine mammals and sea turtles, and including floating vegetation, jellyfish aggregations, and flocks of seabirds. ○ U.S. Navy Protective Measures Assessment Protocol. This module provides the necessary instruction for accessing mitigation requirements during the event planning phase using the Protective Measures Assessment Protocol software tool. ○ U.S. Navy Sonar Positional Reporting System and Marine Mammal Incident Reporting. This module provides instruction on the procedures and activity reporting requirements for the Sonar Positional Reporting System and marine mammal incident reporting.

Procedural Mitigation for Acoustic Stressors

Mitigation measures for acoustic stressors are provided in Tables 43 through 46.

Procedural Mitigation for Active Sonar

Procedural mitigation for active sonar is described in Table 43 below.

TABLE 43—PROCEDURAL MITIGATION FOR ACTIVE SONAR

Procedural mitigation description
Stressor or Activity: • Low-frequency active sonar, mid-frequency active sonar, high-frequency active sonar. • For vessel-based active sonar activities, mitigation applies only to sources that are positively controlled and deployed from manned surface vessels (*e.g.,* sonar sources towed from manned surface platforms). • For aircraft-based active sonar activities, mitigation applies to sources that are positively controlled and deployed from manned aircraft that do not operate at high altitudes (*e.g.,* rotary-wing aircraft). Mitigation does not apply to active sonar sources deployed from unmanned aircraft or aircraft operating at high altitudes (e.g., maritime patrol aircraft). *Number of Lookouts and Observation Platform:* • Hull-mounted sources: ○ Platforms without space or manning restrictions while underway: 2 Lookouts at the forward part of the ship. ○ Platforms with space or manning restrictions while underway: 1 Lookout at the forward part of a small boat or ship. ○ Platforms using active sonar while moored or at anchor (including pierside): 1 Lookout. ○ Pierside sonar testing activities at Port Canaveral, Florida and Kings Bay, Georgia: 4 Lookouts. • Sources that are not hull-mounted: ○ 1 Lookout on the ship or aircraft conducting the activity. *Mitigation Zone Size and Mitigation Requirements:* • Prior to the start of the activity (*e.g.,* when maneuvering on station), observe for floating vegetation and marine mammals; if resource is observed, do not commence use of active sonar. • Low-frequency active sonar at or above 200 dB and hull-mounted mid-frequency active sonar will implement the following mitigation zones: ○ During the activity, observe for marine mammals; power down active sonar transmission by 6 dB if resource is observed within 1,000 yd of the sonar source; power down by an additional 4 dB (10 dB total) if resource is observed within 500 yd of the sonar source; and cease transmission if resource is observed within 200 yd of the sonar source. • Low-frequency active sonar below 200 dB, mid-frequency active sonar sources that are not hull mounted, and high-frequency active sonar will implement the following mitigation zone: ○ During the activity, observe for marine mammals; cease active sonar transmission if resource is observed within 200 yd of the sonar source. • To allow a sighted marine mammal to leave the mitigation zone, the Navy will not recommence active sonar transmission until one of the recommencement conditions has been met: (1) The animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the sonar source; (3) the mitigation zone has been clear from any additional sightings for 10 min. for aircraft-deployed sonar sources or 30 min. for vessel-deployed sonar sources; (4) for mobile activities, the active sonar source has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting; or (5) for activities using hull-mounted sonar, the ship concludes that dolphins are deliberately closing in on the ship to ride the ship's bow wave, and are therefore out of the main transmission axis of the sonar (and there are no other marine mammal sightings within the mitigation zone). • The Navy will notify the Port Authority prior to the commencement of pierside sonar testing activities at Port Canaveral, Florida and Kings Bay, Georgia. At these locations, the Navy will conduct active sonar activities during daylight hours to ensure adequate sightability of manatees, and will equip Lookouts with polarized sunglasses. After completion of pierside sonar testing activities at Port Canaveral and Kings Bay, the Navy will continue to observe for marine mammals for 30 min within the mitigation zone. The Navy will implement a reduction of at least 36 dB from full power for mid-frequency active sonar transmissions at Kings Bay. The Navy will communicate sightings of manatees made during or after pierside sonar testing activities at Kings Bay to the Georgia Department of Natural Resources sightings hotline, Base Natural Resources Manager, and Port Operations. Communications will include information on the time and location of a sighting, the number and size of animals sighted, a description of any research tags (if present), and the animal's direction of travel. Port Operations will disseminate the sightings information to other vessels operating near the sighting and will keep logs of all manatee sightings.

Procedural Mitigation for Airguns

Procedural mitigation for airguns is described in Table 44 below.

TABLE 44—PROCEDURAL MITIGATION FOR AIRGUNS

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

Procedural Mitigation for Pile Driving

Procedural mitigation for pile driving is described in Table 45 below.

TABLE 45—PROCEDURAL MITIGATION FOR PILE DRIVING

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

Procedural Mitigation for Weapons Firing Noise

Procedural mitigation for weapons firing noise is described in Table 46 below.

TABLE 46—PROCEDURAL MITIGATION FOR WEAPONS FIRING NOISE

Procedural mitigation description
Stressor or Activity: • Weapons firing noise associated with large-caliber gunnery activities. *Number of Lookouts and Observation Platform:* • 1 Lookout positioned on the ship conducting the firing. • Depending on the activity, the Lookout could be the same as the one described in Table 49 for Explosive Medium-Caliber and Large-Caliber Projectiles or in Table 60 for Small-, Medium-, and Large-Caliber Non-Explosive Practice Munitions. *Mitigation Zone Size and Mitigation Requirements:* • 30° on either side of the firing line out to 70 yd from the muzzle of the weapon being fired: ○ Prior to the start of the activity, observe for floating vegetation, and marine mammals; if resource is observed, do not commence weapons firing. ○ During the activity, observe for marine mammals; if resource is observed, cease weapons firing. ○ To allow a sighted marine mammal to leave the mitigation zone, the Navy will not recommence weapons firing until one of the recommencement conditions has been met: (1) The animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the firing ship; (3) the mitigation zone has been clear from any additional sightings for 30 min.; or (4) for mobile activities, the firing ship has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting.

Procedural Mitigation for Explosive Stressors

Mitigation measures for explosive stressors are provided in Tables 47 through 57.

Procedural Mitigation for Explosive Sonobuoys

Procedural mitigation for explosive sonobuoys is described in Table 47 below.

TABLE 47—PROCEDURAL MITIGATION FOR EXPLOSIVE SONOBUOYS

Procedural mitigation description
Stressor or Activity: • Explosive sonobuoys. *Number of Lookouts and Observation Platform:* • 1 Lookout positioned in an aircraft or on small boat. *Mitigation Zone Size and Mitigation Requirements:* • 600 yd around an explosive sonobuoy: ○ Prior to the start of the activity (*e.g.,* during deployment of a sonobuoy field, which typically lasts 20–30 min.), conduct passive acoustic monitoring for marine mammals, and observe for floating vegetation and marine mammals; if resource is visually observed, do not commence sonobuoy or source/receiver pair detonations. ○ During the activity, observe for marine mammals; if resource is observed, cease sonobuoy or source/receiver pair detonations. ○ To allow a sighted marine mammal to leave the mitigation zone, the Navy will not recommence the use of explosive sonobuoys until one of the recommencement conditions has been met: (1) The animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the sonobuoy; or (3) the mitigation zone has been clear from any additional sightings for 10 min. when the activity involves aircraft that have fuel constraints, or 30 min. when the activity involves aircraft that are not typically fuel constrained.

Procedural Mitigation for Explosive Torpedoes

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

TABLE 48—PROCEDURAL MITIGATION FOR EXPLOSIVE TORPEDOES

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

Procedural Mitigation for Medium- and Large-Caliber Projectiles

Procedural mitigation for medium- and large-caliber projectiles is described in Table 49 below.

TABLE 49—PROCEDURAL MITIGATION FOR EXPLOSIVE MEDIUM-CALIBER AND LARGE-CALIBER PROJECTILES

Procedural mitigation description
Stressor or Activity: • Gunnery activities using explosive medium-caliber and large-caliber projectiles. • Mitigation applies to activities using a surface target. *Number of Lookouts and Observation Platform:*

TABLE 49—PROCEDURAL MITIGATION FOR EXPLOSIVE MEDIUM-CALIBER AND LARGE-CALIBER PROJECTILES—Continued

Procedural mitigation description
• 1 Lookout on the vessel or aircraft conducting the activity. • For activities using explosive large-caliber projectiles, depending on the activity, the Lookout could be the same as the one described in Table 46 for Weapons Firing Noise. *Mitigation Zone Size and Mitigation Requirements:* • 200 yd around the intended impact location for air-to-surface activities using explosive medium-caliber projectiles, • 600 yd around the intended impact location for surface-to-surface activities using explosive medium-caliber projectiles, or • 1,000 yd around the intended impact location for surface-to-surface activities using explosive large-caliber projectiles: ○ Prior to the start of the activity (*e.g.,* when maneuvering on station), the Navy will observe for floating vegetation and marine mammals; if resource is observed, the Navy will not commence firing. ○ During the activity, the Navy will observe for marine mammals; if resource is observed, the Navy will cease firing. ○ To allow a sighted marine mammal to leave the mitigation zone, the Navy will not recommence firing until one of the recommencement conditions has been met: (1) The animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended impact location; (3) the mitigation zone has been clear from any additional sightings for 10 min. for aircraft-based firing or 30 min. for vessel-based firing; or (4) for activities using mobile targets, the intended impact location has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting.

Procedural Mitigation for Explosive Missiles and Rockets

Procedural mitigation for explosive missiles and rockets is described in Table 50 below.

TABLE 50—PROCEDURAL MITIGATION FOR EXPLOSIVE MISSILES AND ROCKETS

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

Procedural Mitigation for Explosive Bombs

Procedural mitigation for explosive bombs is described in Table 51 below.

TABLE 51—PROCEDURAL MITIGATION FOR EXPLOSIVE BOMBS

Procedural mitigation description
Stressor or Activity: • Explosive bombs. *Number of Lookouts and Observation Platform:* • 1 Lookout positioned in the aircraft conducting the activity. *Mitigation Zone Size and Mitigation Requirements:* • 2,500 yd around the intended target: ○ Prior to the start of the activity (*e.g.,* when arriving on station), the Navy will observe for floating vegetation and marine mammals; if resource is observed, the Navy will not commence bomb deployment. ○ During target approach, the Navy will observe for marine mammals; if resource is observed, the Navy will cease bomb deployment.

TABLE 51—PROCEDURAL MITIGATION FOR EXPLOSIVE BOMBS—Continued

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

Procedural Mitigation for Sinking Exercises

Procedural mitigation for sinking exercises is described in Table 52 below.

TABLE 52—PROCEDURAL MITIGATION FOR SINKING EXERCISES

Procedural mitigation description
Stressor or Activity: • Sinking exercises. *Number of Lookouts and Observation Platform:* • 2 Lookouts (one positioned in an aircraft and one on a vessel). *Mitigation Zone Size and Mitigation Requirements:* • 2.5 nmi around the target ship hulk: ○ 90 min. prior to the first firing, the Navy will conduct aerial observations for floating vegetation, jellyfish aggregations, and marine mammals; if resource is observed, the Navy will not commence firing. ○ During the activity, the Navy will conduct passive acoustic monitoring and visually observe for marine mammals from the vessel; if resource is visually observed, the Navy will cease firing. ○ Immediately after any planned or unplanned breaks in weapons firing of longer than 2 hours, observe for marine mammals from the aircraft and vessel; if resource is observed, the Navy will not commence firing. ○ To allow a sighted marine mammal to leave the mitigation zone, the Navy will not recommence firing until one of the recommencement conditions has been met: (1) The animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the target ship hulk; or (3) the mitigation zone has been clear from any additional sightings for 30 min. ○ For 2 hours after sinking the vessel (or until sunset, whichever comes first), the Navy will observe for marine mammals; if any injured or dead resources are observed, the Navy will allow established incident reporting procedures.

Procedural Mitigation for Explosive Mine Countermeasure and Neutralization Activities

Procedural mitigation for explosive mine countermeasure and neutralization activities is described in Table 53 below.

TABLE 53—PROCEDURAL MITIGATION FOR EXPLOSIVE MINE COUNTERMEASURE AND NEUTRALIZATION ACTIVITIES

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

Procedural Mitigation for Explosive Mine Neutralization Activities Involving Navy Divers

Procedural mitigation for explosive mine neutralization activities involving Navy divers is described in Table 54 below.

TABLE 54—PROCEDURAL MITIGATION FOR EXPLOSIVE MINE NEUTRALIZATION ACTIVITIES INVOLVING NAVY DIVERS

Procedural mitigation description
Stressor or Activity: • Mine neutralization activities involving Navy divers. *Number of Lookouts and Observation Platform:* • 2 Lookouts (two small boats with one Lookout each, or one Lookout on a small boat and one in a rotary-wing aircraft) when implementing the smaller mitigation zone. • 4 Lookouts (two small boats with two Lookouts each), and a pilot or member of an aircrew will serve as an additional Lookout if aircraft are used during the activity, when implementing the larger mitigation zone. *Mitigation Zone Size and Mitigation Requirements:* • The Navy will not set time-delay firing devices (0.1–20 lb net explosive weight) to exceed 10 min. • 500 yd around the detonation site during activities under positive control using 0.1–20 lb net explosive weight, or • 1,000 yd around the detonation site during all activities using time-delay fuses (0.1–20 lb net explosive weight) and during activities under positive control using 21–60 lb net explosive weight charges: ○ Prior to the start of the activity (*e.g.,* when maneuvering on station for activities under positive control; 30 min for activities using time-delay firing devices), the Navy will observe for floating vegetation and marine mammals; if resource is observed, the Navy will not commence detonations or fuse initiation. ○ During the activity, the Navy will observe for marine mammals; if resource is observed, the Navy will cease detonations or fuse initiation. ○ All divers placing the charges on mines will support the Lookouts while performing their regular duties and will report all marine mammal sightings to their supporting small boat or Range Safety Officer. ○ To the maximum extent practicable depending on mission requirements, safety, and environmental conditions, boats will position themselves near the mid-point of the mitigation zone radius (but outside of the detonation plume and human safety zone), will position themselves on opposite sides of the detonation location (when two boats are used), and will travel in a circular pattern around the detonation location with one Lookout observing inward toward the detonation site and the other observing outward toward the perimeter of the mitigation zone. ○ If used, aircraft will travel in a circular pattern around the detonation location to the maximum extent practicable. ○ To allow a sighted marine mammal to leave the mitigation zone, the Navy will not recommence detonations or fuse initiation until one of the recommencement conditions has been met: (1) The animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the detonation site; or (3) the mitigation zone has been clear from any additional sightings for 10 min. during activities under positive control with aircraft that have fuel constraints, or 30 min. during activities under positive control with aircraft that are not typically fuel constrained and during activities using time-delay firing devices. • After completion of an activity using time-delay firing devices, the Navy will observe for marine mammals for 30 min.; if any injured or dead resources are observed, the Navy will follow established incident reporting procedures.

Procedural Mitigation for Maritime Security Operations—Anti-Swimmer Grenades

Procedural mitigation for maritime security operations—anti-swimmer grenades is described in Table 55 below.

TABLE 55—PROCEDURAL MITIGATION FOR MARITIME SECURITY OPERATIONS—ANTI-SWIMMER GRENADES

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

Procedural Mitigation for Line Charge Testing

Procedural mitigation for line charge testing is described in Table 56 below.

TABLE 56—PROCEDURAL MITIGATION FOR LINE CHARGE TESTING

Procedural mitigation description
Stressor or Activity: • Line charge testing. *Number of Lookouts and Observation Platform:* • 1 Lookout positioned on a vessel. *Mitigation Zone Size and Mitigation Requirements:* • 900 yd around the intended detonation location: ○ Prior to the start of the activity (*e.g.,* when maneuvering on station), the Navy will observe for floating vegetation and marine mammals; if resource is observed, the Navy will not commence detonations. ○ During the activity, the Navy will observe for marine mammals; if resource is observed, the Navy will cease detonations. • To allow a sighted marine mammal to leave the mitigation zone, the Navy will not recommence detonations until one of the recommencement conditions has been met: (1) The animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended detonation location; or (3) the mitigation zone has been clear from any additional sightings for 30 min.

Procedural Mitigation for Ship Shock Trials

Procedural mitigation for ship shock trials is described in Table 57 below.

TABLE 57—PROCEDURAL MITIGATION FOR SHIP SHOCK TRIALS

Procedural mitigation description
Stressor or Activity: • Ship shock trials. *Number of Lookouts and Observation Platform:* • A minimum of 10 Lookouts or trained marine species observers (or a combination thereof) positioned either in an aircraft or on multiple vessels *(i.e.,* a Marine Animal Response Team boat and the test ship). • If aircraft are used, Lookouts or trained marine species observers will be in an aircraft and on multiple vessels. • If aircraft are not used, a sufficient number of additional Lookouts or trained marine species observers will be used to provide vessel-based visual observation comparable to that achieved by aerial surveys. *Mitigation Zone Size and Mitigation Requirements:* • The Navy will not conduct ship shock trials in the Jacksonville Operating Area during North Atlantic right whale calving season from November 15 through April 15. • The Navy develops detailed ship shock trial monitoring and mitigation plans approximately 1-year prior to an event and will continue to provide these to NMFS for review and approval. • Pre-activity planning will include selection of one primary and two secondary areas where marine mammal populations are expected to be the lowest during the event, with the primary and secondary locations located more than 2 nmi from the western boundary of the Gulf Stream for events in the Virginia Capes Range Complex or Jacksonville Range Complex. • If it is determined during pre-activity surveys that the primary area is environmentally unsuitable (*e.g.,* observations of marine mammals or presence of concentrations of floating vegetation), the shock trial could be moved to a secondary site in accordance with the detailed mitigation and monitoring plan provided to NMFS. • 3.5 nmi around the ship hull: ○ Prior to the detonation (at the primary shock trial location) in intervals of 5 hrs., 3 hrs., 40 min., and immediately before the detonation, the Navy will observe for floating vegetation and marine mammals; if resource is observed, the Navy will not trigger the detonation. ○ During the activity, the Navy will observe for marine mammals, large schools of fish, jellyfish aggregations, and flocks of seabirds; if resource is observed, the Navy will cease triggering the detonation. ○ To allow a sighted marine mammal to leave the mitigation zone, the Navy will not recommence the triggering of a detonation until one of the recommencement conditions has been met: (1) The animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the ship hull; or (3) the mitigation zone has been clear from any additional sightings for 30 min. ○ After completion of each detonation, the Navy will observe for marine mammals; if any injured or dead resources are observed, the Navy will follow established incident reporting procedures and halt any remaining detonations until the Navy can consult with NMFS and review or adapt the mitigation, if necessary. ○ After completion of the ship shock trial, the Navy will conduct additional observations during the following 2 days (at a minimum) and up to 7 days (at a maximum); if any injured or dead resources are observed, the Navy will follow established incident reporting procedures.

Procedural Mitigation for Physical Disturbance and Strike Stressors

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

Procedural Mitigation for Vessel Movement

Procedural mitigation for vessel movement used during the Proposed Activities is described in Table 58 below.

TABLE 58—PROCEDURAL MITIGATION FOR VESSEL MOVEMENT

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

Procedural Mitigation for Towed In-Water Devices

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

TABLE 59—PROCEDURAL MITIGATION FOR TOWED IN-WATER DEVICES

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

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

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

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

Procedural mitigation description
Stressor or Activity:
• Gunnery activities using small-, medium-, and large-caliber non-explosive practice munitions.
• Mitigation applies to activities using a surface target.
Number of Lookouts and Observation Platform:
• 1 Lookout positioned on the platform conducting the activity.
• Depending on the activity, the Lookout could be the same as the one described in Table 46 for Weapons Firing Noise.
Mitigation Zone Size and Mitigation Requirements:
○ 200 yd around the intended impact location:
○ Prior to the start of the activity (*e.g.,* when maneuvering on station), the Navy will observe for floating vegetation and marine mammals; if resource is observed, the Navy will not commence firing.
○ During the activity, the Navy will observe for marine mammals; if resource is observed, the Navy will cease firing.

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

Procedural mitigation description
○ To allow a sighted marine mammal to leave the mitigation zone, the Navy will not recommence firing until one of the recommencement conditions has been met: (1) The animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended impact location; (3) the mitigation zone has been clear from any additional sightings for 10 min. for aircraft-based firing or 30 min. for vessel-based firing; or (4) for activities using a mobile target, the intended impact location has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting.

Procedural Mitigation for Non-Explosive Missiles and Rockets

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

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

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

Procedural Mitigation for Non-Explosive Bombs and Mine Shapes

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

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

Procedural mitigation description
Stressor or Activity: • Non-explosive bombs. • Non-explosive mine shapes during mine laying activities. *Number of Lookouts and Observation Platform:* • 1 Lookout positioned in an aircraft. *Mitigation Zone Size and Mitigation Requirements:* • 1,000 yd around the intended target: ○ Prior to the start of the activity (*e.g.,* when arriving on station), the Navy will observe for floating vegetation and marine mammals; if resource is observed, the Navy will not commence bomb deployment or mine laying. ○ During approach of the target or intended minefield location, the Navy will observe for marine mammals; if resource is observed, the Navy will cease bomb deployment or mine laying. ○ To allow a sighted marine mammal to leave the mitigation zone, the Navy will not recommence bomb deployment or mine laying until one of the recommencement conditions has been met: (1) The animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended target or minefield location; (3) the mitigation zone has been clear from any additional sightings for 10 min.; or (4) for activities using mobile targets, the intended target has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting.

Mitigation Areas

In addition to procedural mitigation, the Navy will implement mitigation measures within specific areas and/or times to avoid or minimize potential impacts on marine mammals (see Figures 11.2–1 through 11.2–3 of the Navy's rulemaking and LOA application). The Navy reanalyzed existing mitigation areas and considered new habitat areas suggested by the public, NMFS, and other non-Navy organizations, including NARW critical habitat, important habitat for sperm whales, biologically important areas (BIAs), and National Marine Sanctuaries. The Navy worked collaboratively with NMFS to develop mitigation areas using inputs from the Navy's operational community, the best available science discussed in Chapter 3 of the AFTT DEIS/OEIS (Affected Environment and Environmental Consequences), published literature, predicted activity impact footprints, and marine species monitoring and density data. The Navy will continue to work with NMFS to finalize its mitigation areas through the development of the rule. The Navy considered a mitigation area to be effective and thereby warranted, if it met all three of the following criteria and also was determined to be practicable:

▪ The mitigation area is a key area of biological or ecological importance or contains cultural resources: The best available science suggests that the mitigation area contains submerged cultural resources (*e.g.,* shipwrecks) or is important to one or more species or resources for a biologically important life process (*i.e.,* foraging, migration, reproduction) or ecological function (*e.g.,* shallow-water coral reefs that provide critical ecosystem functions);

▪ The mitigation would result in an avoidance or reduction of impacts: Implementing the mitigation would likely result in an avoidance or reduction of impacts on (1) species, stocks, or populations of marine mammals based on data regarding seasonality, density, and animal behavior; or (2) other biological or cultural resources based on their distribution and physical properties; and

▪ The mitigation area would result in a net benefit to the biological or cultural resource: Implementing the mitigation would not simply shift from one area or species to another, resulting in a similar or worse level of effect.

Information on the mitigation measures that the Navy will implement within mitigation areas is provided in Table 63 through Table 65. The mitigation applies year-round unless specified otherwise in the tables.

Mitigation Areas Off Northeastern United States

Mitigation areas for of the Northeastern United States are described in Table 63 below and also depicted in Figure 11.2–1 in the Navy's rulemaking and LOA application.

TABLE 63—MITIGATION AREAS OFF THE NORTHEASTERN UNITED STATES

Mitigation area description
Stressor or Activity: • Sonar. • Explosives. • Physical disturbance and strikes. *Mitigation Area Requirements:* • Northeast North Atlantic Right Whale Mitigation Areas (year-round): ○ The Navy will minimize the use of low-frequency active sonar, mid-frequency active sonar, and high-frequency active sonar to the maximum extent practicable. ○ The Navy will not use Improved Extended Echo Ranging sonobuoys (within 3 nmi of the mitigation area), explosive and non-explosive bombs, in-water detonations, and explosive torpedoes. ○ For activities using non-explosive torpedoes, the Navy will conduct activities during daylight hours in Beaufort sea state 3 or less. The Navy will use three Lookouts (one positioned on a vessel and two in an aircraft during dedicated aerial surveys) to observe the vicinity of the activity. An additional Lookout will be positioned on the submarine, when surfaced. Immediately prior to the start of the activity, Lookouts will observe for floating vegetation and marine mammals; if the resource is observed, the activity will not commence. During the activity, Lookouts will observe for marine mammals; if observed, the activity will cease. To allow a sighted marine mammal to leave the area, the Navy will not recommence the activity until one of the recommencement conditions has been met: (1) The animal is observed exiting the vicinity of the activity; (2) the animal is thought to have exited the vicinity of the activity based on a determination of its course, speed, and movement relative to the activity location; or (3) the area has been clear from any additional sightings for 30 min. During transits and normal firing, ships will maintain a speed of no more than 10 knots. During submarine target firing, ships will maintain speeds of no more than 18 knots. During vessel target firing, ship speeds may exceed 18 knots for brief periods of time (e.g., 10–15 min.). ○ For all activities, before vessel transits, the Navy will conduct a web query or email inquiry to the National Oceanographic and Atmospheric Administration Northeast Fisheries Science Center's North Atlantic Right Whale Sighting Advisory System to obtain the latest North Atlantic right whale sighting information. Vessels will use the obtained sightings information to reduce potential interactions with North Atlantic right whales during transits. Vessels will implement speed reductions after they observe a North Atlantic right whale, if they are within 5 nmi of a sighting reported to the North Atlantic Right Whale Sighting Advisory System within the past week, and when operating at night or during periods of reduced visibility. • Gulf of Maine Planning Awareness Mitigation Area (year-round): ○ The Navy will not plan major training exercises (Composite Training Unit Exercises or Fleet Exercises/Sustainment Exercises), and will not conduct more than 200 hours of hull-mounted mid-frequency active sonar per year. ○ If the Navy needs to conduct major training exercises or more than 200 hours of hull-mounted mid-frequency active sonar per year for national security, it will provide NMFS with advance notification and include the information in any associated training or testing activities or monitoring reports. • Northeast Planning Awareness Mitigation Areas (year-round): ○ The Navy will avoid planning major training exercises (Composite Training Unit Exercises or Fleet Exercises/Sustainment Exercises) to the maximum extent practicable. ○ The Navy will not conduct more than four major training exercises per year (all or a portion of the exercise). ○ If the Navy needs to conduct additional major training exercises for national security, it will provide NMFS with advance notification and include the information in any associated training activity or monitoring reports.

Mitigation Areas off the Mid-Atlantic and Southeastern United States

Mitigation areas off the Mid-Atlantic and Southeastern United States are described in Table 64 below and also depicted in Figure 11.2–2 in the Navy's rulemaking and LOA application.

TABLE 64—MITIGATION AREAS OFF THE MID-ATLANTIC AND SOUTHEASTERN UNITED STATES

Mitigation area description
Stressor or Activity: • Sonar. • Explosives. • Physical disturbance and strikes. *Mitigation Area Requirements:* • Southeast North Atlantic Right Whale Mitigation Area (November 15 through April 15): ○ The Navy will not conduct: (1) Low-frequency active sonar (except as noted below), (2) mid-frequency active sonar (except as noted below), (3) high-frequency active sonar, (4) missile and rocket activities (explosive and non-explosive), (5) small-, medium-, and large-caliber gunnery activities, (6) Improved Extended Echo Ranging sonobuoy activities, (7) explosive and non-explosive bombing activities, (8) in-water detonations, and (9) explosive torpedo activities. ○ To the maximum extent practicable, the Navy will minimize the use of: (1) Helicopter dipping sonar, (2) low-frequency active sonar and hull-mounted mid-frequency active sonar used for navigation training, and (3) low-frequency active sonar and hull-mounted mid-frequency active sonar used for object detection exercises. ○ Before transiting or conducting training or testing activities, the Navy will initiate communication with the Fleet Area Control and Surveillance Facility, Jacksonville to obtain Early Warning System North Atlantic right whale sightings data. The Fleet Area Control and Surveillance Facility, Jacksonville will advise vessels of all reported whale sightings in the vicinity to help vessels and aircraft reduce potential interactions with North Atlantic right whales. Commander, Submarine Force, Atlantic will coordinate any submarine operations that may require approval from the Fleet Area Control and Surveillance Facility, Jacksonville. Vessels will use the obtained sightings information to reduce potential interactions with North Atlantic right whales during transits. Vessels will implement speed reductions after they observe a North Atlantic right whale, if they are within 5 nmi of a sighting reported within the past 12 hours, or when operating at night or during periods of poor visibility. To the maximum extent practicable, vessels will minimize north-south transits. • Mid-Atlantic Planning Awareness Mitigation Areas (year-round): ○ The Navy will avoid planning major training exercises (Composite Training Unit Exercises or Fleet Exercises/Sustainment Exercises) to the maximum extent practicable. ○ The Navy will not conduct more than four major training exercises per year (all or a portion of the exercise). ○ If the Navy needs to conduct additional major training exercises for national security, it will provide NMFS with advance notification and include the information in any associated training activity or monitoring reports.

Mitigation Areas in the Gulf of Mexico

Mitigation areas in the Gulf of Mexico are described in Table 65 below and also depicted in Figure 11.2–3 in the Navy's rulemaking and LOA application.

TABLE 65—MITIGATION AREAS IN THE GULF OF MEXICO

Mitigation area description
Stressor or Activity: • Sonar. *Mitigation Area Requirements:* • Gulf of Mexico Planning Awareness Mitigation Areas (year-round): ○ The Navy will avoid planning major training exercises (i.e., Composite Training Unit Exercises or Fleet Exercises/Sustainment Exercises) involving the use of active sonar to the maximum extent practicable. ○ The Navy will not conduct any major training exercises in the Gulf of Mexico Planning Awareness Mitigation Areas under the Proposed Activity. ○ If the Navy needs to conduct additional major training exercises in these areas for national security, it will provide NMFS with advance notification and include the information in any associated training activity or monitoring reports.

Summary of Mitigation

The Navy's mitigation measures are summarized in Tables 66 and 67. Figure 11.3–1 in the Navy's rulemaking and LOA application depicts the mitigation areas that the Navy developed for marine mammals in the AFTT Study Area.

Summary of Procedural Mitigation

A summary of procedural mitigation is described in Table 66 below.

TABLE 66—SUMMARY OF PROCEDURAL MITIGATION

Stressor or activity	Summary of mitigation zone or other mitigation
Environmental Awareness and Education	Afloat Environmental Compliance Training for applicable personnel.
Active Sonar	Depending on sonar source: 1,000 yd power down, 500 yd power down, and 200 yd shut down; or 200 yd shut down.
Airguns	150 yd.

TABLE 66—SUMMARY OF PROCEDURAL MITIGATION—Continued

Stressor or activity	Summary of mitigation zone or other mitigation
Pile Driving	100 yd.
Weapons Firing Noise	30° on either side of the firing line out to 70 yd.
Explosive Sonobuoys	600 yd.
Explosive Torpedoes	2,100 yd.
Explosive Medium-Caliber and Large-Caliber Projectiles	1,000 yd. (large-caliber projectiles), 600 yd. (medium-caliber projectiles during surface-to-surface activities), or 200 yd. (medium-caliber projectiles during air-to-surface activities).
Explosive Missiles and Rockets	900 yd. (0.6–20 lb net explosive weight), or 2,000 yd. (21–500 lb net explosive weight).
Explosive Bombs	2,500 yd.
Sinking Exercises	2.5 nmi.
Explosive Mine Countermeasure and Neutralization Activities	600 yd (0.1–5 lb net explosive weight), or 2,100 yd (6–650 lb net explosive weight).
Mine Neutralization Activities Involving Navy Divers	500 yd (0.1–20 lb net explosive weight for positive control charges), or 1,000 yd (21–60 lb net explosive weight for positive control charges and all charges using time-delay fuses).
Maritime Security Operations—Anti-Swimmer Grenades	200 yd.
Line Charge Testing	900 yd.
Ship Shock Trials	3.5 nmi.
Vessel Movement	500 yd (whales), or 200 yd (other marine mammals).
Towed In-Water Devices	250 yd.
Small-, Medium-, and Large-Caliber Non-Explosive Practice Munitions.	200 yd.
Non-Explosive Missiles and Rockets	900 yd.
Non-Explosive Bombs and Mine Shapes	1,000 yd.

Notes: lb: pounds; nmi: nautical miles; yd: yards.

Summary of Mitigation Areas

A summary of mitigation areas is described in Table 67 below. Mitigation areas for marine mammals in the AFTT Study Area are also depicted in Figure 11.3–1 in the Navy's rulemaking and LOA application.

TABLE 67—SUMMARY OF MITIGATION AREAS FOR MARINE MAMMALS

Mitigation area	Summary of mitigation requirements
Mitigation Areas for Marine Mammals	
Northeast North Atlantic Right Whale Mitigation Area.	• The Navy will minimize use of active sonar to the maximum extent practicable. • The Navy will not use explosives that detonate in the water. • The Navy will conduct non-explosive torpedo testing during daylight hours in Beaufort sea state 3 or less using three Lookouts (one on a vessel, two in an aircraft during dedicated aerial surveys) and an additional Lookout on the submarine when surfaced; during transits, ships will maintain a speed of no more than 10 knots; during firing, ships will maintain a speed of no more than 18 knots except for brief periods of time during vessel target firing. • Navy will obtain the latest North Atlantic right whale sightings data. • Vessels will implement speed reductions after they observe a North Atlantic right whale, if they are within 5 nmi of a sighting reported within the past week, and when operating at night or during periods of reduced visibility.
Gulf of Maine Planning Awareness Mitigation Area.	• The Navy will not plan major training exercises. • The Navy will not conduct more than 200 hours of hull-mounted mid-frequency active sonar per year.
Northeast Planning Awareness Mitigation Areas, Mid-Atlantic Planning Awareness Mitigation Areas.	• The Navy will avoid planning major training exercises to the maximum extent practicable. • The Navy will not conduct more than four major training exercises per year (all or a portion of the exercise).
Southeast North Atlantic Right Whale Mitigation Area (November 15 through April 15).	• The Navy will not conduct active sonar except as necessary for navigation and object detection training, and dipping sonar. • The Navy will not expend explosive or non-explosive ordnance. • The Navy will obtain the latest North Atlantic right whale sightings data. • Vessels will implement speed reductions after they observe a North Atlantic right whale, if they are within 5 nmi of a sighting reported within the past 12 hours, and when operating at night or during periods of reduced visibility. • To the maximum extent practicable, vessels will minimize north-south transits.
Gulf of Mexico Planning Awareness Mitigation Areas.	• The Navy will avoid planning major training exercises to the maximum extent practicable. • The Navy will not conduct any major training exercises (all or a portion of the exercise) in each area under the Proposed Activity.

Notes: min.: minutes; nmi: nautical miles.

Mitigation Areas for Seafloor Resources

Mitigation areas for seafloor resources are described in Table 68 and Table 69 below. Because these measures, in particular, are not related directly to protecting marine mammals and their habitat, they are not a requirement of this MMPA rulemaking. However, they are part of the Navy's Proposed Activity and are therefore included here for informational purposes.

TABLE 68—MITIGATION AREAS FOR SEAFLOOR RESOURCES

Mitigation area description
Stressor or Activity: • Explosives. • Physical disturbance and strikes. Resource Protection Focus: • Shallow-water coral reefs. • Live hard bottom. • Artificial reefs. • Shipwrecks. Mitigation Area Requirements (year-round): • Within the anchor swing circle of shallow-water coral reefs, live hard bottom, artificial reefs, and shipwrecks: ○ The Navy will not conduct precision anchoring (except in designated anchorages). • Within a 350-yd radius of live hard bottom, artificial reefs, and shipwrecks: ○ The Navy will not conduct explosive mine countermeasure and neutralization activities or explosive mine neutralization activities involving Navy divers. ○ The Navy will not place mine shapes, anchors, or mooring devices on the seafloor. • Within a 350-yd radius of shallow-water coral reefs: ○ The Navy will not conduct explosive or non-explosive small-, medium-, and large-caliber gunnery activities using a surface target; explosive or non-explosive missile and rocket activities using a surface target; explosive or non-explosive bombing and mine laying activities; explosive or non-explosive mine countermeasure and neutralization activities; and explosive or non-explosive mine neutralization activities involving Navy divers. ○ The Navy will not place mine shapes, anchors, or mooring devices on the seafloor. • Within the South Florida Ocean Measurement Facility Testing Range: ○ The Navy will use real-time geographic information system and global positioning system (along with remote sensing verification) during deployment, installation, and recovery of anchors and mine-like objects and during deployment of bottom-crawling unmanned underwater vehicles in waters deeper than 10 ft to avoid shallow-water coral reefs and live hard bottom. ○ Vessels deploying anchors, mine-like objects, and bottom-crawling unmanned underwater vehicles will aim to hold a relatively fixed position over the intended mooring or deployment location using a dynamic positioning navigation system with global positioning system. ○ The Navy will minimize vessel movement and drift in accordance with mooring installation and deployment plans, and will conduct activities during sea and wind conditions that allow vessels to maintain position and speed control during deployment, installation, and recovery of anchors, mine-like objects, and bottom-crawling unmanned underwater vehicles. ○ Vessels will operate within waters deep enough to avoid bottom scouring or prop dredging, with at least a 1-ft clearance between the deepest draft of the vessel (with the motor down) and the seafloor at mean low water. ○ The Navy will not anchor vessels or spud over shallow-water coral reefs and live hard bottom. ○ The Navy will use semi-permanent anchoring systems that are assisted with riser buoys over soft bottom habitats to avoid contact of mooring cables with shallow-water coral reefs and live hard bottom.

TABLE 69—SUMMARY OF MITIGATION AREAS FOR SEAFLOOR RESOURCES

Mitigation area	Summary of mitigation requirements
Mitigation Areas for Seafloor Resources	
Shallow-water coral reefs	• The Navy will not conduct precision anchoring (except in designated anchorages), explosive mine countermeasure and neutralization activities, explosive or non-explosive mine neutralization activities involving Navy divers, explosive or non-explosive small-, medium-, and large-caliber gunnery activities using a surface target, explosive or non-explosive missile and rocket activities using a surface target, or explosive or non-explosive bombing or mine laying activities. • The Navy will not place mine shapes, anchors, or mooring devices on the seafloor. • Within the South Florida Ocean Measurement Facility Testing Range, the Navy will implement additional measures, such as using real-time positioning and remote sensing information to avoid shallow-water coral reefs during deployment, installation, and recovery of anchors and mine-like objects, and during deployment of bottom-crawling unmanned underwater vehicles.
Live hard bottom	• The Navy will not conduct precision anchoring (except in designated anchorages), explosive mine countermeasure and neutralization activities, or explosive mine neutralization activities involving Navy divers. • The Navy will not place mine shapes, anchors, or mooring devices on the seafloor. • Within the South Florida Ocean Measurement Facility Testing Range, the Navy will implement additional measures, such as using real-time positioning and remote sensing information to avoid live hard bottom during deployment, installation, and recovery of anchors and mine-like objects, and during deployment of bottom-crawling unmanned underwater vehicles.
Artificial reefs, Shipwrecks	• The Navy will not conduct precision anchoring (except in designated anchorages), explosive mine countermeasure and neutralization activities, or explosive mine neutralization activities involving Navy divers. • The Navy will not place mine shapes, anchors, or mooring devices on the seafloor.

Mitigation Conclusions

NMFS has carefully evaluated the Navy's proposed mitigation measures—many of which were developed with NMFS' input during the previous phases of Navy training and testing authorizations—and considered a broad range of other measures (*i.e.,* the measures considered but eliminated in the Navy's EIS, which reflect many of the comments that have arisen via NMFS or public input in past years) in the context of ensuring that NMFS prescribes the means of effecting the least practicable adverse impact on the affected marine mammal species and stocks and their habitat. Our evaluation of potential measures included consideration of the following factors in relation to one another: The manner in which, and the degree to which, the successful implementation of the mitigation measures is expected to reduce the likelihood and/or magnitude of adverse impacts to marine mammal species and stocks and their habitat; the proven or likely efficacy of the measures; and the practicability of the measures for applicant implementation, including consideration of personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity.

Based on our evaluation of the Navy's proposed measures, as well as other measures considered by NMFS, NMFS has preliminarily determined that the Navy's proposed mitigation measures (especially when the adaptive management component is taken into consideration (see Adaptive Management, below)) are appropriate 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 these activities and the proposed mitigation measures. While NMFS has preliminarily determined that the Navy's proposed mitigation measures would effect the least practicable adverse impact on the affected species 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.

Proposed Monitoring

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

Integrated Comprehensive Monitoring Program (ICMP)

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

- An increase in our understanding of the likely occurrence of marine mammals and/or ESA-listed marine species in the vicinity of the action (*i.e.,* presence, abundance, distribution, and/or density of species);
- An increase in our understanding of the nature, scope, or context of the likely exposure of marine mammals and/or ESA-listed species to any of the potential stressor(s) associated with the action (*e.g.,* sound, explosive detonation, or military expended materials), through better understanding of one or more of the following: (1) The action and the environment in which it occurs (*e.g.,* sound source characterization, propagation, and ambient noise levels); (2) the affected species (*e.g.,* life history or dive patterns); (3) the likely co-occurrence of marine mammals and/or ESA-listed marine species with the action (in whole or part), and/or; (4) the likely biological or behavioral context of exposure to the stressor for the marine mammal and/or ESA-listed marine species (*e.g.,* age class of exposed animals or known pupping, calving or feeding areas);
- An increase in our understanding of how individual marine mammals or ESA-listed marine species respond (behaviorally or physiologically) to the specific stressors associated with the action (in specific contexts, where possible, *e.g.,* at what distance or received level);
- An increase in our understanding of how anticipated individual responses, to individual stressors or anticipated combinations of stressors, may impact either: (1) The long-term fitness and survival of an individual; or (2) the population, species, or stock (*e.g.,* through effects on annual rates of recruitment or survival);
- An increase in our understanding of the effectiveness of mitigation and monitoring measures;
- A better understanding and record of the manner in which the authorized entity complies with the incidental take regulations and LOAs and ESA Incidental Take Statement;
- An increase in the probability of detecting marine mammals (through improved technology or methods), both specifically within the mitigation zone (thus allowing for more effective implementation of the mitigation) and in general, to better achieve the above goals; and
- Ensuring that adverse impact of activities remains at the least practicable level.

Strategic Planning Process for Marine Species Monitoring

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

Past and Current Monitoring in the AFTT Study Area

NMFS has received multiple years' worth of annual exercise and monitoring reports addressing active sonar use and explosive detonations within the AFTT Study Area and other Navy range complexes. The data and information contained in these reports have been considered in developing mitigation and monitoring measures for the proposed training and testing activities within the AFTT Study Area. The Navy's annual exercise and monitoring reports may be viewed at: *https://www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-military-readiness-activities* and *http://www.navymarinespeciesmonitoring.us.*

The Navy's marine species monitoring program typically supports 10–15 projects in the Atlantic at any given time with an annual budget of approximately $3.5M. Current projects cover a range of species and topics from collecting baseline data on occurrence and distribution, to tracking whales and sea turtles, to conducting behavioral response studies on beaked whales and pilot whales. The navy's marine species monitoring web portal provides details on past and current monitoring projects, including technical reports, publications, presentations, and access to available data and can be found at: *https://www.navymarinespecies monitoring.us/regions/atlantic/current-projects/.*

Adaptive Management

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

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

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

Proposed Reporting

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

Notification of Injured, Live Stranded or Dead Marine Mammals

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

Annual AFTT Monitoring Report

The Navy shall submit an annual report to NMFS of the AFTT monitoring describing the implementation and results from the previous calendar year. Data collection methods will be standardized across range complexes and AFTT Study Area to allow for comparison in different geographic locations. 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. Such a report would describe progress of knowledge made with respect to intermediate scientific objectives within the AFTT Study Area associated with the Integrated Comprehensive Monitoring Program. Similar study questions shall be treated together so that summaries can be provided for each topic area. The report need not include analyses and content that does not provide direct assessment of cumulative progress on the monitoring plan study questions.

Annual AFTT Exercise Report

Each year, the Navy shall submit a preliminary report to NMFS detailing the status of authorized sound sources within 21 days after the anniversary of the date of issuance of the LOA. Each year, the Navy shall submit a detailed report to NMFS within 3 months after the anniversary of the date of issuance of the LOA. The annual report shall contain information on Major Training

Exercises (MTEs) and Testing Exercises, Sinking Exercise (SINKEX) events, and a summary of all sound sources used (total hours or quantity (per the LOA) of each bin of sonar or other non-impulsive source; total annual number of each type of explosive exercises; and total annual expended/detonated rounds (missiles, bombs, sonobuoys, etc.) for each explosive bin). The analysis in the detailed report will be based on the accumulation of data from the current year's report and data presented in the previous report. Information included in the classified annual reports may be used to inform future adaptive management of activities within the AFTT Study Area.

Major Training Exercises Notification

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

Five-Year Close-Out Exercise Report

This report will be included as part of the 2023 annual exercise report. This report will provide the annual totals for each sound source bin with a comparison to the annual allowance and the five-year total for each sound source bin with a comparison to the five-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 EIS and final rule determinations. The report will be submitted to NMFS three months after the expiration of the rule. NMFS will provide comments to the Navy on the draft close-out report, if any, within three months of receipt. The report will be considered final after the Navy has addressed NMFS' comments, or three months after the submittal of the draft if NMFS does not provide comments.

Preliminary Analysis and Negligible Impact Determination

Negligible Impact Analysis

Introduction

NMFS has defined negligible impact as ''an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival'' (50 CFR 216.103). A negligible impact finding is based on the lack of likely adverse effects on annual rates of recruitment or survival (*i.e.,* population-level effects). An estimate of the number of takes alone is not enough information on which to base an impact determination. In addition to considering estimates of the number of marine mammals that might be ''taken'' through mortality, serious injury, and Level A or Level B harassment (as presented in Tables 39–41), NMFS considers other factors, such as the likely nature of any responses (*e.g.,* intensity, duration), the context of any responses (*e.g.,* critical reproductive time or location, migration), as well as effects on habitat, and the likely effectiveness of the mitigation. We also assess the number, intensity, and context of estimated takes by evaluating this information relative to population status. Consistent with the 1989 preamble for NMFS's implementing regulations (54 FR 40338; September 29, 1989), the impacts from other past and ongoing anthropogenic activities are incorporated into this analysis via their impacts on the environmental baseline (*e.g.,* as reflected in the regulatory status of the species, population size and growth rate where known, other ongoing sources of human-caused mortality, ambient noise levels, and specific consideration of take by Level A harassment or serious injury or mortality (hereafter referred to as M/SI) previously authorized for other NMFS activities).

In the Estimated Take section, we identified the subset of potential effects that would be expected to rise to the level of takes, and then identified the number of each of those takes that we believe could occur (mortality) or are likely to occur (harassment) based on the methods described. Not all takes are created equal, in other words, the impact that any given take will have is dependent on many case-specific factors that need to be considered in the negligible impact analysis (*e.g.,* the context of behavioral exposures such as duration or intensity of an disturbance, the health of impacted animals, the status of a species that incurs fitness-level impacts to individuals, *etc.*). Here, we evaluate the likely impacts of the enumerated harassment takes that are proposed for authorization or anticipated to occur in this rule, in the context of the specific circumstances surrounding these predicted take. We also include a specific assessment of serious injury or mortality takes that could occur, as well as consideration of the traits and statuses of the affected species and stocks. Last, we pull all of this information, as well as other more taxa-specific information, together into group-specific discussions that support our negligible impact conclusions for each stock.

Harassment

The Navy's proposed activity reflects representative levels/ranges of training and testing activities, accounting for the natural fluctuation in training, testing, and deployment schedules. This approach is representative of how Navy's activities are conducted over any given year over any given five-year period. Specifically, to calculate take, the Navy provided a range of levels for each activity/source type for a year—they used the maximum annual level to calculate annual takes, and they used the sum of three nominal years (average level) and two maximum years to calculate five-year takes for each source type. The Proposed Activity contains a more realistic annual representation of activities, but includes years of a higher maximum amount of testing to account for these fluctuations. There may be some flexibility in that the exact number of hours, items, or detonations that may vary from year to year, but take totals would not exceed the five-year totals indicated in Tables 39 through 41. We base our analysis and negligible impact determination (NID) on the maximum number of takes that could occur or are likely to occur, although, as stated before, the number of takes are only a part of the analysis, which includes extensive qualitative consideration of other contextual factors that influence the degree of impact of the takes on the affected individuals. To avoid repetition, we provide some general analysis immediately below that applies to all the species listed in Tables 39 through 41, given that some of the anticipated effects of the Navy's training and testing activities on marine mammals are expected to be relatively similar in nature. However, below that, we break our analysis into species (and/or stock), or groups of species (and the associated stocks) where relevant similarities exist, to provide more specific information related to the anticipated effects on individuals or where there is information about the status or structure of any species that would lead to a differing assessment of the effects on the species or stock.

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

Generally speaking, the Navy and NMFS anticipate more severe effects from takes resulting from exposure to higher received levels (though this is in no way a strictly linear relationship for behavioral effects throughout species, individuals, or circumstances) and less severe effects from takes resulting from exposure to lower received levels. However, there is also growing evidence of the importance of distance in predicting marine mammal behavioral response to sound—*i.e.,* sounds of a similar level emanating from a more distant source have been shown to be less likely to evoke a response of equal magnitude (DeRuiter 2012). The estimated number of Level A and Level B takes does not equate to the number of individual animals the Navy expects to harass (which is lower), but rather to the instances of take (*i.e.,* exposures above the Level A and Level B harassment threshold) that are anticipated to occur over the five-year period. These instances may represent either a very brief exposure (seconds) or, in some cases, longer durations of exposure within a day. Some individuals may experience multiple instances of take over the course of the year, while some members of a species or stock may not experience take at all. Depending on the location, duration, and frequency of activities, along with the distribution and movement of marine mammals, individual animals may be exposed to impulse or non-impulse sounds at or above the Level A and Level B harassment threshold on multiple days. However, the Navy is currently unable to estimate the number of individuals that may be taken during training and testing activities. The model results estimate the total number of takes that may occur to a smaller number of individuals.

Some of the lower level physiological stress responses (*e.g.,* orientation or startle response, change in respiration, change in heart rate) discussed earlier would also likely co-occur with the predicted harassments, although these responses are more difficult to detect and fewer data exist relating these responses to specific received levels of sound. Level B takes, then, may have a stress-related physiological component as well; however, we would not expect the Navy's generally short-term, intermittent, and (in the case of sonar) transitory activities to create conditions of long-term, continuous noise leading to long-term physiological stress responses in marine mammals.

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

For sonar (LFAS/MFAS/HFAS) used in the AFTT Study Area, the Navy provided information estimating the percentage of animals that may exhibit a significant behavior response under each behavioral response function that would occur within 6-dB increments (percentages discussed below in the Group and Species-Specific Analysis section). As mentioned above, an animal's exposure to a higher received level is more likely to result in a behavioral response that is more likely to lead to adverse effects on the reproductive success or survivorship of the animal. The majority of Level B takes are expected to be in the form of milder responses (*i.e.,* lower-level exposures that still rise to the level of take, but would likely be less severe in the range of responses that qualify as take) of a generally shorter duration. We anticipate more severe effects from takes when animals are exposed to higher received levels. These discussions are presented within each species group below in the Group and Species-Specific Analysis section. Specifically, given a range of behavioral responses that may be classified as Level B harassment, to the degree that higher received levels are expected to result in more severe behavioral responses, only a smaller percentage of the anticipated Level B harassment (see the Group and Species-Specific Analysis section below for more detailed information) from Navy activities might necessarily be expected to potentially result in more severe responses. To fully understand the likely impacts of the predicted/authorized take on an individual (*i.e.,* what is the likelihood or degree of fitness impacts), one must look closely at the available contextual information, such as the duration of likely exposures and the likely severity of the exposures (*e.g.,* will they occur from high level hull-mounted sonars or smaller less impactful sources). Moore and Barlow (2013) emphasizes the importance of context (*e.g.,* behavioral state of the animals, distance from the sound source, etc.) in evaluating behavioral responses of marine mammals to acoustic sources.

Diel Cycle

As noted previously, many animals perform vital functions, such as feeding, resting, traveling, and socializing on a diel cycle (24-hour cycle). Behavioral reactions to noise exposure (when taking place in a biologically important context, such as disruption of critical life functions, displacement, or avoidance of important habitat) are more likely to be significant if they last more than one diel cycle or recur on subsequent days (Southall *et al.,* 2007). Consequently, a behavioral response lasting less than one day and not recurring on subsequent days is not considered severe unless it could directly affect reproduction or survival (Southall *et al.,* 2007). Note that there is a difference between multiple-day substantive behavioral reactions and multiple-day anthropogenic activities. For example, just because an at-sea exercise lasts for multiple days does not necessarily mean that individual animals are either exposed to those exercises for multiple days or, further, exposed in a manner resulting in a sustained multiple day substantive behavioral response. Large multi-day Navy exercises such as ASW activities, typically include vessels that are continuously moving at speeds typically 10–15 knots, or higher, and likely cover large areas that are relatively far from shore (typically more than 12 nmi from shore) and in waters greater than 600 ft deep, in addition to the fact that marine mammals are moving as well, which would make it unlikely that the same animal could remain in the immediate vicinity of the ship for the entire duration of the exercise. Further, the Navy does not necessarily operate active sonar the entire time during an exercise. While it is certainly possible that these sorts of exercises could overlap with individual marine mammals multiple days in a row at levels above those anticipated to result in a take, because of the factors mentioned above, it is considered unlikely for the majority of takes. However, it is also worth noting that the Navy conducts many different types of noise-producing activities over the course of the year and it is likely that some marine mammals will be exposed to more than one and taken on multiple days, even if they are not sequential.

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

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

Last, as described previously, Navy modeling uses the best available science to predict the instances of exposure above certain acoustic thresholds, which are equated, as appropriate, to harassment takes (and further corrected to account for mitigation and avoidance). As further noted, for active acoustics, it is more challenging to parse out the number of individuals taken from this larger number of instances. One method that NMFS can use to help better understand the overall scope of the impacts is to compare these total instances of take against the abundance of that stock. For example, if there are 100 takes in a population of 100, one can assume either that every individual was exposed above acoustic thresholds in no more than one day, or that some smaller number were exposed in one day but a few of those individuals were exposed in multiple days. At a minimum, it provides a relative picture of the scale of impacts to each stock. When calculating the proportion of a population affected by takes (*e.g.,* the number of takes divided by population abundance), it is important to choose an appropriate population estimate to make the comparison. While the SARs provide the official population estimate for a given species or stock in a given year (and are typically based solely on the most recent survey data), the SARs are often not used to estimate takes, instead modeled density information is used. If takes are calculated from another dataset (for example a broader sample of survey data) and compared to the population estimate from the SARs, it may distort the percent of the population affected because of different population baselines.

The estimates found in NMFS's SARs remain the official estimates of stock abundance where they are current. These estimates are typically generated from the most recent shipboard and/or aerial surveys conducted. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance within U.S. waters. NMFS's SAR estimates also may not incorporate correction for detection bias. In these cases, they should generally be considered as underestimates, especially for cryptic or long-diving species (*e.g.,* beaked whales, *Kogia* spp., sperm whales). In some cases, NMFS's abundance estimates show substantial year-to-year variability. For the reasons stated above, we used the Navy's abundance predictions to make relative comparisons between the exposures predicted by the outputs of the model and the overall abundance predicted by the model. However, our use of the Navy's abundance estimates is not intended to make any statement about NMFS's SAR abundance estimates.

The Navy uses, and NMFS supports the use of spatially and temporally explicit density models that vary in space and time to estimate their potential impacts to species. See the *U.S. Navy Marine Species Density Database Phase III for the Atlantic Fleet Training and Testing Area Technical Report* to learn more on how the Navy selects density information and the models selected for individual species. These models may better characterize how Navy impacts can vary in space and time but often predict different population abundances than the SARs.

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

The Navy Study Area covers a broad area in the western North Atlantic Ocean and the Navy has tried to find density estimates for this entire area, where appropriate given species distributions. However, only a small number of Navy training and testing activities occur outside of the U.S. EEZ. As such, NMFS believes that the average population predicted by Navy models across seasons in the U.S. EEZ is the best baseline to use when analyzing takes as a proportion of population. This is a close approximation of the actual population used in Navy take analysis as occasionally sound can propagate outside of the U.S. EEZ and a small number of exercises do occur in international waters. This approximation will be less accurate for species with major changes in density close to the U.S. EEZ or far offshore. In all cases it is important to understand the differences between Navy models and the SARs on a species by species case. Models of individual species or stocks were not available for all species and takes had to be proportioned to the species or stock level from takes predicted on models at higher taxonomic levels. See the various Navy technical reports mentioned previously in this rule that detail take estimation and density model selection for details.

TTS

NMFS and the Navy have estimated that some individuals of some species of marine mammals may sustain some level of TTS from active sonar. As mentioned previously, TTS can last from a few minutes to days, be of varying degree, and occur across various frequency bandwidths, all of which determine the severity of the impacts on the affected individual, which can range from minor to more severe. Tables 72–77 indicate the amounts of TTS that may be incurred by different stocks from exposure to active sonar and explosives. No TTS is estimated from airguns or piledriving activities. The TTS sustained by an animal is primarily classified by three characteristics:

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

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

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

Based on the range of degree and duration of TTS reportedly induced by exposures to non-pulse sounds of energy higher than that to which free-swimming marine mammals in the field are likely to be exposed during LFAS/MFAS/HFAS training and testing exercises in the AFTT Study Area, it is unlikely that marine mammals would ever sustain a TTS from MFAS that alters their sensitivity by more than 20 dB for more than a few hours (and any incident of TTS would likely be far less severe due to the short duration of the majority of the events and the speed of a typical vessel). Also, for the same reasons discussed in the Diel Cycle section, and because of the short distance within which animals would need to approach the sound source, it is unlikely that animals would be exposed to the levels necessary to induce TTS in subsequent time periods such that their recovery is impeded. Additionally, though the frequency range of TTS that marine mammals might sustain would overlap with some of the frequency ranges of their vocalization types, the frequency range of TTS from MFAS (the source from which TTS would most likely be sustained because the higher source level and slower attenuation make it more likely that an animal would be exposed to a higher received level) would not usually span the entire frequency range of one vocalization type, much less span all types of vocalizations or other critical auditory cues. If impaired, marine mammals would typically be aware of their impairment and 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 typically pings every 50 seconds for hull-mounted sources. Hull-mounted anti-submarine sonars can also be used in an object detection mode known as ''Kingfisher'' mode (*e.g.,* used on vessels when transiting to and from port), pulse length is shorter, but pings are much closer together in both time and space, since the vessel goes slower when operating in this mode. For the majority of sources, the pulse length is significantly shorter than hull-mounted active sonar, on the order of several microseconds to tens of microseconds. For hull-mounted active sonar, though some of the vocalizations that marine mammals make are less than one second long, there is only a 1 in 50 chance that they would occur exactly when the ping was received, and when vocalizations are longer than one second, only parts of them are masked. Alternately, when the pulses are only several microseconds long, the majority of most animals' vocalizations would not be masked.

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

PTS From Sonar and Explosives and Tissue Damage From Explosives

Tables 72–77 indicates the number of individuals of each of species and stock for which Level A harassment in the form of PTS resulting from exposure to active sonar and/or explosives estimated to occur. Tables 72–77 also indicate the number of individuals of each of species and stock for which Level A harassment in the form of tissue damage resulting from exposure to explosive detonations is estimated to occur. The number of individuals to potentially incur PTS annually (from sonar and explosives) for the predicted species ranges from 0 to 471 (471 for harbor porpoise), but is more typically a few up to 33 (with the exception of a few species). The number of individuals to potentially incur tissue damage from explosives for the predicted species ranges from 0 to 36 (36 for short-beaked common dolphin), but is typically zero in most cases. Overall the Navy's model estimated that 8 delphinidae annually would be exposed to explosives during training and testing at levels that could result in non-auditory injury. The Navy's model estimated that 1 sperm whale and 94 delphinidae annually could experience non-auditory injury. Overall, takes from Level A harassment (PTS and Tissue Damage) account for less than one percent of all total takes.

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

If a marine mammal is able to approach a surface vessel within the distance necessary to incur PTS, the likely speed of the vessel (nominally 10–15 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 dependent upon the degree of PTS and the frequency band it is in, and many animals are able to compensate for the shift, although it may include energetic costs. We also assume that the acoustic exposures sufficient to trigger onset PTS (or TTS) would be accompanied by physiological stress responses, although the sound characteristics that correlate with specific stress responses in marine mammals are poorly understood. As discussed above for Behavioral Harassment, we would not expect the Navy's generally short-term, intermittent, and (in the case of sonar) transitory activities to create conditions of long-term, continuous noise leading to long-term physiological stress responses in marine mammals.

For explosive activities, the Navy implements mitigation measures (described in Proposed Mitigation Measures) during explosive activities, including delaying detonations when a marine mammal is observed in the mitigation zone. Observing for marine mammals during the explosive activities will include aerial and passive acoustic detection methods (when they are available and part of the activity) before the activity begins, in order to cover the mitigation zones that can range from 200 yds (183 m) to 2,500 yds (2,286 m) depending on the source (*e.g.,* explosive sonobuoy, explosive torpedo, explosive bombs) and 2.5 nmi for sinking exercise (see Tables 47–56).

Observing for marine mammals during ship shock (which includes lookouts in aircraft or on multiple vessels), begins 5 hrs before the detonation and extends 3.5 nmi from the ship's hull (see Table 57). Nearly all explosive events will occur during daylight hours to improve the sightability of marine mammals improving mitigation effectiveness. The proposed mitigation is expected to reduce the likelihood that all of the proposed takes will occur, however, we analyze the type and amount of Level A take indicated in Tables 39 through 41. Generally speaking, the number and degree of potential injury are low.

Serious Injury and Mortality

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

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

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

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

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

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

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

Nonetheless, NMFS recognizes that as a quantitative tool, PBR may be useful in certain instances as a consideration when evaluating the impacts of other human-caused activities on marine mammal stocks. Outside the commercial fishing context, PBR can help inform the potential effects of M/SI, most readily for determining when anticipated M/SI clearly would not contribute to exceeding the negligible impact level. We first calculate a metric for each species or stock that incorporates information regarding ongoing anthropogenic mortality/serious injury into the PBR value (*i.e.,* PBR minus the total annual anthropogenic mortality/serious injury estimate), which is called ''residual PBR.'' (Wood *et al.,* 2012). We then consider the maximum potential incidental M/SI from the activities being evaluated relative to an insignificance threshold, which is 10 percent of residual PBR for that species or stock. For a species or stock with incidental M/SI less than 10 percent of residual PBR, we consider M/SI from the specified activities to represent an insignificant incremental increase in ongoing anthropogenic M/SI that alone (*i.e.,* in the absence of any other take) cannot affect annual rates of recruitment and survival. In a prior incidental take rulemaking and in the commercial fishing context, this threshold is identified as the significance threshold, but it is more accurately an insignificance threshold outside commercial fishing because it represents the level at which there is no need to consider other factors in determining the role of M/SI in affecting rates of recruitment and survival. Assuming that any additional incidental take by harassment would not exceed the negligible impact level, the anticipated M/SI caused by the activities being evaluated would have a negligible impact on the species or stock.

Where M/SI for a species or stock exceeds the insignificance threshold—or even residual PBR—that information is relevant to, but not determinative of, whether the M/SI along with any anticipated take by harassment exceeds negligible impact. We also consider all relevant information that could either increase or reduce the level of concern related to the significance of a given level of take. Specifically, we consider implementation of mitigation measures, additional population stressors, and other possible effects—both positive and negative—in addition to the interaction of those mortalities with incidental taking by harassment.

Our evaluation of the M/SI for each of the species and stocks for which mortality could occur follows. No mortalities or serious injuries are anticipated from Navy's sonar activities. In addition, all mortality authorized for some of the same species or stocks over the next several years pursuant to our final rulemaking for the NMFS Northeast Fisheries Science Center has been incorporated into the residual PBR.

We first consider maximum potential incidental M/SI from Navy's ship strike analysis for the affected mysticetes and sperm whales (see Table 70) and from the Navy's explosive detonations for the affected dolphin species (see Table 71) in consideration of NMFS's threshold for identifying insignificant M/SI take (10 percent of residual PBR (69 FR 43338; July 20, 2004)). By considering the maximum potential incidental M/SI in relation to PBR and ongoing sources of anthropogenic mortality, we begin our evaluation of whether the potential incremental addition of M/SI through Navy's ship strikes and explosive detonations may affect the species' or stock's annual rates of recruitment or survival. We also consider the interaction of those mortalities with incidental taking of that species or stock by harassment pursuant to the specified activity.

Based on the methods discussed previously, NMFS believes that mortal takes of three large whales over the course of the five-year rule could occur, but that no more than one of any species of humpback whale, fin whale, sei whale, minke whale, blue whale, or sperm whale (either GOM or North Atlantic) would occur. This means an annual average of 0.2 whales from each species as described in Table 70 (*i.e.,* 1 take over 5 years divided by 5 to get the annual number) is proposed for authorization.

The Navy has also requested a small number of takes by serious injury or mortality from explosives. To calculate the annual average of mortalities for explosives in Table 71 we used the same method as described for vessel strikes. The annual average is the number of takes divided by 5 years to get the annual number.

TABLE 70—SUMMARY INFORMATION RELATED TO AFTT SHIP STRIKE, 2018–2023

Species (stock)	Stock abundance (Nbest) *	Annual proposed take by serious injury or mortality [1]	Total annual M/SI * [2]	Fisheries interactions (Y/N); annual rate of M/SI from fisheries interactions *	Vessel collisions (Y/N); annual rate of M/SI from vessel collision *	PBR *	NEFSC authorized take (annual)	Residual PBR–PBR minus annual M/SI (%) [3]	Stock trend * [4]	UME (Y/N); number and year
Fin whale (Western North Atlantic).	1,618	0.2	3.8	Y; 1.8	Y; 2	2.5	0	−1.3	?	N
Sei whale (Nova Scotia).	357	0.2	0.8	N	Y; 0.8	0.5	0	−0.3	?	N
Minke Whale (Canadian East Coast).	2,591	0.2	8.25	Y; 6.45	Y; 1.6	14	1	4.75	?	?
Blue whale (Western North Atlantic).	unknown	0.2	unknown	N	N	0.9	0	unknown	?	?
Humpback whale (Gulf of Maine).	823	0.2	9.05	Y; 7.25	Y; 1.8	13	0	3.95	↑	Y/27 in 2017 (53 in 2016 and 2017 combined).
Sperm whale (North Atlantic).	2,288	0.2	0.8	Y; 0.8	Y; 0.2	3.6	0	2.8	?	?
Sperm whale (Gulf of Mexico).	763	0.2	0	N	N	1.1	0	1.1	?	Y/5 in 2010–2014.

* Presented in the SARS.

[1] This column represent the annual take by serious injury or mortality by vessel collision and was calculated by the number of mortalities proposed for authorization divided by five years (the length of the rule and LOAs).

[2] This column represents the total number of incidents of M/SI that could potentially accrue to the specified species or stock. This number comes from the SAR, but deducts the takes accrued from either Navy strikes or NEFSC takes to ensure not double-counted against PBR. However, for these species, there were no were no takes from either Navy or NEFSC to deduct that would be considered double-counting.

[3] This value represents the calculated PBR less the average annual estimate of ongoing anthropogenic mortalities (*i.e.,* total annual human-caused M/SI, which is presented in the SARs).

[4] See relevant SARs for more information regarding stock status and trends.

TABLE 71. SUMMARY INFORMATION RELATED TO AFTT SERIOUS INJURY OR MORTALITY FROM EXPLOSIVES (SHIP SHOCK TRIALS), 2018–2023

Species (stock)	Stock abundance (Nbest) *	Annual proposed take by serious injury or mortality [1]	Total annual M/SI* [2]	Fisheries interactions (Y/N); annual rate of M/SI from fisheries interactions *	PBR *	NEFSC authorized take (annual)	Residual PBR–PBR minus annual M/SI [3]	Stock trend * [4]	UME (Y/N); number and year
Atlantic white-sided dolphin (Western N. Atlantic).	48,819	0.2	74	74	304	0.6	230	?	N
Pantropical spotted dolphin (Northern Gulf of Mexico).	50,880	0.2	4.4	4.4	407	0	402.6	?	Y/3 in 2010–2014.
Short-beaked common dolphin (Western N. Atlantic).	70,184	1.2	409	409	577	2	168	?	N
Spinner dolphin (Northern Gulf of Mexico).	11,411	0.2	0	0	62	0	62	?	Y/7 in 2010–2014.

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

Humpback Whale

For humpback whale (Gulf of Maine stock) PBR is currently set at 13 and the total annual M/SI of 9.05 yielding a residual PBR of 3.95. The M/SI value includes incidental fishery interaction records of 7.25, and records of vessel collisions of 1.8. The proposed authorization of 0.2 mortalities is below the insignificance threshold of 10 percent of residual PBR (0.395); therefore, we consider the addition of 0.2 an insignificant incremental addition to human-caused mortality. This information will be considered in combination with our assessment of the impacts of harassment takes later in the section.

While the proposed authorization of mortalities is below the insignificant threshold, because of the going UME for humpback whales, we address what actions may be occurring that may reduce the risk of mortalities of humpbacks. Of note, the Atlantic Large Whale Take Reduction Plan (ALWTRP) is a program to reduce the risk of serious injury and death of large whales caused by accidental entanglement in U.S. commercial trap/pot and gillnet fishing gear. It aims to reduce the number of whales taken by gear entanglements focusing on fin whales, humpback whales, and NARW. Effective September 1, 2015 the ALWTRP included new gear marking areas for gillnets and trap/pots for Jeffrey's Ledge and Jordan Basin (Gulf of Maine), two important high-use areas for humpback whales and NARWs. The only study available that examined the effectiveness of the ALWTRP reviewed the regulations up to 2009 (Pace *et al.* 2014) and the results called for additional mitigation measures needed to reduce entanglements. After this study period, NMFS put two major regulatory actions in place—the 2007 sinking groundline rule that went into effect in 2009 (73 FR 51228) and the 2014 vertical line rule that went into effect in 2015 (79 FR 36586). NMFS Fisheries Science Centers are convening a working group in January 2018 to make recommendations on the best analytical approach to measure how effective these regulations have been. However, the Office of Law Enforcement (OLE) report that of gear checked by OLE under the ALWTRP, they found a compliance rate of 94.49 percent in FY–2015 and 84.42 percent in FY–2016.

Sperm Whale (North Atlantic)

For sperm whales (North Atlantic stock) PBR is currently set at 3.6 and the total annual M/SI of 0.8 yielding a residual PBR of 2.8. The M/SI value includes incidental fishery interaction records of 0.6, and records of vessel collisions of 2.0. The proposed authorization of 0.2 mortalities falls below the insignificance threshold of 10 percent of residual PBR (0.28), therefore, we consider the addition of 0.2 an insignificant incremental addition to human-caused mortality. This information will be considered in combination with our assessment of the impacts of harassment takes later in the section.

Sperm Whale (Gulf of Mexico)

For sperm whales (Gulf of Mexico stock) PBR is currently set at 1.1 and the total annual M/SI of 0 yielding a residual PBR of 1.1. The M/SI value includes incidental fishery interaction records of 0, and records of vessel collisions of 0. The proposed authorization of 0.2 mortalities does not fall below the insignificance threshold of 10 percent of residual PBR (0.11), but is below residual PBR, which means that the total anticipated human-caused mortality is still not expected to exceed that needed to allow the stock to reach or maintain its OSP level. The information contained here will be considered in combination with the harassment assessment included later in this section.

Additional information on sperm whale mortalities was considered in our analysis because the proposed mortalities did not fall below the insignificant threshold of 10 percent of residual PBR (however, still below residual PBR). Sperm whales associated with a UME (described below) appears to be an isolated event and the UME investigation determined that the DWH oil spill is the most likely explanation for the elevated stranding numbers in the northern Gulf of Mexico. An UME was declared for cetaceans in the northern Gulf of Mexico 2010–2014 (for more information refer to the Description of Marine Mammals section). During 2010–2013, five sperm whales from this stock were considered to be part of the UME. No vessel strikes have been documented in recent years (2009–2013) for sperm whales in the Gulf of Mexico. Historically, one possible sperm whale mortality due to a vessel strike has been documented for the Gulf of Mexico. The incident occurred in 1990 in the vicinity of Grande Isle, Louisiana. Deep cuts on the dorsal surface of the whale indicated the ship strike was probably pre-mortem (Jensen and Silber 2004). The status of sperm whales in the northern Gulf of Mexico, relative to OSP, is unknown.

There are insufficient data to determine the population trends for this stock.

Minke Whale

For minke whales (Canadian East Coast stock) PBR is currently set at 14 and the total annual M/SI of 8.25 yielding a residual PBR of 5.75. The M/SI value includes incidental fishery interaction records of 6.45, and records of vessel collisions of 1.6. The proposed authorization of 0.2 mortalities annually from the Navy's activities (in addition to the 1.0 annual mortality from the NEFSC) yields a total of 1.2 mortalities, which does not fall below the insignificance threshold of 10 percent of residual PBR (0.575), but is below residual PBR. This means that the total anticipated human-caused mortality is still not expected to exceed that needed to allow the stock to reach or maintain its OSP level. In addition, the abundance of minke whales is likely greater as the most recent estimate is substantially lower than the estimate from the previous 2015 SAR abundance (20,741 minkes with a PBR of 162). The 2015 SAR abundance included data from the 2007 Canadian Trans-North Atlantic Sighting Surveys (TNASS) while the current estimate did not. For the purposes of the 2016 SAR, as recommended in the GAMMS II Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable, so the 2016 SAR estimate must not include data from the 2007 TNASS. The 2016 SARS indicated that the estimate should not be interpreted as a decline in abundance of this stock, as previous estimates are not directly comparable. Therefore, the PBR is likely much greater for this species, which could mean that the real residual PBR may not be exceeded. The information contained here will be considered in combination with the harassment assessment included later in this section.

Blue Whale

For blue whales (Western North Atlantic stock) PBR is currently set at 0.9 and the total annual M/SI is unknown and therefore residual PBR is unknown. The proposed authorization of 0.2 mortalities is below PBR and there is no other known mortality, so the total anticipated human-caused mortality is not expected to exceed PBR. Additional information on blue whale mortalities was considered in our analysis because the proposed mortalities did not fall below the insignificant threshold of 10 percent of residual PBR (however, still below PBR). There have been no observed fishery-related mortalities or serious injury. There are no recent confirmed records of mortality or serious injury to blue whales in the U.S. Atlantic EEZ. One historical record points to a ship strike; however it was concluded that the whale may have been died outside the U.S. Atlantic EEZ. In March 1998, a dead 20 m (66 ft) male blue whale was brought into Rhode Island waters on the bow of a tanker. The cause of death was determined to be ship strike; however, some of the injuries were difficult to explain from the necropsy. Therefore, we think the likelihood of the Navy hitting a blue whale is discountable. There are insufficient data to determine population trends for this species. This information will be considered in combination with our assessment of the impacts of harassment takes later in the section.

Fin Whale

For fin whales (Western North Atlantic stock) PBR is currently set at 2.5 and the total annual M/SI of 3.8 yielding a residual PBR of −1.3. The fact that residual PBR is negative means that the total anticipated human-caused mortality is expected to exceed PBR even in the absence of additional take by the Navy. However, we note that there is a strong likelihood the abundance estimate used to calculate PBR was biased low due to incomplete coverage of the stock's range, and, therefore, this PBR calculation is likely low. The best abundance estimate available for the fin whale stock is 1,618 and that it is likely that the available estimate underestimates this stock's abundance because much of the stock's range was not included in the surveys upon which the estimate is based.

Proposed mortality above residual PBR (however, still below PBR) necessitates the consideration of all additional available information on mortality in the analysis. Of note, the ALWTRP (as described above) is a program to reduce the risk of serious injury and death of large whales caused by accidental entanglement in U.S. commercial trap/pot and gillnet fishing gear. It aims to reduce the number of whales taken by gear entanglements focusing on fin whales, humpback whales, and NARW. NMFS Fisheries Science Centers are convening a working group in January 2018 to make recommendations on the best analytical approach to measure how effective these regulations have been.

As noted previously, PBR, as a tool, is inherently conservative and is not intended to be used as an absolute cap. The Navy's proposed serious injury or mortality take of 0.2 individual fin whales is low in and of itself (the lowest non-zero value possible over a five-year period), and as a portion of the total projected overage of human-caused mortality of 3.8. Additionally, as noted above, PBR may be underestimated, which could mean that the real residual PBR may not be exceeded. However, the exceedance of residual PBR necessitates that close attention to the remainder of the impacts on fin whales from this activity to ensure that the total authorized impacts are negligible.

Sei Whale

For sei whales (Nova Scotia stock) PBR is currently set at 0.5 and the total annual M/SI of 0.8 yielding a residual PBR of −0.3. The M/SI value includes incidental fishery interaction records of 0, and records of vessel collisions of 0.8. The fact that residual PBR is negative means that the total anticipated human-caused mortality is expected to exceed PBR even in the absence of additional take by the Navy. However, we note that there is a strong likelihood the abundance estimate used to calculate PBR was biased low due to incomplete coverage of the stock's range, and, therefore, this PBR calculation may also be low. It should be noted that the population abundance estimate of 357 is considered the best available for the Nova Scotia stock of sei whales. However, this estimate must be considered conservative because all of the known range of this stock was not surveyed. It should be noted that the abundance survey from which it was derived excluded waters off the Scotian Shelf, an area encompassing a large portion of the stated range of the stock. The status of this stock relative to OSP in the U.S. Atlantic EEZ is unknown. There are insufficient data to determine population trends for sei whales.

Proposed mortality above residual PBR (however, still below PBR) necessitates the consideration of all additional available information on mortality in the analysis. As noted previously, PBR, as a tool, is inherently conservative and is not intended to be used as an absolute cap. The Navy's proposed serious injury or mortality take of 0.2 individual sei whales is low in and of itself (the lowest non-zero value possible over a five-year period), and the total projected overage of human-caused mortality of 0.8 is also low. However, the exceedance of residual PBR necessitates that close attention to the remainder of the impacts on sei whales from the Navy's activities to ensure that the total authorized impacts are negligible.

Atlantic White-Sided Dolphin

For Atlantic white-sided dolphins (Western Atlantic stock) PBR is currently set at 304 and the total annual M/SI of 74 yielding a residual PBR of 230. The proposed authorization of 0.2 mortalities from the Navy's activities (in addition to 0.6 mortalities from the NEFSC) yields a total of 0.8 mortalities, which falls below the insignificance threshold of 10 percent of residual PBR (23.0). Therefore, we consider the addition of 0.8 an insignificant incremental increase to human-caused mortality and do not consider additional factors related to mortality further. This information will be considered in combination with our assessment of the impacts of harassment takes later in the section.

Pantropical Spotted Dolphin

The Pantropical spotted dolphins (Northern Gulf of Mexico stock) PBR is currently set at 407 and the total annual M/SI of 4.4 yielding a residual PBR of 402.6. The proposed authorization of 0.2 mortalities annually falls below the insignificance threshold of 10 percent of residual PBR (40.26) and, therefore, we consider the addition of 0.2 an insignificant incremental increase to human-caused mortality and do not consider additional factors related to mortality further. This information will be considered in combination with our assessment of the impacts of harassment takes later in the section.

Short-Beaked Common Dolphin

For short-beaked common dolphins (Western North Atlantic stock) PBR is currently set at 577 and the total annual M/SI of 409 yielding a residual PBR of 168. The proposed authorization of 1.2 mortalities annually from the Navy's activities (in addition to the 2.0 mortalities from the NEFSC) yields a total of 3.2 mortalities annually and falls below the insignificance threshold of 10 percent of residual PBR (16.8) and, therefore, we consider the addition of 3.2 an insignificant incremental increase to human-caused mortality and do not consider additional factors related to mortality further. This information will be considered in combination with our assessment of the impacts of harassment takes later in the section.

Spinner Dolphin

The spinner dolphins (Northern Gulf of Mexico stock) PBR is currently set at 62 and the total annual M/SI of 0 yielding a residual PBR of 62. The proposed authorization of 0.2 mortalities annually falls below the insignificance threshold of 10 percent of residual PBR (6.2) and, therefore, we consider the addition of 0.2 an insignificant incremental increase to human-caused mortality and do not consider additional factors related to mortality further. This information will be considered in combination with our assessment of the impacts of harassment.

Group and Species-Specific Analysis

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

The amount and type of incidental take of marine mammals anticipated to occur from exposures to sonar and other active acoustic sources and explosions during the five-year training and testing period are shown in Tables 39 and 40 as well as ship shock trials shown in Table 41. The vast majority of predicted exposures (greater than 99 percent) are expected to be Level B harassment (non-injurious TTS and behavioral reactions) from acoustic and explosive sources during training and testing activities at relatively low received levels.

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

Mysticetes

In Table 72 below, for mysticetes, we indicate the total annual mortality, Level A and Level B harassment, and a number indicating the instances of total take as a percentage of abundance. Overall, takes from Level A harassment (PTS and Tissue Damage) account for less than one percent of all total takes.

Table 72: Annual takes of Level B and Level A harassment, mortality for mysticetes in the AFTT study area and number indicating the instances of total take as a percentage of stock abundance.

		Instances of indicated types of incidental take (not all takes represent separate individuals, especially for disturbance)					Total takes		Abundance		Instances of total take as percentage of abundance	
		Level B Harassment		Level A Harassment								
Species	Stock	Behavioral Disturbance	TTS (may also include disturbance)	PTS	Tissue Damage	Mortality	In EEZ	Inside and Outside EEZ	In EEZ	Inside and Outside EEZ	In EEZ	Inside and Outside EEZ
Suborder Mysticeti (baleen whales)												
Family Balaenidae (right whales)												
North Atlantic right whale*	Western North Atlantic	209	376	0	0	0	585	585	343	343	171	171
Family Balaenopteridae (roquals)												
Blue whale*	Western North Atlantic (Gulf of St. Lawrence)	12	32	0	0	0.2	44	47	9	104	491	46
Bryde's whale	Northern Gulf of Mexico	27	31	1	0	0	59	59	50	50	118	118
	NSD	76	260	0	0	0	336	360	50	563	672	64
Minke whale	Canadian East Coast	768	3,201	5	0	0.2	3974	4146	730	7686	544	54
Fin whale*	Western North Atlantic	1,740	3,824	33	0	0.2	5597	5649	1,660	14769	337	38
Humpback whale	Gulf of Maine	241	472	3	0	0.2	716	767	496	4580	144	17
Sei whale*	Nova Scotia	243	560	4	0	0.2	807	833	246	11737	328	7

Note: Above we compare predicted takes to abundance estimates generated from the same underlying density estimate, versus abundance estimates from the SARs, which are not based on the same data and would not be appropriate for this purpose. Note that comparisons are made both within the EEZ only (where density estimates have lesser uncertainty and takes are notably greater) and across the whole Study Area (which offers a more comprehensive comparison for many stocks).

The annual mortality of 0.2 is because we expect no more than one mortality over the course of five years from vessel strikes as previously described above.

Of these species, North Atlantic right whale, blue whale, fin whale, and sei whale are listed as endangered under the ESA and depleted under the MMPA. NMFS is currently engaged in an internal Section 7 consultation under the ESA and the outcome of that consultation will further inform our final decision.

As noted previously, the estimated takes represent instances of take, not the number of individuals taken, and in almost all cases—some individuals are expected to be taken more than one time, which means that the number of individuals taken is smaller than the total estimated takes. In other words, where the instances of take exceed 100 percent of the population, repeated takes of some individuals are predicted. Generally speaking, the higher the number of takes as compared to the population abundance, the more repeated takes of individuals are likely, and the higher the actual percentage of individuals in the population that are likely taken at least once in a year. We look at this comparative metric to give us a relative sense across species/stocks of where larger portions of the stocks are being taken by Navy activities and where there is a higher likelihood that the same individuals are being taken across multiple days and where that number of days might be higher. In the ocean, the use of sonar and other active acoustic sources is often transient and is unlikely to repeatedly expose the same individual animals within a short period, for example within one specific exercise. However, some repeated exposures across different activities could occur over the year, especially where numerous activities occur in generally the same area with more resident species. In short, we expect that the total anticipated takes represent exposures of a smaller number of individuals of which some would be exposed multiple times, but based on the nature of the Navy's activities and the movement patterns of marine mammals, it is unlikely that any particular subset would be taken over more than a few sequential days—*i.e.,* where repeated takes of individuals are likely to occur. They are more likely to result from non-sequential exposures from different activities and marine mammals are not predicted to be taken for more than a few days in a row, at most. As described elsewhere, the nature of the majority of the exposures would be expected to be of a less severe nature and based on the numbers it is still likely that any individual exposed multiple time is still only taken on a small percentage of the days of the year.

Use of sonar and other transducers would typically be transient and temporary. The majority of acoustic effects to mysticetes from sonar and other active sound sources during testing and training activities would be primarily from ASW events. It is important to note although ASW is one of the warfare areas of focus during MTEs, there are significant periods when active ASW sonars are not in use. Nevertheless, behavioral reactions are assumed more likely to be significant during MTEs than during other ASW activities due to the duration (*i.e.,* multiple days) and scale (*i.e.,* multiple sonar platforms) of the MTEs. In other words, in the range of potential behavioral effects that might expect to be part of a response that qualifies as an instance take (which by nature of the way it is modeled/counted, occurs within one day), the less severe end might include exposure to comparatively lower levels of a sound, at a detectably greater distance from the animal, for a few or several minutes, and that could result in a behavioral response such as avoiding an area that an animal would otherwise have chosen to move through or feed in for some amount of time or breaking off one or a few feeding bouts. The more severe end, which occurs a smaller amount of the time (when the animal gets close enough to the source to receive a comparatively higher level, is exposed continuously to one source for a longer time, or is exposed intermittently to different sources throughout a day) might result in an animal having a more severe flight response and leaving a larger area for a day or more or potentially losing feeding opportunities for a day. As noted in the Potential Effects section, there are multiple examples from behavioral response studies of odontocetes ceasing their feeding dives when exposed to sonar pulses at certain levels, but alternately, blue whales were less likely to show a visible response to sonar exposures at certain levels when feeding then they have been observed responding to when traveling.

Most Level B harassments to mysticetes from hull-mounted sonar (MF1) in the AFTT Study Area would result from received levels between 160 and 172 dB SPL (64 percent). Therefore, the majority of Level B takes are expected to be in the form of milder responses (*i.e.,* lower-level exposures that still rise to the level of take, but would likely be less severe in the range of responses that qualify as take) of a generally shorter duration. As mentioned earlier in this section, we anticipate more severe effects from takes when animals are exposed to higher received levels. Occasional milder behavioral reactions are unlikely to cause long-term consequences for individual animals or populations, and even if some smaller subset of the takes are in the form of a longer (several hours or a day) and more moderate response, because they are not expected to be repeated over sequential multiple days, impacts to individual fitness are not anticipated.

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

While MTEs may have a longer duration they are not concentrated in small geographic areas over that time period. MTES use thousands to 10s of thousands of square miles of ocean space during the course of the event. There is no Navy activity in the proposed action that is both long in duration (more than a day) and concentrated in the same location. For example, Goldbogen *et al.* (2013) indicated some horizontal displacement of deep foraging blue whales in response to simulated MFA sonar. Given these animals' mobility and large ranges, we would expect these individuals to temporarily select alternative foraging sites nearby until the exposure levels in their initially selected foraging area have decreased. Therefore, temporary displacement from initially selected foraging habitat is not expected to impact the fitness of any individual animals because we would expect suitable foraging to be available in close proximity.

Richardson *et al.* (1995) noted that avoidance (temporary displacement of an individual from an area) reactions are the most obvious manifestations of disturbance in marine mammals. Avoidance is qualitatively different from the startle or flight response, but also differs in the magnitude of the response (*i.e.,* directed movement, rate of travel, etc.). Oftentimes avoidance is temporary, and animals return to the area once the noise has ceased. Some mysticetes may avoid larger activities such as a MTE as it moves through an area, although these activities generally do not use the same training locations day-after-day during multi-day activities. Therefore, displaced animals could return quickly after the MTE finishes. Due to the limited number and broad geographic scope of MTEs, it is unlikely that most mysticetes would encounter a major training exercise more than once per year and no MTEs will occur in the Gulf of Mexico Planning Awareness Area. In the ocean, the use of sonar and other active acoustic sources is transient and is unlikely to expose the same population of animals repeatedly over a short period except around homeports and fixed instrumented ranges.

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, though we have analyzed the impacts that are anticipated to occur that we have therefore proposed to authorize. As noted previously, when an animal incurs a threshold shift, it occurs in the frequency from that of the source up to one octave above—this means that threshold shift caused by Navy sonar sources will typically occur in the range of 2–20 kHz, and if resulting from hull-mounted sonar, will be in the range of 3.5–7 kHz. The majority of mysticete vocalizations, including for right whales, occurs in frequencies below 1kHz, which means that TTS incurred by mysticetes will not interfere with conspecific communication. When we look in ocean areas where the Navy has been intensively training and testing with sonar and other active acoustic sources for decades, there is no data suggesting any long-term consequences to mysticetes from exposure to sonar and other active acoustic sources.

The Navy will implement mitigation areas that will avoid or reduce impacts to mysticetes and contains BIAs for large whales and critical habitat for NARW. The NARW is a small, at risk species with an ongoing UME. In order to mitigate the number and potential severity of any NARW takes, from November 15 through April 15, the Navy will not conduct LFAS/MFAS/HFAS, except for sources that will be minimized to the maximum extent practicable during helicopter dipping, navigation training, and object detection exercises within the Southeast NARW Mitigation Area. As discussed previously, the majority of takes result from exposure to the higher power hull-mounted sonar during major training exercises, which will not occur here. The activities that are allowed to occur such as those used for navigation training or object detection exercises use lower level sources that operate in a manner less likely to result in more concerning affects (*i.e.,* single sources for shorter overall amounts of time—*e.g.,* activity is less than two hours). Animals in these protected areas are engaged in important behaviors, either feeding or interacting with calves, during which if they were disturbed the impacts could be more impactful (*e.g.,* if whales were displaced from preferred feeding habitat for weeks, there could be energetic consequences more likely to lead to an adverse effects on fitness, or if exposure to activities caused a severe disturbance to a cow-calf pair that resulted in the pair becoming separated, it could increase the risk of predation for the calf). By limiting activities in these, the number of takes that would occur in areas is decreased and the probability of a more severe impact is reduced. The Southeast NARW Mitigation Area encompasses a portion of the NARW migration and calving areas identified by LaBrecque *et al.* (2015a) and a portion of the southeastern NARW critical habitat. Outside of the Southeast NARW

Mitigation Area, active sonar would be used for ASW activities and for pierside sonar testing at Kings Bay, Georgia. The best available density data for the AFTT Study Area shows that the areas of highest density are off the southeastern United States in areas that coincide with the Southeast NARW Mitigation Area. Therefore, the majority of active sonar use would occur outside of the areas of highest seasonal NARW density and important use off the southeastern United States. In addition, before transiting or conducting testing and training activities, the Navy will coordinate to obtain Early Warning System NARW sighting data to help vessels and aircraft reduce potential interactions with NARWs.

The Navy will also minimize the use of active sonar in the Northeast NARW Mitigation Area. Refer to Proposed Mitigation Measures for a description of the area. A limited number of torpedo activities (non-explosive) would be conducted in August and September. Many NARW will have migrated south out of the area by that time. Torpedo training or testing activities would not occur within 2.7 nmi of the Stellwagen Bank NMS which is critical habitat for NARW foraging. Stellwagen Bank NMS also provides feeding and nursery grounds for NARW, humpback, sei and fin whales. The Northeast NARW Mitigation Area also contains the NARW feedings BIAs (3), NARW mating BIA (1), and NARW critical habitat.

The large whale feeding BIAs are included in the Navy's Gulf of Maine Mitigation Area. The humpback whale (1), minke whale (2), fin whale (2), and sei whale (1) feeding BIAs are within the Gulf of Maine Mitigation Area where the Navy will not plan MTEs, and will not conduct more than 200 hrs of hull-mounted MFAS per year. The Northeast Mitigation Area, which is just south of the Gulf of Maine Mitigation Area, will also avoid MTEs to the maximum extent possible and not conduct more than four MTEs per year.

The Bryde's whale BIA is inclusive of the Gulf of Mexico Planning Awareness Mitigation Areas where the Navy will avoid planning MTEs (*i.e.,* Composite Training Unit Exercises or Fleet Exercises/Sustainment Exercises) involving the use of active sonar to the maximum extent practicable. The Navy will not conduct any major training exercises in the Gulf of Mexico Planning Awareness Mitigation Areas under the Proposed Activity.

As described previously there are three ongoing UMEs for NARW, humpback whales, and minke whales. There is significant concern regarding the status of the NARW, both because of the ongoing UME and because of the overall status of the stock. However, the Navy's mitigation measures make NARW mortality unlikely—and we do not propose to authorize such take—and the newly expanded mitigation areas further reduce the extent of potential behavioral disruption in areas that are important for NARW, hence reducing the significance of such disruption. NMFS also has concern regarding the UME for humpback whales. NMFS, in coordination with our stranding network partners, continue to investigate the recent mortalities, environmental conditions, and population monitoring to better understand how the recent humpback whale mortalities occurred. Ship speed reduction rules are in effect for commercial and large vessel during high concentrations of NARW, and require vessels greater than or equal to 65 feet in length to reduce speeds to 10 knots or less while entering or departing ports. While this rule was put into place primarily for the NARW presence in New England and Mid-Atlantic waters, it does benefit other whale species, such as humpback whales that are in those areas from November through July. NOAA is reviewing ship-tracking data to ensure compliance with the ship speed reduction rule around Cape Cod, New York, and the Chesapeake Bay areas. However, the Navy's mitigation measures make humpback mortality low to unlikely and therefore, NMFS proposes to authorize only one mortality over the entire five-year period of the rule. The UME for minke whales was recently declared. More research is needed on the preliminary findings of the necropsies. As part of the UME investigation process, NOAA is assembling an independent team of scientists to coordinate with the Working Group on Marine Mammal Unusual Mortality Events to review the data collected, sample stranded whales, and determine the next steps for the investigation.

In summary and as described above, the following information primarily supports our preliminary determination that the impacts resulting from Navy's activities are not expected to adversely affect the mysticete stocks taken through effects on annual rates of recruitment or survival:

- As described in the ''Serious Injury or Mortality'' section above, up to one serious injury or mortality over five years is proposed for authorization for large whales (see Table 70). As described above, the proposed mortality for humpback whale and sperm whale (North Atlantic stock) fall below the insignificance threshold, the proposed mortality for the sperm whale (Gulf of Mexico stock) and minke whale is below residual PBR, and while residual PBR is not known for blue whales (as total annual M/SI is unknown), no other fishery-related or ship strike mortalities are known to have occurred, so the total human-caused mortality is very low. The total human-caused mortality for fin and sei whales is already projected to exceed PBR even in the absence of additional mortality caused by the Navy. However, as discussed in greater detail previously, the ALWTRP is in place to reduce the likelihood of entanglement of large whales by trap/pot and gillnet fishing gear and NMFS is currently analyzing its effectiveness. When we consider the factors discussed above, the fact that the PBR metric is inherently conservative, and the fact that the Navy's potential incremental increase in the mortal takes is fractionally small (0.2 annually) are considered, NMFS believes that this single death over five years will not result in adverse impacts on annual rates of recruitment or survival.
- As described above, any PTS that may occur is expected to be of a small degree, and any TTS of a relatively small degree because of the unlikelihood that animals would be close enough for a long enough period of time to incur more severe PTS (for sonar) and the anticipated effectiveness of mitigation in preventing very close exposures for explosives. Further, as noted above, any threshold shift incurred from sonar would be in the frequency range of 2–20 kHz, which above the frequency of the majority of mysticete vocalizations, and therefore would not be expected to interfere with conspecific communication.
- While the majority of takes are caused by exposure during ASW activities the impacts from these exposures are not expected to have either significant or long-term effects because (and as discussed above):
  - ASW activities typically involve fast-moving assets (relative to marine mammal swim speeds) and individuals are not expected to be exposed either for long periods within a day or over many sequential days,
  - As discussed, the majority of the harassment takes result from hull-mounted sonar during MTEs. When distance cut offs for mysticetes are applied, this means that all of the takes from hull-mounted sonar (MF1) result from above exposure 160 dB. However, the majority (*e.g.,* 64 percent) of the takes results from exposures below 172 dB. The majority of the takes have a relatively lower likelihood to have severe impacts.

• For the total instances of all of the different types of takes, the numbers indicating the instances of total take as a percentage of abundance are between 7 and 118 percent over the whole Navy Study Area, and between 118 and 672 percent in the US EEZ alone (Table 72). While these percentages may seem high, when spread over the entire year and a very large range, the scale of the effects are such that over the whole Navy Study area, individuals are taken an average of 0 or 1–2 times per year, and some subset of these individuals in the US EEZ are taken an average of 1–7 times (based on the percentages above, respectively, but with some taken more or less). These averages allow that perhaps a smaller subset is taken with a slightly higher average and larger variability of highs and lows, but still with no reason to think that any individuals would be taken every day for weeks or months out of the year, much less on sequential days. These behavioral takes are not all expected to be of particularly high intensity and nor are they likely to occur over sequential days, which suggests that the overall scale of impacts for any individual would be relatively low.

• NMFS is very concerned about the status of the NARW stock, both because of the increased number of deaths and because of the health of the rest of the stock. However, the Navy's mitigation measures make ship strike unlikely (and it is unauthorized) and the newly expanded mitigation areas further reduce the behavioral disruption in areas that are important for NARW, hence reducing the likelihood of more severe impacts that would be more likely to lead to fitness impacts, as discussed above.

• The Navy's mitigation areas are inclusive of BIAs for mysticetes and will avoid or reduce the number and severity of impacts to these stocks (Table 72).

Consequently, the AFTT activities are not expected to adversely impact rates of recruitment or survival of any of the stocks of mysticete whales (Table 72 above in this section).

Sperm Whales, Dwarf Sperm Whales, and Pygmy Sperm Whales

In Table 73 below, for sperm whale, dwarf sperm whales, and pygmy sperm whales, we indicate the total annual mortality, Level A and Level B harassment, and a number indicating the instances of total take as a percentage of abundance. Overall, takes from Level A harassment (PTS and Tissue Damage) account for less than one percent of all total takes.

Table 73. Annual takes of Level B and Level A harassment, mortality for sperm whales, dwarf sperm whales, and pygmy sperm whales in the AFTT study area and number indicating the instances of total take as a percentage of stock abundance.

		Instances of indicated types of incidental take (not all takes represent separate individuals, especially for disturbance)					Total takes		Abundance		Instances of total take as percentage of abundance	
		Level B Harassment		Level A Harassment								
Species	Stock	Behavioral Disturbance	TTS (may also include disturbance)	PTS	Tissue Damage	Mortality	In EEZ	Inside and Outside EEZ	In EEZ	Inside and Outside EEZ	In EEZ	Inside and Outside EEZ
Suborder Odontoceti (toothed whales)												
Family Physeteridae (sperm whale)												
Sperm whale*	Gulf of Mexico Oceanic	1,107	25	0	0	0	1132	1132	2,114	2,114	54	54
	North Atlantic	22,229	627	3	1	0.2	22860	26740	3,950	61,700	579	43
Family Kogiidae (sperm whales)												
Dwarf sperm whale	Gulf of Mexico Oceanic	339	453	70	0	0	862	862	1,107	1,107	78	78
	Western North Atlantic	3,851	8,975	94	0	0	12920	13164	611	3,641	2116	362
Pygmy sperm whale	Northern Gulf of Mexico	339	453	70	0	0	862	862	1,107	1,107	78	78
	Western North Atlantic	3,851	8,975	94	0	0	12920	13164	611	3,641	2116	362

Note: Above we compare predicted takes to abundance estimates generated from the same underlying density estimate, versus abundance estimates from the SARs, which are not based on the same data and would not be appropriate for this purpose. Note that comparisons are made both within the EEZ only (where density estimates have lesser uncertainty and takes are notably greater) and across the whole Study Area (which offers a more comprehensive comparison for many stocks).

The annual mortality of 0.2 is because we expect no more than one mortality over the course of five years from vessel strikes as previously described above.

Sperm whales (*Physeter microcephalus*) are listed as endangered under the ESA and depleted under the MMPA. NMFS is currently engaged in an internal Section 7 consultation under the ESA and the outcome of that consultation will further inform our final decision.

As noted previously, the estimated takes represent instances of take, not the number of individuals taken, and in almost all cases—some individuals are expected to be taken more than one time, which means that the number of individuals taken is smaller than the total estimated takes. In other words, where the instances of take exceed 100 percent of the population, repeated takes of some individuals are predicted. Generally speaking, the higher the number of takes as compared to the population abundance, the more repeated takes of individuals are likely, and the higher the actual percentage of individuals in the population that are likely taken at least once in a year. We look at this comparative metric to give us a relative sense across species/stocks of where larger portions of the stocks are being taken by Navy activities and where there is a higher likelihood that the same individuals are being taken across multiple days and where that number of days might be higher. In the ocean, the use of sonar and other active acoustic sources is often transient and is unlikely to repeatedly expose the same individual animals within a short period, for example within one specific exercise, however, some repeated exposures across different activities could occur over the year, especially where events occur in the generally the same area with more resident species. In short, we expect that the total anticipated takes represent exposures of a smaller number of individuals of which some were exposed multiple times, but based on the nature of the Navy activities and the movement patterns of marine mammals, it is unlikely any particular subset would be taken over more than a few sequential days—*i.e.,* where repeated takes of individuals are likely to occur, they are more likely to result from non-sequential exposures from different activities and marine mammals are not predicted to be taken for more than a few days in a row, at most. As described elsewhere, the nature of the majority of the exposures would be expected to be of a less severe nature and based on the numbers it is still likely that any individual exposed multiple times is still only taken on a small percentage of the days of the year. For example, the number of dwarf sperm whale and pygmy sperm whale (Western North Atlantic stocks) takes in the US EEZ are notably higher as compared to the abundance in the US EEZ, suggesting that on average, 16 percent of the individuals that comprise the abundance in the US EEZ might be taken an average of 21 times per year based on the percentages above in Table 73. The greater likelihood is that not every individual is taken, or perhaps a smaller subset is taken with a slightly higher average and larger variability of highs and lows, but still with no reason to think that any individuals would be taken every day for months out of the year, much less on sequential days. In addition, although NMFS does not currently identify a trend for *Kogia spp.* populations, recent survey effort and stranding data show a simultaneous increase in at-sea abundance and strandings, suggesting growing *Kogia* spp. abundance (NMFS, 2011; 2013a; Waring *et al.,* 2007; 2013).

Most Level B harassments to sperm whales and *Kogia spp.* from hull-mounted sonar (MF1) in the AFTT Study Area would result from received levels between 160 and 166 dB SPL (66 percent). Therefore, the majority of Level B takes are expected to be in the form of milder responses (*i.e.,* lower-level exposures that still rise to the level of take, but would likely be less severe in the range of responses that qualify as take) of a generally shorter duration. As mentioned earlier in this section, we anticipate more severe effects from takes when animals are exposed to higher received levels. Occasional milder behavioral reactions are unlikely to cause long-term consequences for individual animals or populations, and even if some smaller subset of the takes are in the form of a longer (several hours or a day) and more moderate response, because they are not expected to be repeated over sequential multiple days, impacts to individual fitness are not anticipated.

Sperm whales have shown resilience to acoustic and human disturbance, although they may react to sound sources and activities within a few kilometers. Sperm whales that are exposed to activities that involve the use of sonar and other active acoustic sources may alert, ignore the stimulus, avoid the area by swimming away or diving, or display aggressive behavior (Richardson, 1995; Nowacek, 2007; Southall *et al.,* 2007; Finneran and Jenkins, 2012). Some (but not all) sperm whale vocalizations might overlap with the MFAS/HFAS TTS frequency range, which could temporarily decrease an animal's sensitivity to the calls of conspecifics or returning echolocation signals. However, as noted previously, NMFS does not anticipate TTS of a long duration or severe degree to occur as a result of exposure to MFAS/HFAS. Recovery from a threshold shift (TTS) can take a few minutes to a few days, depending on the exposure duration, sound exposure level, and the magnitude of the initial shift, with larger threshold shifts and longer exposure durations requiring longer recovery times (Finneran *et al.,* 2005; Mooney *et al.,* 2009a; Mooney *et al.,* 2009b; Finneran and Schlundt, 2010).

The quantitative analysis predicts a few PTS per year from sonar and other transducers (during training and testing activities); however, *Kogia* whales would likely avoid sound levels that could cause higher levels of TTS (greater than 20 dB) or PTS. TTS and PTS thresholds for high-frequency cetaceans, including *Kogia* whales, are lower than for all other marine mammals, which leads to a higher number of estimated impacts relative to the number of animals exposed to the sound as compared to other hearing groups (*e.g.,* mid-frequency cetaceans).

The Navy will implement a mitigation area that will avoid or reduce impacts to sperm whales (*Physeter microcephalus*). Nearly the entire important sperm whale habitat (Mississippi Canyon) is included in the Gulf of Mexico Mitigation Area where the Navy will avoid planning MTEs involving the use of active sonar to the maximum extent practical.

In summary and as described above, the following factors primarily support our preliminary determination that the impacts resulting from Navy's activities are not expected to adversely affect sperm whales and *Kogia spp.* through effects on annual rates of recruitment or survival:

- As described in the ''Serious Injury or Mortality'' section above, up to one mortality over five years (0.2 annually) is proposed for authorization for sperm whales (either Gulf of Mexico or North Atlantic stocks). The proposed serious injury or mortality for sperm whales falls below the insignificant threshold for the North Atlantic stock. It does not fall below the insignificance threshold for the Gulf of Mexico stock, but is below residual PBR, which means that the total anticipated human-caused mortality is not expected to exceed PBR. Historically, one possible sperm whale mortality due to a vessel strike has been documented for the Gulf of Mexico in 1990. NMFS believes that this single death over five years will not result in adverse impacts on annual rates of recruitment or survival.
- As described above, any PTS that may occur is expected to be of a relatively smaller degree because of the unlikelihood that animals would be close enough for a long enough amount of time to incur more severe PTS (for sonar) and the anticipated effectiveness of mitigation in preventing very close exposures for explosives.
- Large threshold shifts are not anticipated for these activities because of the unlikelihood that animals will remain within the ensonified area (due to the short duration of the majority of exercises, the speed of the vessels (relative to marine mammals swim speeds), and the short distance within which the animal would need to approach the sound source) at high levels for the duration necessary to induce larger threshold shifts.
- While the majority of takes are caused by exposure during ASW activities, the impacts from these exposures are not expected to have either significant or long-term effects because (and as discussed above):
  - ASW activities typically involve fast-moving assets (relative to marine mammal swim speeds) and individuals are not expected to be exposed either for long periods within a day or over many sequential days,
  - As discussed, the majority of the harassment takes result from hull-mounted sonar during MTEs. When distance cut offs are applied for odontecetes, this means that all of the takes from hull-mounted sonar (MF1) result from above exposure 160 dB. However, the majority (*e.g.,* 66 percent) of the takes results from exposures below 166 dB. The majority of the takes have a relatively lower likelihood in have severe impacts.

• For the total instances of all of the different types of takes, the numbers indicating the instances of total take as a percentage of abundance are between 54 and 362 percent over the whole Navy Study Area, and between 54 and 579 percent in the US EEZ alone for all species except the Western North Atlantic dwarf and pygmy sperm whales, which are 2116 (Table 73). While these percentages may seem high, when spread over the entire year and a very large range, the scale of the effects are such that over the whole Navy Study area, individuals are taken an average of 0 or 1–4 times per year, and some subset of these individuals for all but pygmy and dwarf sperm whales in the US EEZ are taken an average of 1–6 times (based on the percentages above, respectively, but with some taken more or less). A subset of dwarf and pygmy sperm whales in the US EEZ (about 16 percent of the total abundance of the Navy Study Area) could be taken an average of 21 times each. These averages allow that perhaps a smaller subset is taken with a slightly higher average and larger variability of highs and lows, but still with no reason to think that any individuals would be taken every day for weeks or months out of the year, much less on sequential days. These behavioral takes are not all expected to be of particularly high intensity and nor are they likely to occur over sequential days, which suggests that the overall scale of impacts for any individual would be relatively low.

• For the endangered sperm whale (Gulf of Mexico), additional mitigation measures further reduce the likelihood of behavioral disruption in areas that are important for sperm whales. Nearly the entire important sperm whale habitat (Mississippi Canyon) is included in the Gulf of Mexico Mitigation Area.

• *Kogia spp.* are not depleted under the MMPA, nor are they listed under the ESA. Although NMFS does not currently identify a trend for *Kogia spp.* populations, recent survey effort and stranding data show a simultaneous increase in at-sea abundance and strandings, suggesting growing *Kogia spp.* abundance (NMFS, 2011; 2013a; Waring *et al.,* 2007; 2013).

• The AFTT activities are not expected to occur in an area/time of specific importance for reproductive, feeding, or other known critical behaviors for sperm whales or *Kogia spp.* and there is no designated critical habitat in the AFTT Study Area.

Consequently, the AFTT activities are not expected to adversely impact rates of recruitment or survival of any of the analyzed stocks of sperm whales, dwarf sperm whales, or pygmy sperm whales (Table 73 above in this section).

Dolphins and Small Whales

In Table 74 below, for dolphins and small whales, we indicate the total annual mortality, Level A and Level B harassment, and a number indicating the instances of total take as a percentage of abundance. Overall, takes from Level A harassment (PTS and Tissue Damage) account for less than one percent of all total takes.

Table 74. Annual takes of Level B and Level A harassment, mortality for dolphins and small whales in the AFTT study area and number indicating the instances of total take as a percentage of stock abundance.

		Instances of indicated types of incidental take (not all takes represent separate individuals, especially for disturbance)					Total takes		Abundance		Instances of total take as percentage of abundance	
		Level B Harassment		Level A Harassment								
Species	Stock	Behavioral Disturbance	TTS (may also include disturbance)	PTS	Tissue Damage	Mortality	In EEZ	Inside and Outside EEZ	In EEZ	Inside and Outside EEZ	In EEZ	Inside and Outside EEZ
Suborder Odontoceti (toothed whales)												
Atlantic spotted dolphin	Northern Gulf of Mexico	69,225	3,610	3	0	0	72838	72838	47,676	47,676	153	153
	Western North Atlantic	198,387	18,832	26	6	0	217251	235053	52,118	250,648	417	94
Atlantic white sided dolphin	Western North Atlantic	42,894	2,158	7	3	0.2	45062	47147	14,332	137,305	314	34
Bottlenose dolphin	Choctawhatchee Bay	941	32	0	0	0	973	973	99	99	984	984
	Gulf of Mexico Eastern Coastal	42	0	0	0	0	42	42	9,888	9,888	0	0
	Gulf of Mexico Northern Coastal	15,644	834	2	0	0	16480	16480	8,476	8,476	194	194
	Gulf of Mexico Western Coastal	7,191	635	0	0	0	7826	7826	33,903	33,903	23	23
	Indian River Lagoon Estuarine System	255	31	0	0	0	286	286	36	36	790	790
	Jacksonville Estuarine System	74	13	0	0	0	87	87	27	27	320	320
	Mississippi Sound, Lake Borgne, Bay Boudreau	1	0	0	0	0	1	1	198	198	1	1
	Northern Gulf of Mexico Continental Shelf	121,223	6,287	15	1	0	127526	127526	72,043	72,043	177	177
	Northern Gulf of Mexico Oceanic	13,947	706	8	2	0	14663	14663	18,364	18,364	80	80
	Northern North Carolina Estuarine System	2,844	483	0	0	0	3327	3327	3,622	3,622	92	92
	Southern North Carolina Estuarine System	0	0	0	0	0	0	0	0	0	0	/
	Western North Atlantic Northern Florida Coastal	1,145	90	0	0	0	1235	1235	906	906	136	136
	Western North Atlantic Central Florida Coastal	7,100	513	0	0	0	7613	7613	4,528	4,528	168	168
	Western North Atlantic Northern Migratory Coastal	33,993	3,051	7	0	0	37051	37051	9,962	9,962	372	372
	Western North Atlantic Offshore	389,543	34,500	77	9	0	424129	431022	64,298	186,260	660	231
	Western North Atlantic South Carolina/Georgia Coastal	5,544	416	0	0	0	5960	5960	3,622	3,622	165	165
	Western North Atlantic Southern Migratory Coastal	15,411	1,305	2	0	0	16718	16718	7,245	7,245	231	231
Clymene dolphin	Northern Gulf of Mexico	4,174	99	5	2	0	4280	4280	10,942	10,942	39	39
	Western North Atlantic	90,269	7,353	10	3	0	97635	111052	15,370	171,202	635	65
False killer whale	Northern Gulf of Mexico	1,902	72	1	0	0	1975	1975	3,136	3,136	63	63
	Western North Atlantic	10,655	839	0	0	0	11494	12402	1,254	16,144	917	77
Fraser's dolphin	Northern Gulf of Mexico	1,123	58	2	1	0	1184	1184	1,637	1,637	72	72
	Western North Atlantic	4,070	258	0	0	0	4328	5637	411	17,588	1053	32
Killer whale	Northern Gulf of Mexico	33	0	0	0	0	33	33	176	176	19	19
	Western North Atlantic	109	6	0	0	0	115	122	15	472	767	26
Long-finned pilot whale	Western North Atlantic	33,440	1,577	7	1	0	35025	38810	3,863	447,431	907	9
Melon-headed whale	Northern Gulf of Mexico	3,067	66	3	1	0	3137	3137	6,725	6,725	47	47
	Western North Atlantic	47,715	3,673	3	0	0	51391	55537	5,821	69,526	883	80
Pantropical spotted dolphin	Northern Gulf of Mexico	25,924	596	15	6	0.2	26541	26541	82,055	82,055	32	32
	Western North Atlantic	191,781	14,576	8	1	0	206366	232860	30,088	275,964	686	84
Pygmy killer whale	Northern Gulf of Mexico	720	16	1	0	0	737	737	2,062	2,062	36	36
	Western North Atlantic	8,232	604	0	0	0	8836	9660	1,052	12,296	840	79
Risso's dolphin	Northern Gulf of Mexico	1,647	43	1	0	0	1691	1691	3,096	3,096	55	55
	Western North Atlantic	38,336	2,194	2	0	0	40532	41497	5,601	39,085	724	106
Rough-toothed dolphin	Northern Gulf of Mexico	3,849	177	1	1	0	4028	4028	4,824	4,824	83	83
	Western North Atlantic	24,848	2,407	0	0	0	27255	29138	2,793	34,768	976	84
Short-beaked common dolphin	Western North Atlantic	540,513	30,552	101	36	1.2	571203	571464	73,481	520,317	777	110
Short-finned pilot whale	Northern Gulf of Mexico	1,835	26	3	0	0	1864	1864	2,032	2,032	92	92
	Western North Atlantic	38,691	2,334	5	1	0	41031	54640	6,578	450,146	624	12
Spinner dolphin	Northern Gulf of Mexico	7,803	277	31	14	0.2	8125	8125	13,653	13,653	60	60
	Western North Atlantic	94,193	8,105	5	1	0	102304	110540	11,280	135,573	907	82
Striped dolphin	Northern Gulf of Mexico	2,449	69	2	1	0	2521	2521	4,871	4,871	52	52
	Western North Atlantic	165,832	11,292	16	4	0	177144	202821	52,222	322,542	339	63
White-beaked dolphin	Western North Atlantic	80	4	0	0	0	84	84	42	42	200	200

Note: Above we compare predicted takes to abundance estimates generated from the same underlying density estimate, versus abundance estimates from the SARs, which are not based on the same data and would not be appropriate for this purpose. Note that comparisons are made both within the EEZ only (where density estimates have lesser uncertainty and takes are notably greater) and across the whole Study Area (which offers a more comprehensive comparison for many stocks).

The annual mortality of 0.2 is because we expect no more than one mortality over the course of five years from vessel strikes as previously described above.

As noted previously, the estimated takes represent instances of take, not the number of individuals taken, and in almost all cases—some individuals are expected to be taken more than one time, which means that the number of individuals taken is smaller than the total estimated takes. In other words, where the instances of take exceed 100 percent of the population, repeated takes of some individuals are predicted. Generally speaking, the higher the number of takes as compared to the population abundance, the more repeated takes of individuals are likely, and the higher the actual percentage of individuals in the population that are likely taken at least once in a year. We look at this comparative metric to give us a relative sense across species/stocks of where larger portions of the stocks are being taken by Navy activities and where there is a higher likelihood that the same individuals are being taken across multiple days and where that number of days might be higher. In the ocean, the use of sonar and other active acoustic sources is often transient and is unlikely to repeatedly expose the same individual animals within a short period, for example within one specific exercise, however, some repeated exposures across different activities could occur over the year, especially where events occur in the generally the same area with more resident species. In short, we expect that the total anticipated takes represent exposures of a smaller number of individuals of which some were exposed multiple times, but based on the nature of the Navy activities and the movement patterns of marine mammals, it is unlikely any particular subset would be taken over more than a few sequential days—*i.e.,* where repeated takes of individuals are likely to occur, they are more likely to result from non-sequential exposures from different activities and marine mammals are not predicted to be taken for more than a few days in a row, at most. As described elsewhere, the nature of the majority of the exposures would be expected to be of a less severe nature and based on the numbers it is still likely that any individual exposed multiple times is still only taken on a small percentage of the days of the year. For example, for Choctawatchee Bay stock of bottlenose dolphins, takes in the US EEZ are notably higher as compared to the abundance in the US EEZ, suggesting that on average, individuals might be taken an average of 10 times per year based on the percentages above. The greater likelihood is that not every individual is taken, or perhaps a smaller subset is taken with a slightly higher average and larger variability of highs and lows, but still with no reason to think that any individuals would be taken every day for months out of the year, much less on sequential days. For other stocks, Fraser's dolphin for example (Western North Atlantic stock), takes in the US EEZ are notably higher as compared to the abundance in the US EEZ, suggesting that on average, the 2–3 percent of the individuals that comprise the abundance in the US EEZ might be taken an average of 10 times per year based on the percentages above—but when takes are considered across the whole study area, they equate to only about 32 percent of the abundance, suggesting that no more than a third of the individuals would be taken and those that are would be only once a year on average.

Most Level B harassments to dolphins and small whales from hull-mounted sonar (MF1) in the AFTT Study Area would result from received levels between 160 and 166 dB SPL (66 percent). Therefore, the majority of Level B takes are expected to be in the form of milder responses (*i.e.,* lower-level exposures that still rise to the level of take, but would likely be less severe in the range of responses that qualify as take) of a generally shorter duration. As mentioned earlier in this section, we anticipate more severe effects from takes when animals are exposed to higher received levels. Occasional milder behavioral reactions are unlikely to cause long-term consequences for individual animals or populations, and even if some smaller subset of the takes are in the form of a longer (several hours or a day) and more moderate response, because they are not expected to be repeated over sequential multiple days, impacts to individual fitness are not anticipated.

Research and observations show that if delphinids are exposed to sonar or other active acoustic sources they may react in a number of ways depending on their experience with the sound source and what activity they are engaged in at the time of the acoustic exposure. Delphinids may not react at all until the sound source is approaching within a few hundred meters to within a few kilometers depending on the environmental conditions and species. Delphinids that are exposed to activities that involve the use of sonar and other active acoustic sources may alert, ignore the stimulus, change their behaviors or vocalizations, avoid the sound source by swimming away or diving, or be attracted to the sound source (Richardson, 1995; Nowacek, 2007; Southall *et al.,* 2007; Finneran and Jenkins, 2012).

Many of the recorded delphinid vocalizations overlap with the MFAS/HFAS TTS frequency range (2–20 kHz); however, as noted above, NMFS does not anticipate TTS of a serious degree or extended duration to occur as a result of exposure to MFAS/HFAS.

Of the BIAs for small and resident populations of bottlenose dolphin (Gulf of Mexico and East Coast), these identified areas are within bays and estuaries where the Navy does not use explosives and conduct limited activities by sonar and other transducers. For example, in the Northern North Carolina Estuarine dolphins (BIA), one-third of the takes are from sub-navigation and ship object avoidance (less impactful sonar activity) events which occur in/out of Chesapeake Bay. This area is on the northern border of this BIA which further reduces the possibility of modeled takes that would result in significant impacts. The other two-thirds of the takes for the Northern North Carolina Estuarine dolphins are from Civilian Port Defense which would occur at most only once in five years in the vicinity of that BIA. Similarly, for the Indian River Lagoon Estuarine system bottlenose dolphins (BIA), all the level B takes are from also from the less impactful sonar activity of sub-navigation and ship object avoidance and are events of short duration (approx. 30 minutes). Two small and resident populations of bottlenose dolphin BIAs (Northern North Carolina Estuarine System and Southern North Carolina Estuarine System) may be impacted during pile driving activities for the Elevated Causeway System at Marine Corps Base Camp Lejeune, North Carolina; however, only one modeled take of a Northern North Carolina Estuarine System bottlenose dolphin is predicted. There are no modeled takes from any activities to Southern North Carolina Estuarine System bottlenose dolphins (BIA) and only one modeled take to Mississippi Sound BIA from sonar. No takes are predicted from airguns for any bottlenose dolphin BIAs. Therefore, impacts are expected to be short-term and minor by Level B harassment and mostly all behavioral takes. Abandonment of the area would not be anticipated to the small and resident bottlenose dolphin populations (BIAs) from the Navy's training and testing activities.

One of these BIAs, the bottlenose dolphin of Barataria Bay, Louisiana (and showing persistent impacts by the Cetacean UME in the Northern Gulf of Mexico) were recently fitted with satellite-linked transmitters, showing that most dolphins remained within the bay, while those that entered nearshore coastal waters remained within 1.75 km (Wells *et al.,* 2017). While the Navy's activities are very limited in this type of habitat, the Navy is not conducting training or testing where Barataria Bay dolphins inhabit and therefore no takes will occur to this stock.

In summary and as described above, the following factors primarily support our preliminary determination that the impacts resulting from Navy's activities are not expected to adversely affect dolphins and small whales taken through effects on annual rates of recruitment or survival:

• As described in the ''Serious Injury or Mortality'' section (Table 71), up to nine serious injuries or mortalities over five years are proposed for authorization for four species of dolphins (short-beaked common dolphin, Atlantic white-sided dolphin, pantropical spotted dolphin, and spinner dolphins). However, the proposed serious injury or mortality for these species falls below the insignificance threshold, and, therefore, we consider the addition an insignificant incremental increase to human-caused mortality.

• As described above, any PTS that may occur is expected to be of a relatively smaller degree because of the unlikelihood that animals would be close enough for a long enough amount of time to incur more severe PTS (for sonar) and the anticipated effectiveness of mitigation in preventing very close exposures for explosives.

• While the majority of takes are caused by exposure during ASW activities, the impacts from these exposures are not expected to have either significant or long-term effects because (and as discussed above):

○ ASW activities typically involve fast-moving assets (relative to marine mammal swim speeds) and individuals are not expected to be exposed either for long periods within a day or over many sequential days.

○ As discussed, the majority of the harassment takes result from hull-mounted sonar during MTEs. When distance cut offs are applied for odontecetes, this means that all of the takes from hull-mounted (MF1) sonar result from above exposure 160 dB. However, the majority (*e.g.,* 66 percent) of the takes results from exposures below 166 dB. The majority of the takes have a relatively lower likelihood to have severe impacts.

• For the total instances of all of the different types of takes, the numbers indicating the instances of total take as a percentage of abundance are between 1 and 984 percent over the whole Navy Study Area (with more than half the stocks being under 100), and between 1 and 1053 percent in the US EEZ alone (Table 74). While these percentages may seem high, when spread over the entire year and a very large range, the scale of the effects are such that over the whole Navy Study area, individuals are taken an average of 0 or 1–10 times per year (with the majority closer to 1), and some subset of these individuals in the US EEZ are taken an average of 1–11 times (based on the percentages above, respectively, but with some taken more or less). These averages allow that perhaps a smaller subset is taken with a slightly higher average and larger variability of highs and lows, but still with no reason to think that any individuals would be taken every day for weeks or months out of the year, much less on sequential days. These behavioral takes are not all expected to be of particularly high intensity and nor are they likely to occur over sequential days, which suggests that the overall scale of impacts for any individual would be relatively low.

• Of the BIAs for small and resident populations of bottlenose dolphin BIAs (Gulf of Mexico and East Coast), these identified areas are within bays and estuaries where the Navy does not use explosives nor generally train/test with sonar and other transducers. Therefore, impacts are short-term and minor mostly due to Level B harassment behavioral takes. Significant impacts are not anticipated to the small and resident bottlenose dolphin populations (BIAs) from the Navy's training and testing activities.

• No takes are anticipated or authorized for the Barataria Bay dolphins (one of the BIAs for bottlenose dolphin and showing persistent impacts by the Cetacean UME in the Northern Gulf of Mexico).

• The AFTT activities are not expected to occur routinely in an area/time of specific importance for reproductive, feeding, or other known critical behaviors for delphinids. Stocks of delphinid species found in the AFTT Study Area are not depleted under the MMPA, nor are they listed under the ESA.

Consequently, the activities are not expected to adversely impact rates of recruitment or survival of any of the stocks of analyzed delphinid species (Table 74, above in this section).

Porpoises

In Table 75, below for porpoises, we indicate the total annual mortality, Level A and Level B harassment, and a number indicating the instances of total take as a percentage of abundance. Overall, takes from Level A harassment (PTS and Tissue Damage) account for less than one percent of all total takes.

Table 75. Annual takes of Level B and Level A harassment, mortality for porpoises in the AFTT study area and number indicating the instances of total take as a percentage of stock abundance.

		Instances of indicated types of incidental take (not all takes represent separate individuals, especially for disturbance)					Total takes		Abundance		Instances of total take as percentage of abundance	
		Level B Harassment		Level A Harassment								
Species	Stock	Behavioral Disturbance	TTS (may also include disturbance)	PTS	Tissue Damage	Mortality	In EEZ	Inside and Outside EEZ	In EEZ	Inside and Outside EEZ	In EEZ	Inside and Outside EEZ
Suborder Odontoceti (toothed whales)												
Family Phocoenidae (porpoises)												
Harbor porpoise	Gulf of Maine/Bay of Fundy	137,509	26,510	471	0	0	164490	166392	16,552	195,727	994	85

Note: Above we compare predicted takes to abundance estimates generated from the same underlying density estimate, versus abundance estimates from the SARs, which are not based on the same data and would not be appropriate for this purpose. Note that comparisons are made both within the EEZ only (where density estimates have lesser uncertainty and takes are notably greater) and across the whole Study Area (which offers a more comprehensive comparison for many stocks).

Nearly 100 percent of takes annually for harbor porpoises are from Level B harassment either behavioral or TTS (less than 1 percent for PTS) (Table 75 above). No mortalities are anticipated. As noted previously, the estimated takes represent instances of take, not the number of individuals taken, and in almost all cases—some individuals are expected to be taken more than one time, which means that the number of individuals taken is smaller than the total estimated takes. In other words, where the instances of take exceed 100 percent of the population, repeated takes of some individuals are predicted. Generally speaking, the higher the number of takes as compared to the population abundance, the more repeated takes of individuals are likely, and the higher the actual percentage of individuals in the population that are likely taken at least once in a year. We look at this comparative metric to give us a relative sense across species/stocks of where larger portions of the stocks are being taken by Navy activities and where there is a higher likelihood that the same individuals are being taken across multiple days and where that number of days might be higher. In the ocean, the use of sonar and other active acoustic sources is often transient and is unlikely to repeatedly expose the same individual animals within a short period, for example within one specific exercise, however, some repeated exposures across different activities could occur over the year, especially where events occur in the generally the same area with more resident species. In short, we expect that the total anticipated takes represent exposures of a smaller number of individuals of which some were exposed multiple times, but based on the nature of the Navy activities and the movement patterns of marine mammals, it is unlikely any particular subset would be taken over more than a few sequential days—*i.e.,* where repeated takes of individuals are likely to occur, they are more likely to result from non-sequential exposures from different activities and marine mammals are not predicted to be taken for more than a few days in a row, at most. As described elsewhere, the nature of the majority of the exposures would be expected to be of a less severe nature and based on the numbers it is still likely that any individual exposed multiple times is still only taken on a small percentage of the days of the year. For harbor porpoise, takes in the US EEZ are notably higher as compared to the abundance in the US EEZ, suggesting that on average, the 8 percent of the individuals that comprise the abundance in the US EEZ might be taken an average of 10 times per year based on the percentages above—but when takes are considered across the whole Study area, they equate to only about 85 percent of the abundance, suggesting that not all individuals will be taken every year, and those that are would be only once a year on average.

The greater likelihood is that not every individual is taken or perhaps a smaller subset is taken with a slightly higher average and larger variability of highs and lows, but still with no reason to think that any individuals would be taken every day for months out of the year, much less on sequential days.

Most Level B harassments to harbor porpoise from hull-mounted sonar (MF1) in the AFTT Study Area would result from received levels between 154 and 160 dB SPL (59 percent). Therefore, the majority of Level B takes are expected to be in the form of milder responses (*i.e.,* lower-level exposures that still rise to the level of take, but would likely be less severe in the range of responses that qualify as take) of a generally shorter duration. As mentioned earlier in this section, we anticipate more severe effects from takes when animals are exposed to higher received levels. Occasional milder behavioral reactions are unlikely to cause long-term consequences for individual animals or populations, and even if some smaller subset of the takes are in the form of a longer (several hours or a day) and more moderate response, because they are not expected to be repeated over sequential multiple days, impacts to individual fitness are not anticipated.

The number of harbor porpoise behaviorally harassed by exposure to LFAS/MFAS/HFAS in the AFTT Study Area is generally higher than the other species. Of note, harbor porpoises have been shown to be particularly sensitive to sound and therefore have been assigned a lower harassment threshold, *i.e.,* a more distant distance cutoff (40 km for high source level, 20 km for moderate source level). This means that many of the authorized takes are expected to result from lower-level exposures, but we also note the growing literature to support the fact that marine mammals differentiate sources of the same level emanating from different distances, and exposures from more distant sources are likely comparatively less impactful. 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.

A small and resident population area for harbor porpoises identified by LaBrecque *et al.* (2015a, 2015b) overlaps a portion of the northeast corner of the Northeast Range Complexes. Navy testing activities that use sonar and other transducers could occur year round within the Northeast Range Complexes. The harbor porpoise BIA is included in the Gulf of Maine Mitigation Area where the Navy will not plan MTEs (Composite Training Unit or Fleet/Sustainment Exercises) and will not conduct more than 200 hrs of hull-mounted MFAS per year. As discussed above, harbor porpoise reactions to sonar could be significant in some cases. Due to the limited overlap of the identified harbor porpoise area and the Northeast Range Complexes, only a subset of estimated behavioral reactions would occur within the identified harbor porpoise small and resident population area. It is unlikely that these behavioral reactions would have significant impacts on the natural behavior of harbor porpoises or cause abandonment of the harbor porpoise small and resident population area identified by LaBrecque *et al.* (2015a, 2015b). Due to the intermittent nature of explosive activities that could take place within the identified harbor porpoise area, significant impacts to natural behaviors within or abandonment of the small and resident population area for harbor porpoises are not anticipated.

Animals that experience hearing loss (TTS or PTS) may have reduced ability to detect relevant sounds such as predators, prey, or social vocalizations. Some porpoise vocalizations might overlap with the MFAS/HFAS TTS frequency range (2–20 kHz). Recovery from a threshold shift (TTS; partial hearing loss) can take a few minutes to a few days, depending on the exposure duration, sound exposure level, and the magnitude of the initial shift, with larger threshold shifts and longer exposure durations requiring longer recovery times (Finneran *et al.,* 2005; Mooney *et al.,* 2009a; Mooney *et al.,* 2009b; Finneran and Schlundt, 2010). More severe shifts may not fully recover and thus would be considered PTS.

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 species is wary of human activity and will display profound avoidance behavior for anthropogenic sound sources in many situations at levels down to 120 dB re 1 µPa (Southall, 2007). Harbor porpoises routinely avoid and swim away from large motorized vessels (Barlow *et al.,* 1988; Evans *et al.,* 1994; Palka and Hammond, 2001; Polacheck and Thorpe, 1990). Harbor porpoises may startle and temporarily leave the immediate area of the training or testing until after the event ends.

ASW training activities using hull mounted sonar proposed for the AFTT Study Area generally last for only a few hours. Some ASW exercises can generally last for 2–10 days, or as much as 21 days for an MTE-Large Integrated ASW (see Table 1.3–1 of the Navy's rulemaking and LOA application). For these multi-day exercises there will be extended intervals of non-activity in between active sonar periods. In addition, the Navy does not typically conduct ASW activities in the same locations. Given the average length of ASW events (times of continuous sonar use) and typical vessel speed, combined with the fact that the majority of porpoises in the AFTT Study Area would not likely remain in an area for successive days, it is unlikely that an animal would be exposed to active sonar at levels likely to result in a substantive response (*e.g.,* interruption of feeding) that would then be carried on for more than one day or on successive days.

In summary and as described above, the following factors primarily support our preliminary determination that the impacts resulting from Navy's activities are not expected to adversely affect harbor porpoises taken through effects on annual rates of recruitment or survival:

- No mortalities of harbor porpoises are proposed for authorization or anticipated to occur.
- As described above, any PTS that may occur is expected to be of a relatively smaller degree because of the unlikelihood that harbor porpoise would be close enough for a long enough amount of time to incur more severe PTS (for sonar) and the anticipated effectiveness of mitigation in preventing very close exposures for explosives.
- While the majority of takes are caused by exposure during ASW activities, the impacts from these exposures are not expected to have either significant or long-term effects because (and as discussed above):
  - ASW activities typically involve fast-moving assets (relative to marine mammal swim speeds) and individuals are not expected to be exposed either for long periods within a day or over many sequential days.
  - As discussed, the majority of the harassment takes result from hull-mounted sonar during MTEs. When distance cut offs are applied for harbor porpoise, this means that all of the takes from hull-mounted sonar (MF1) result from above exposure 154 dB. However, the majority (*e.g.,* 59 percent) of the takes results from exposures below 160 dB. The majority of the takes have a relatively lower likelihood to have severe impacts.
- For the total instances of all of the different types of takes, the number indicating the instances of total take as a percentage of abundance is 994 percent over the whole Navy Study Area, and 85 percent in the US EEZ alone (Table 75). While these percentages may seem high, when spread over the entire year and a very large range, the scale of the effects are such that over the whole Navy Study area, individuals are taken an average of 0 or 1 times per year, and the 8 percent of these individuals in the US EEZ are taken an average of 10 times (based on the percentages above in Table 75, respectively, but with some taken more or less). These averages allow that perhaps a smaller subset is taken with a slightly higher average and larger variability of highs and lows, but still with no reason to think that any individuals would be taken every day for weeks or months out of the year, much less on sequential days. These behavioral takes are not all expected to be of particularly high intensity and nor are they likely to occur over sequential days, which suggests that the overall scale of impacts for any individual would be relatively low.
- The AFTT activities could occur in areas important for harbor porpoises; however, due to the geographic dispersion and limited duration of those activities, they are unlikely to have a significant impact on feeding, reproduction, or other known critical behaviors.
- Harbor porpoise found in the AFTT Study Area are not depleted under the MMPA, nor are they listed under the ESA.
- The harbor porpoise BIA is included in the Gulf of Maine Mitigation Area where the Navy will not plan MTEs (Composite Training Unit or Fleet/Sustainment Exercises) and will not conduct more than 200 hrs of hull-mounted MFAS per year.

Consequently, the activities are not expected to adversely impact rates of recruitment or survival of any of the analyzed harbor porpoise stocks (Table 65).

Beaked Whales

In Table 76 below, for beaked whales, we indicate the total annual mortality, Level A and Level B harassment, and a number indicating the instances of total take as a percentage of abundance. Overall, takes from Level A harassment (PTS and Tissue Damage) account for less than one percent of all total takes.

Table 76. Annual takes of Level B and Level A harassment, mortality for beaked whales in the AFTT study area and number indicating the instances of total take as a percentage of stock abundance.

		Instances of indicated types of incidental take (not all takes represent separate individuals, especially for disturbance)					Total takes		Abundance		Instances of total take as percentage of abundance	
		Level B Harassment		Level A Harassment								
Species	Stock	Behavioral Disturbance	TTS (may also include disturbance)	PTS	Tissue Damage	Mortality	In EEZ	Inside and Outside EEZ	In EEZ	Inside and Outside EEZ	In EEZ	Inside and Outside EEZ
Suborder Odontoceti (toothed whales)												
Family Ziphiidae (beaked whales)												
Blainville's beaked whale	Northern Gulf of Mexico	1,420	8	0	0	0	1428	1428	966	966	148	148
	Western North Atlantic	20,931	190	1	0	0	21122	24263	1,274	14,277	1658	170
Cuvier's beaked whale	Northern Gulf of Mexico	1,487	8	0	0	0	1495	1495	966	966	155	155
	Western North Atlantic	77,321	696	3	0	0	78020	89408	4,704	52,716	1659	170
Gervais' beaked whale	Northern Gulf of Mexico	1,420	8	0	0	0	1428	1428	966	966	148	148
	Western North Atlantic	20,931	190	1	0	0	21122	24263	1,274	14,277	1658	170
Northern bottlenose whale	Western North Atlantic	1,906	4	0	0	0	1910	2118	100	688	1910	308
Sowersby's beaked whale	Western North Atlantic	20,960	190	1	0	0	21151	24292	1,274	14,277	1660	170
True's beaked whale	Western North Atlantic	20,960	190	1	0	0	21151	24292	1,274	14,277	1660	170

Note: Above we compare predicted takes to abundance estimates generated from the same underlying density estimate, versus abundance estimates from the SARs, which are not based on the same data and would not be appropriate for this purpose. Note that comparisons are made both within the EEZ only (where density estimates have lesser uncertainty and takes are notably greater) and across the whole Study Area (which offers a more comprehensive comparison for many stocks).

As noted previously, the estimated takes represent instances of take, not the number of individuals taken, and in almost all cases—some individuals are expected to be taken more than one time, which means that the number of individuals taken is smaller than the total estimated takes. In other words, where the instances of take exceed 100 percent of the population, repeated takes of some individuals are predicted. Generally speaking, the higher the number of takes as compared to the population abundance, the more repeated takes of individuals are likely, and the higher the actual percentage of individuals in the population that are likely taken at least once in a year. We look at this comparative metric to give us a relative sense across species/stocks of where larger portions of the stocks are being taken by Navy activities and where there is a higher likelihood that the same individuals are being taken across multiple days and where that number of days might be higher. In the ocean, the use of sonar and other active acoustic sources is often transient and is unlikely to repeatedly expose the same individual animals within a short period, for example within one specific exercise, however, some repeated exposures across different activities could occur over the year, especially where events occur in the generally the same area with more resident species. In short, we expect that the total anticipated takes represent exposures of a smaller number of individuals of which some were exposed multiple times, but based on the nature of the Navy activities and the movement patterns of marine mammals, it is unlikely any particular subset would be taken over more than a few sequential days—*i.e.,* where repeated takes of individuals are likely to occur, they are more likely to result from non-sequential exposures from different activities and marine mammals are not predicted to be taken for more than a few days in a row, at most. As described elsewhere, the nature of the majority of the exposures would be expected to be of a less severe nature and based on the numbers it is still likely that any individual exposed multiple times is still only taken on a small percentage of the days of the year. For the Atlantic stocks of beaked whales, takes in the US EEZ are notably higher as compared to the abundance in the US EEZ, suggesting that on average, for the 10 percent or less of the individuals that comprise the abundance in the US EEZ, they might be taken an average of 16–19 times per year based on the percentages above—but when takes are considered across the whole Study area, they equate to only about 170–308 percent of the abundance, suggesting that across the Study Area, individuals would be taken an average of 1–3 times per year. The greater likelihood is that not every individual is taken, or perhaps a smaller subset is taken with a slightly higher average and larger variability of highs and lows, but still with no reason to think that any individuals would be taken every day for weeks or months out of the year, much less on sequential days.

Most Level B harassments to beaked whales from hull-mounted sonar (MF1) in the AFTT Study Area would result from received levels between 148 and 160 dB SPL (91 percent). Therefore, the majority of Level B takes are expected to be in the form of milder responses (*i.e.,* lower-level exposures that still rise to the level of take, but would likely be less severe in the range of responses that qualify as take) of a generally shorter duration. As mentioned earlier in this section, we anticipate more severe effects from takes when animals are exposed to higher received levels. Occasional milder behavioral reactions are unlikely to cause long-term consequences for individual animals or populations, and even if some smaller subset of the takes are in the form of a longer (several hours or a day) and more moderate response, because they are not expected to be repeated over sequential multiple days, impacts to individual fitness are not anticipated.

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, *i.e.,* a more distant distance cutoff (50 km for high source level, 25 km for moderate source level). This means that many of the authorized takes are expected to result from lower-level exposures, but we also note the growing literature to support the fact that marine mammals differentiate sources of the same level emanating from different distances, and exposures from more distant sources are likely comparatively less impactful.

Behavioral responses can range from a mild orienting response, or a shifting of attention, to flight and panic (Richardson, 1995; Nowacek, 2007; Southall *et al.,* 2007; Finneran and Jenkins, 2012). Research has also shown that beaked whales are especially sensitive to the presence of human activity (Tyack *et al.,* 2011; Pirotta *et al.,* 2012). Beaked whales have been documented to exhibit avoidance of human activity or respond to vessel presence (Pirotta *et al.,* 2012). Beaked whales were observed to react negatively to survey vessels or low altitude aircraft by quick diving and other avoidance maneuvers, and none were observed to approach vessels (Wursig *et al.,* 1998). Some beaked whale vocalizations (*e.g.,* Northern bottlenose whale) may overlap with the MFAS/HFAS TTS frequency range (2–20 kHz); however, as noted above, NMFS does not anticipate TTS of a serious degree or extended duration to occur as a result of exposure to MFAS/HFAS.

It has been speculated for some time that beaked whales might have unusual sensitivities to sonar sound due to their likelihood of stranding in conjunction with MFAS use. Research and observations show that if beaked whales are exposed to sonar or other active acoustic sources they may startle, break off feeding dives, and avoid the area of the sound source to levels of 157 dB re 1 µPa, or below (McCarthy *et al.,* 2011). Acoustic monitoring during actual sonar exercises revealed some beaked whales continuing to forage at levels up to 157 dB re 1 µPa (Tyack *et al.* 2011). Stimpert *et al.* (2014) tagged a Baird's beaked whale, which was subsequently exposed to simulated MFAS. Changes in the animal's dive behavior and locomotion were observed when received level reached 127 dB re 1µPa. However, Manzano-Roth *et al.* (2013) found that for beaked whale dives that continued to occur during MFAS activity, differences from normal dive profiles and click rates were not detected with estimated received levels up to 137 dB re 1 µPa while the animals were at depth during their dives. And in research done at the Navy's fixed tracking range in the Bahamas, animals were observed to leave the immediate area of the anti-submarine warfare training exercise (avoiding the sonar acoustic footprint at a distance where the received level was ''around 140 dB'' SPL, according to Tyack *et al.* [2011]) but return within a few days after the event ended (Claridge and Durban, 2009; Moretti *et al.,* 2009, 2010; Tyack *et al.,* 2010, 2011; McCarthy *et al.,* 2011). Tyack *et al.* (2011) report that, in reaction to sonar playbacks, most beaked whales stopped echolocating, made long slow ascent to the surface, and moved away from the sound. A similar behavioral response study conducted in Southern California waters during the 2010–2011 field season found that Cuvier's beaked whales exposed to MFAS displayed behavior ranging from initial orientation changes to avoidance responses characterized by energetic fluking and swimming away from the source (DeRuiter *et al.,* 2013b). However, the authors did not detect similar responses to incidental exposure to distant naval sonar exercises at comparable received levels, indicating that context of the exposures (*e.g.,* source proximity, controlled source ramp-up) may have been a significant factor. The study itself found the results inconclusive and meriting further investigation. Cuvier's beaked whale responses suggested particular sensitivity to sound exposure as consistent with results for Blainville's beaked whale.

Populations of beaked whales and other odontocetes on the Bahamas and other Navy fixed ranges that have been operating for decades, appear to be stable. Behavioral reactions (avoidance of the area of Navy activity) seem likely in most cases if beaked whales are exposed to anti-submarine sonar within a few tens of kilometers, especially for prolonged periods (a few hours or more) since this is one of the most sensitive marine mammal groups to anthropogenic sound of any species or group studied to date and research indicates beaked whales will leave an area where anthropogenic sound is present (Tyack *et al.,* 2011; De Ruiter *et al.,* 2013; Manzano-Roth *et al.,* 2013; Moretti *et al.,* 2014). Research involving tagged Cuvier's beaked whales in the SOCAL Range Complex reported on by Falcone and Schorr (2012, 2014) indicates year-round prolonged use of the Navy's training and testing area by these beaked whales and has documented movements in excess of hundreds of kilometers by some of those animals. Given that some of these animals may routinely move hundreds of kilometers as part of their normal pattern, leaving an area where sonar or other anthropogenic sound is present may have little, if any, cost to such an animal. Photo identification studies in the SOCAL Range Complex, a Navy range that is utilized for training and testing, have identified approximately 100 individual Cuvier's beaked whale individuals with 40 percent having been seen in one or more prior years, with re-sightings up to 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. Based on the best available science, the Navy and NMFS believe that beaked whales that exhibit a significant TTS or behavioral reaction due to sonar and other active acoustic training or testing activities would generally not have long-term consequences for individuals or populations.

NMFS does not expect strandings, serious injury, or mortality of beaked whales to occur as a result of training activities. Stranding events coincident with Navy MFAS use in which exposure to sonar is believed to have been a contributing factor were detailed in the Stranding and Mortality section of this proposed rule. However, for some of these stranding events, a causal relationship between sonar exposure and the stranding could not be clearly established (Cox *et al.,* 2006). In other instances, sonar was considered only one of several factors that, in their aggregate, may have contributed to the stranding event (Freitas, 2004; Cox *et al.,* 2006). Because of the association between tactical MFAS use and a small number of marine mammal strandings, the Navy and NMFS have been considering and addressing the potential for strandings in association with Navy activities for years. In addition to a suite of mitigation measures intended to more broadly minimize impacts to marine mammals, the reporting requirements set forth in this rule ensure that NMFS is notified if a stranded marine mammal is found (see General Notification of Injured or Dead Marine Mammals in the regulatory text below). Additionally, through the MMPA process (which allows for adaptive management), NMFS and the Navy will determine the appropriate way to proceed in the event that a causal relationship were to be found between Navy activities and a future stranding.

In summary and as described above, the following factors primarily support our preliminary determination that the impacts resulting from the Navy's activities are not expected to adversely affect beaked whales taken through effects on annual rates of recruitment or survival:

- No mortalities of beaked whales are proposed for authorization or anticipated to occur.

• As described above, any PTS that may occur is expected to be of a relatively smaller degree because of the unlikelihood that animals would be close enough for a long enough amount of time to incur more severe PTS (for sonar) and the anticipated effectiveness of mitigation in preventing very close exposures for explosives.

• While the majority of takes are caused by exposure during ASW activities the impacts from these exposures are not expected to have either significant or long-term effects because (and as discussed above):

○ ASW activities typically involve fast-moving assets (relative to marine mammals swim speeds) and individuals are not expected to be exposed either for long periods within a day or over many sequential days.

○ As discussed, the majority of the harassment takes result from hull-mounted sonar during MTEs. When distance cut offs are applied for beaked whales, this means that all of the takes from hull-mounted sonar (MF1) result from above exposure 148 dB. However, the majority (*e.g.,* 91 percent) of the takes results from exposures below 160 dB. The majority of the takes have a relatively lower likelihood to have severe impacts.

• For the total instances of all of the different types of takes of the three Gulf of Mexico stocks of beaked whales, the numbers indicating the instances of total take as a percentage of abundance are between 148 and 155 (Table 76). When spread over the entire year and a very large range, the scale of the effects are such that individuals are taken an average of 1–2 times per year (based on the percentages above, respectively, but with some taken more or less). These averages allow that perhaps a smaller subset is taken with a slightly higher average and larger variability of highs and lows, but still with no reason to think that any individuals would be taken for more than several days out of the year, much less on sequential days. These behavioral takes are not all expected to be of particularly high intensity and nor are they likely to occur over sequential days, which suggests that the overall scale of impacts for any individual would be relatively low.

• For the total instances of all of the different types of takes of the Atlantic stocks of beaked whales, the numbers indicating the instances of total take as a percentage of abundance are between 170 and 308 percent over the whole Navy Study Area, and between 1658 and 1910 percent in the US EEZ alone (Table 76). While these percentages may seem high, when spread over the entire year and a very large range, the scale of the effects are such that over the whole Navy Study area, individuals are taken an average of 1–3 times per year, and the 10 percent or fewer of these individuals in the US EEZ are taken an average of 16–19 times (based on the percentages above, respectively, but with some taken more or less). These averages allow that perhaps a smaller subset is taken with a slightly higher average and larger variability of highs and lows, but still with no reason to think that any individuals would be taken every day for weeks or months out of the year, much less on sequential days. These behavioral takes are not all expected to be of particularly high intensity and nor are they likely to occur over sequential days, which suggests that the overall scale of impacts for any individual would be relatively low.

• The AFTT activities are not expected to occur in an area/time of specific importance for reproductive, feeding, or other known critical behaviors for beaked whales.

• Beaked whales found in the AFTT Study Area are not depleted under the MMPA, nor are they listed under the ESA.

Consequently, the activities are not expected to adversely impact rates of recruitment or survival of any of the beaked whale stocks analyzed (Table 76 above in this section).

Pinnipeds

In Table 77 below, for pinnipeds, we indicate the total annual mortality, Level A and Level B harassment, and a number indicating the instances of total take as a percentage of abundance. Overall, takes from Level A harassment (PTS and Tissue Damage) account for less than one percent of all total takes.

Table 77: Annual takes of Level B and Level A harassment, mortality for pinnipeds in the AFTT study area and number indicating the instances of total take as a percentage of stock abundance.

		Instances of indicated types of incidental take (not all takes represent separate individuals, especially for disturbance)					Total takes		Abundance		Instances of total take as percentage of abundance	
		Level B Harassment		Level A Harassment								
Species	Stock	Behavioral Disturbance	TTS (may also include disturbance)	PTS	Tissue Damage	Mortality	In EEZ	Inside and Outside EEZ	In EEZ	Inside and Outside EEZ	In EEZ	Inside and Outside EEZ
Suborder Pinnipedia												
Family Phocidae (true seals)												
Gray seal	Western North Atlantic	809	1,528	3	0	0	2340	2340	2,472	2,472	95	95
Harbor seal	Western North Atlantic	1,310	2,477	6	0	0	3793	3793	11,122	11,122	34	34
Harp seal	Western North Atlantic	6,339	9,955	3	0	0	16297	16297	7,242	7,242	225	225
Hooded seal	Western North Atlantic	448	466	0	0	0	914	914	880	880	104	104

Note: Above we compare predicted takes to abundance estimates generated from the same underlying density estimate, versus abundance estimates from the SARs, which are not based on the same data and would not be appropriate for this purpose. Note that comparisons are made both within the EEZ only (where density estimates have lesser uncertainty and takes are notably greater) and across the whole Study Area (which offers a more comprehensive comparison for many stocks).

As noted previously, the estimated takes represent instances of take, not the number of individuals taken, and in almost all cases—some individuals are expected to be taken more than one time, which means that the number of individuals taken is smaller than the total estimated takes. In other words, where the instances of take exceed 100 percent of the population, repeated takes of some individuals are predicted. Generally speaking, the higher the number of takes as compared to the population abundance, the more repeated takes of individuals are likely, and the higher the actual percentage of individuals in the population that are likely taken at least once in a year. We look at this comparative metric to give us a relative sense across species/stocks of where larger portions of the stocks are being taken by Navy activities and where there is a higher likelihood that the same individuals are being taken across multiple days and where that number of days might be higher. In the ocean, the use of sonar and other active acoustic sources is often transient and is unlikely to repeatedly expose the same individual animals within a short period, for example within one specific exercise, however, some repeated exposures across different activities could occur over the year, especially where events occur in generally the same area with more resident species. In short, we expect that the total anticipated takes represent exposures of a smaller number of individuals of which some were exposed multiple times, but based on the nature of the Navy activities and the movement patterns of marine mammals, it is unlikely any particular subset would be taken over more than a few sequential days—*i.e.,* where repeated takes of individuals are likely to occur, they are more likely to result from non-sequential exposures from different activities and marine mammals are not predicted to be taken for more than a few days in a row, at most. As described elsewhere, the nature of the majority of the exposures would be expected to be of a less severe nature and based on the numbers it is still likely that any individual exposed multiple times is still only taken on a small percentage of the days of the year. The greater likelihood is that not every individual is taken, or perhaps a smaller subset is taken with a slightly higher average and larger variability of highs and lows, but still with no reason to think that any individuals would be taken every day for months out of the year, much less on sequential days.

Most Level B harassments to beaked whales from hull-mounted sonar (MF1) in the AFTT Study Area would result from received levels between 166 and 172 dB SPL (76 percent). Therefore, the majority of Level B takes are expected to be in the form of milder responses (*i.e.,* lower-level exposures that still rise to the level of take, but would likely be less severe in the range of responses that qualify as take) of a generally shorter duration. As mentioned earlier in this section, we anticipate more severe effects from takes when animals are exposed to higher received levels. Occasional milder behavioral reactions are unlikely to cause long-term consequences for individual animals or populations, and even if some smaller subset of the takes are in the form of a longer (several hours or a day) and more moderate response, because they are not expected to be repeated over sequential multiple days, impacts to individual fitness are not anticipated.

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 AFTT Study Area that are taken by Level B harassment, on the basis of reports in the literature as well as Navy monitoring from past activities, will likely be limited to reactions such as increased swimming speeds, increased surfacing time, or decreased foraging (if such activity were occurring). Most likely, individuals will simply move away from the sound source and be temporarily displaced from those areas, or not respond at all. In areas of repeated and frequent acoustic disturbance, some animals may habituate or learn to tolerate the new baseline or fluctuations in noise level. Habituation can occur when an animal's response to a stimulus wanes with repeated exposure, usually in the absence of unpleasant associated events (Wartzok *et al.,* 2003). While some animals may not return to an area, or may begin using an area differently due to training and testing activities, most animals are expected to return to their usual locations and behavior. Given their documented tolerance of anthropogenic sound (Richardson *et al.,* 1995 and Southall *et al.,* 2007), repeated exposures of individuals (*e.g.,* harbor seals) to levels of sound that may cause Level B harassment are unlikely to result in hearing impairment or to significantly disrupt foraging behavior. As stated above, pinnipeds may habituate to or become tolerant of repeated exposures over time, learning to ignore a stimulus that in the past has not accompanied any overt threat.

Thus, even repeated Level B harassment of some small subset of an overall stock is unlikely to result in any significant realized decrease in fitness to those individuals, and would not result in any adverse impact to the stock as a whole. Evidence from areas where the Navy extensively trains and tests provides some indication of the possible consequences resulting from those proposed activities. Almost all of the impacts estimated by the quantitative assessment are due to navigation and object avoidance (detection) activities in navigation lanes entering Groton, Connecticut. Navigation and object avoidance (detection) activities normally involve a single ship or submarine using a limited amount of sonar, therefore significant reactions are unlikely, especially in phocid seals. If seals are exposed to sonar or other active acoustic sources, they may react in various ways, depending on their experience with the sound source and what activity they are engaged in at the time of the acoustic exposure. Seals 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. The use of sonar from navigation and object avoidance in Groton, Connecticut likely exposes the same sub-population of animals multiple times throughout the year. However, phocid seals are likely to only have minor and short-term behavioral reactions to these types of activities and significant behavioral reactions would not be expected in most cases, and long-term consequences for individual seals from a single or several impacts per year are unlikely.

Generally speaking, most pinniped stocks in the AFTT Study Area are thought to be stable or increasing. In summary and as described above, the following factors primarily support our preliminary determination that the impacts resulting from the Navy's activities are not expected to adversely affect pinnipeds taken through effects on annual rates of recruitment or survival:

- No mortalities of pinnipeds are proposed for authorization or anticipated to occur.
- As described above, any PTS that may occur is expected to be of a relatively smaller degree because of the unlikelihood that animals would be close enough for a long enough amount of time to incur more severe PTS (for sonar) and the anticipated effectiveness of mitigation in preventing very close exposures for explosives.
- While the majority of takes are caused by exposure during ASW activities, the impacts from these exposures are not expected to have either significant or long-term effects because (and as discussed above):
  - ASW activities typically involve fast-moving assets (relative to marine mammals swim speeds) and individuals are not expected to be exposed either for long periods within a day or over many sequential days.
  - As discussed, the majority of the harassment takes result from hull-mounted sonar during MTEs. When distance cut offs are applied for pinnipeds, this means that all of the takes from hull-mounted sonar (MF1) result from above exposure 166 dB. However, the majority (*e.g.,* 76 percent) of the takes results from exposures below 172 dB. The majority of the takes have a relatively lower likelihood in have severe impacts.
- For the total instances of all of the different types of takes of pinnipeds, the numbers indicating the instances of total take as a percentage of abundance are between 34 and 225 (Table 77). When spread over the entire year and a very large range, the scale of the effects are such that individuals are taken an average of 0 to 1–2 times per year (based on the percentages above, respectively, but with some taken more or less). These averages allow that perhaps a smaller subset is taken with a slightly higher average and larger variability of highs and lows, but still with no reason to think that any individuals would be taken for more than several days out of the year, much less on sequential days. These behavioral takes are not all expected to be of particularly high intensity and nor are they likely to occur over sequential days, which suggests that the overall scale of impacts for any individual would be relatively low.
- The AFTT activities are not expected to occur in an area/time of specific importance for reproductive, feeding, or other known critical behaviors for pinnipeds. Pinnipeds found in the AFTT Study Area are not depleted under the MMPA, nor are they listed under the ESA.

Consequently, the activities are not expected to adversely impact rates of recruitment or survival of any of the analyzed stocks of pinnipeds (Table 77 above in this section).

Preliminary Determination

Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the proposed monitoring and mitigation measures, NMFS preliminarily finds that the total marine mammal take from the proposed activity will have a negligible impact on all affected marine mammal species or stocks.

Subsistence Harvest of Marine Mammals

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

ESA

There are five marine mammal species under NMFS jurisdiction that are listed As endangered or threatened under the ESA with confirmed or possible occurrence in the AFTT Study Area: Blue whale, fin whale, sei whale, sperm whale, and NARW. The Navy will consult with NMFS pursuant to section 7 of the ESA, and NMFS will also consult internally on the issuance of these regulations and LOAs under section 101(a)(5)(A) of the MMPA for AFTT activities. Consultation will be concluded prior to a determination on the issuance of the final rule and LOAs.

National Marine Sanctuaries Act

Some Navy activities may potentially affect resources within NMS. Pursuant to Section 304(d) of the National Marine Sanctuaries Act (NMSA), the Navy is consulting on activities as documented in the AFTT DEIS/OEIS on potential impacts to sanctuary resources, including marine mammals. The Navy will initiate consultation with NOAA's Office of National Marine Sanctuaries pursuant to the requirements of the NMSA as warranted by ongoing analysis of the activities and their effects on sanctuary resources.

NEPA

To comply with the National Environmental Policy Act of 1969 (NEPA; 42 U.S.C. 4321 *et seq.*) and NOAA Administrative Order (NAO) 216–6A, NMFS must review its Proposed Activity (*i.e.,* the issuance of an incidental take authorization) with respect to potential impacts on the human environment.

Accordingly, NMFS plans to adopt the Navy's EIS/OEIS for AFTT Study Area provided our independent evaluation of the document finds that it includes adequate information analyzing the effects on the human environment of issuing regulations and LOAs. NMFS is a cooperating agency on the Navy's DEIS.

The Navy's DEIS/OEIS was made available for public comment at *www.aftteis.com/* on June 30, 2017.

We will review all comments submitted in response to this document prior to concluding our NEPA process or making a final decision on the final rule and LOA requests.

Classification

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

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

List of Subjects in 50 CFR Part 218

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

Dated: March 1, 2018.

Samuel D. Rauch III,

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

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

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

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

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

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

Subpart I—Taking and Importing Marine Mammals; U.S. Navy's Atlantic Fleet Training and Testing (AFTT)

Sec.
218.80 Specified activity and specified geographical region.
218.81 Effective dates.
218.82 Permissible methods of taking.
218.83 Prohibitions.
218.84 Mitigation requirements.
218.85 Requirements for monitoring and reporting.
218.86 Letters of Authorization.
218.87 Renewals and modifications of Letters of Authorization.
218.88–218.89 [Reserved]

Subpart I—Taking and Importing Marine Mammals; U.S. Navy's Atlantic Fleet Training and Testing (AFTT)

§ 218.80 Specified activity and specified geographical region.

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

(b) The taking of marine mammals by the Navy may be authorized in Letters of Authorization (LOAs) only if it occurs within the Atlantic Fleet Training and Testing (AFTT) Study Area, which includes areas of the western Atlantic Ocean along the east coast of North America, portions of the Caribbean Sea, and the Gulf of Mexico. The AFTT Study Area begins at the mean high tide line along the U.S. coast and extends east to the 45-degree west longitude line, north to the 65 degree north latitude line, and south to approximately the 20-degree north latitude line. The AFTT Study Area also includes Navy pierside locations, bays, harbors, and inland waterways, and civilian ports where training and testing occurs.

(c) The taking of marine mammals by the Navy is only authorized if it occurs incidental to the Navy's conducting training and testing activities. The Navy's use of sonar and other transducers, in-water detonations, air guns, pile driving/extraction, and vessel movements incidental to training and testing exercises may cause take by harassment, serious injury or mortality as defined by the MMPA through the various warfare mission areas in which the Navy would conduct including amphibious warfare, anti-submarine warfare, expeditionary warfare, surface warfare, mine warfare, and other activities (sonar and other transducers ship shock trials, pile driving and removal activities, airguns, vessel strike).

§ 218.81 Effective dates.

Regulations in this subpart are effective [*date 30 days after date of publication of the final rule in the* ***Federal Register***] through [*date 5 years and 30 days after date of publication of the final rule in the* ***Federal Register***].

§ 218.82 Permissible methods of taking.

Under LOAs issued pursuant to § 216.106 of this chapter and § 218.87, the Holder of the LOAs (hereinafter ''Navy'') may incidentally, but not intentionally, take marine mammals within the area described in § 218.80(b) by Level A harassment and Level B harassment associated with the use of active sonar and other acoustic sources and explosives as well as serious injury or mortality associated with ship shock trials and vessel strikes provided the activity is in compliance with all terms, conditions, and requirements of these regulations in this subpart and the applicable LOAs.

§ 218.83 Prohibitions.

Notwithstanding takings contemplated in § 218.82 and authorized by LOAs issued under § 216.106 of this chapter and § 218.86, no person in connection with the activities described in § 218.82 may:

(a) Violate, or fail to comply with, the terms, conditions, and requirements of this subpart or an LOA issued under § 216.106 of this chapter and § 218.86;

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

(c) Take any marine mammal specified in such LOAs in any manner other than as specified;

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

§ 218.84 Mitigation requirements.

When conducting the activities identified in § 218.80(c), the mitigation measures contained in any LOAs issued under § 216.106 of this chapter and § 218.86 must be implemented. These mitigation measures shall include the following requirements, but are not limited to:

(a) *Procedural Mitigation.* Procedural mitigation is mitigation that the Navy shall implement whenever and wherever an applicable training or testing activity takes place within the AFTT Study Area for each applicable activity category or stressor category and includes acoustic stressors (*i.e.,* active sonar, air guns, pile driving, weapons firing noise), explosive stressors (*i.e.,* sonobuoys, torpedoes, medium-caliber and large-caliber projectiles, missiles and rockets, bombs, sinking exercises, mines, anti-swimmer grenades, line charge testing and ship shock trials), and physical disturbance and strike stressors *(i.e.,* vessel movement, towed in-water devices, small-, medium-, and large-caliber non-explosive practice munitions, non-explosive missiles and rockets, non-explosive bombs and mine shapes).

(1) *Environmental Awareness and Education.* Appropriate personnel involved in mitigation and training or testing activity reporting under the Proposed Activity shall complete one or more modules of the U.S Navy Afloat Environmental Compliance Training Series, as identified in their career path training plan. Modules include: Introduction to the U.S. Navy Afloat Environmental Compliance Training Series, Marine Species Awareness Training, U.S. Navy Protective Measures Assessment Protocol, and U.S. Navy Sonar Positional Reporting System and Marine Mammal Incident Reporting.

(2) *Active Sonar.* Active sonar includes low-frequency active sonar, mid-frequency active sonar, and high-frequency active sonar. For vessel-based active sonar activities, mitigation applies only to sources that are positively controlled and deployed from manned surface vessels (*e.g.,* sonar sources towed from manned surface platforms). For aircraft-based active sonar activities, mitigation applies to sources that are positively controlled and deployed from manned aircraft that

do not operate at high altitudes (*e.g.,* rotary-wing aircraft). Mitigation does not apply to active sonar sources deployed from unmanned aircraft or aircraft operating at high altitudes (*e.g.,* maritime patrol aircraft).

(i) Number of Lookouts and Observation Platform—(A) Hull-mounted sources: Two lookouts at the forward part of the ship for platforms without space or manning restrictions while underway; One lookout at the forward part of a small boat or ship for platforms with space or manning restrictions while underway; One lookout for platforms using active sonar while moored or at anchor (including pierside); and Four lookouts for pierside sonar testing activities at Port Canaveral, Florida and Kings Bay, Georgia.

(B) Non-hull mounted sources: One lookout on the ship or aircraft conducting the activity.

(ii) Mitigation Zone and Requirements—(A) Prior to the start of the activity the Navy shall observe for floating vegetation and marine mammals; if resource is observed, the Navy shall not commence use of active sonar.

(B) During low-frequency active sonar at or above 200 decibel (dB) and hull-mounted mid-frequency active sonar the Navy shall observe for marine mammals and power down active sonar transmission by 6 dB if resource is observed within 1,000 yards (yd) of the sonar source; power down by an additional 4 dB (10 dB total) if resource is observed within 500 yd of the sonar source; and cease transmission if resource is observed within 200 yd of the sonar source.

(C) During low-frequency active sonar below 200 dB, mid-frequency active sonar sources that are not hull mounted, and high-frequency active sonar the Navy shall observe for marine mammals and cease active sonar transmission if resource is observed within 200 yd of the sonar source.

(D) To allow a sighted marine mammal to leave the mitigation zone, the Navy shall not recommence active sonar transmission until one of the recommencement conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the sonar source; the mitigation zone has been clear from any additional sightings for 10 min for aircraft-deployed sonar sources or 30 min for vessel-deployed sonar sources; for mobile activities, the active sonar source has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting; or for activities using hull-mounted sonar, the ship concludes that dolphins are deliberately closing in on the ship to ride the ship's bow wave, and are therefore out of the main transmission axis of the sonar (and there are no other marine mammal sightings within the mitigation zone).

(E) The Navy shall notify the Port Authority prior to the commencement of pierside sonar testing activities at Port Canaveral, Florida and Kings Bay, Georgia. At these locations, the Navy shall conduct active sonar activities during daylight hours to ensure adequate sightability of manatees, and shall equip Lookouts with polarized sunglasses. After completion of pierside sonar testing activities at Port Canaveral and Kings Bay, the Navy shall continue to observe for marine mammals for 30 min within the mitigation zone. The Navy shall implement a reduction of at least 36 dB from full power for mid-frequency active sonar transmissions at Kings Bay. The Navy shall communicate sightings of manatees made during or after pierside sonar testing activities at Kings Bay to the Georgia Department of Natural Resources sightings hotline, Base Natural Resources Manager, and Port Operations. Communications shall include information on the time and location of a sighting, the number and size of animals sighted, a description of any research tags (if present), and the animal's direction of travel. Port Operations shall disseminate the sightings information to other vessels operating near the sighting and shall keep logs of all manatee sightings.

(3) *Air Guns.* (i) Number of Lookouts and Observation Platform—One lookout positioned on a ship or pierside.

(ii) Mitigation Zone and Requirements—150 yd around the air gun.

(A) Prior to the start of the activity (*e.g.,* when maneuvering on station), the Navy shall observe for floating vegetation, and marine mammals; if resource is observed, the Navy shall not commence use of air guns.

(B) During the activity, the Navy shall observe for marine mammals; if resource is observed, the Navy shall cease use of air guns.

(C) To allow a sighted marine mammal to leave the mitigation zone, the Navy shall not recommence the use of air guns until one of the recommencement conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the air gun; the mitigation zone has been clear from any additional sightings for 30 min; or for mo108bile activities, the air gun has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting.

(4) *Pile Driving.* Pile driving and pile extraction sound during Elevated Causeway System training.

(i) Number of Lookouts and Observation Platform—One lookout positioned on the shore, the elevated causeway, or a small boat.

(ii) Mitigation Zone and Requirements—100 yd around the pile driver.

(A) Thirty minutes prior to the start of the activity, the Navy shall observe for floating vegetation and marine mammals; if resource is observed, the Navy shall not commence impact pile driving or vibratory pile extraction.

(B) During the activity, the Navy shall observe for marine mammals; if resource is observed, the Navy shall cease impact pile driving or vibratory pile extraction.

(C) To allow a sighted marine mammal to leave the mitigation zone, the Navy shall not recommence pile driving until one of the recommencement conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the pile driving location; or the mitigation zone has been clear from any additional sightings for 30 min.

(D) In the Navy Cherry Point Range Complex, the Navy shall maintain a log detailing any sightings and injuries to manatees during pile driving. If a manatee was sighted during the activity, upon completion of the activity, the Navy project manager or civilian equivalent shall prepare a report that summarizes all information on manatees encountered and submit the report to the USFWS, Raleigh Field Office. The Navy shall report any injury of a manatee to the USFWS, NMFS, and the North Carolina Wildlife Resources Commission.

(5) *Weapons Firing Noise.* Weapons firing noise associated with large-caliber gunnery activities.

(i) Number of Lookouts and Observation Platform—One lookout shall be positioned on the ship conducting the firing. Depending on the activity, the lookout could be the same as the one described in Explosive Medium-Caliber and Large-Caliber Projectiles or in Small-, Medium-and Large-Caliber Non-Explosive Practice Munitions.

(ii) Mitigation Zone and Requirements—Thirty degrees on either side of the firing line out to 70 yd from the muzzle of the weapon being fired.

(A) Prior to the start of the activity, the Navy shall observe for floating vegetation, and marine mammals; if resource is observed, the Navy shall not commence weapons firing.

(B) During the activity, the Navy shall observe for marine mammals; if resource is observed, the Navy shall cease weapons firing.

(C) To allow a sighted marine mammal to leave the mitigation zone, the Navy shall not recommence weapons firing until one of the recommencement conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the firing ship; the mitigation zone has been clear from any additional sightings for 30 min; or for mobile activities, the firing ship has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting.

(6) *Explosive Sonobuoys.* (i) Number of Lookouts and Observation Platform—One lookout positioned in an aircraft or on small boat.

(ii) Mitigation Zone and Requirements—600 yd around an explosive sonobuoy.

(A) Prior to the start of the activity (*e.g.,* during deployment of a sonobuoy field, which typically lasts 20–30 min), the Navy shall conduct passive acoustic monitoring for marine mammals, and observe for floating vegetation and marine mammals; if resource is visually observed, the Navy shall not commence sonobuoy or source/receiver pair detonations.

(B) During the activity, the Navy shall observe for marine mammals; if resource is observed, the Navy shall cease sonobuoy or source/receiver pair detonations.

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

(7) *Explosive Torpedoes.* (i) Number of Lookouts and Observation Platform—One lookout positioned in an aircraft.

(ii) Mitigation Zone and Requirements—2,100 yd around the intended impact location.

(A) Prior to the start of the activity (*e.g.,* during deployment of the target), the Navy shall conduct passive acoustic monitoring for marine mammals, and observe for floating vegetation, jellyfish aggregations, and marine mammals; if resource is visually observed, the Navy shall not commence firing.

(B) During the activity, the Navy shall observe for marine mammals and jellyfish aggregations; if resource is observed, the Navy shall cease firing.

(C) To allow a sighted marine mammal to leave the mitigation zone, the Navy shall not recommence firing until one of the recommencement conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended impact location; or the mitigation zone has been clear from any additional sightings for 10 min when the activity involves aircraft that have fuel constraints, or 30 min when the activity involves aircraft that are not typically fuel constrained. After completion of the activity, the Navy shall observe for marine mammals; if any injured or dead resources are observed, the Navy shall follow established incident reporting procedures.

(8) *Explosive Medium-Caliber and Large-Caliber Projectiles.* Gunnery activities using explosive medium-caliber and large-caliber projectiles. Mitigation applies to activities using a surface target.

(i) Number of Lookouts and Observation Platform—One Lookout on the vessel or aircraft conducting the activity. For activities using explosive large-caliber projectiles, depending on the activity, the Lookout could be the same as the one described in Weapons Firing Noise in paragraph (a)(5)(i) of this section.

(ii) Mitigation Zone and Requirements—(A) 200 yd around the intended impact location for air-to-surface activities using explosive medium-caliber projectiles,

(B) 600 yd around the intended impact location for surface-to-surface activities using explosive medium-caliber projectiles, or

(C) 1,000 yd around the intended impact location for surface-to-surface activities using explosive large-caliber projectiles:

(D) Prior to the start of the activity (*e.g.,* when maneuvering on station), the Navy shall observe for floating vegetation and marine mammals; if resource is observed, the Navy shall not commence firing.

(E) During the activity, observe for marine mammals; if resource is observed, the Navy shall cease firing.

(F) To allow a sighted marine mammal to leave the mitigation zone, the Navy shall not recommence firing until one of the recommencement conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended impact location; the mitigation zone has been clear from any additional sightings for 10 min. for aircraft-based firing or 30 min for vessel-based firing; or for activities using mobile targets, the intended impact location has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting.

(9) *Explosive Missiles and Rockets.* Aircraft-deployed explosive missiles and rockets. Mitigation applies to activities using a surface target.

(i) Number of Lookouts and Observation Platform—One lookout positioned in an aircraft.

(ii) Mitigation Zone and Requirements—(A) 900 yd around the intended impact location for missiles or rockets with 0.6–20 lb net explosive weight, or

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

(C) Prior to the start of the activity (*e.g.,* during a fly-over of the mitigation zone), the Navy shall observe for floating vegetation and marine mammals; if resource is observed, the Navy shall not commence firing.

(D) During the activity, the Navy shall observe for marine mammals; if resource is observed, the Navy shall cease firing.

(E) To allow a sighted marine mammal to leave the mitigation zone, the Navy shall not recommence firing until one of the recommencement conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended impact location; or the mitigation zone has been clear from any additional sightings for 10 min when the activity involves aircraft that have fuel constraints, or 30 min when the activity involves aircraft that are not typically fuel constrained.

(10) *Explosive Bombs.* (i) Number of Lookouts and Observation Platform—One lookout positioned in an aircraft conducting the activity.

(ii) Mitigation Zone and Requirements—2,500 yd around the intended target.

(A) Prior to the start of the activity (*e.g.,* when arriving on station), the Navy shall observe for floating vegetation and marine mammals; if resource is observed, the Navy shall not commence bomb deployment.

(B) During target approach, the Navy shall observe for marine mammals; if resource is observed, the Navy shall cease bomb deployment.

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

(11) *Sinking Exercises.* (i) Number of Lookouts and Observation Platform—Two lookouts (one positioned in an aircraft and one on a vessel).

(ii) Mitigation Zone and Requirements—2.5 nmi around the target ship hulk.

(A) 90 min prior to the first firing, the Navy shall conduct aerial observations for floating vegetation, jellyfish aggregations, and marine mammals; if resource is observed, the Navy shall not commence firing.

(B) During the activity, the Navy shall conduct passive acoustic monitoring and visually observe for marine mammals from the vessel; if resource is visually observed, the Navy shall cease firing. Immediately after any planned or unplanned breaks in weapons firing of longer than 2 hrs, the Navy shall observe for marine mammals from the aircraft and vessel; if resource is observed, the Navy shall not commence firing.

(C) To allow a sighted marine mammal to leave the mitigation zone, the Navy shall not recommence firing until one of the recommencement conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the target ship hulk; or the mitigation zone has been clear from any additional sightings for 30 min. For 2 hrs after sinking the vessel (or until sunset, whichever comes first), observe for marine mammals; if any injured or dead resources are observed, the Navy shall follow established incident reporting procedures.

(12) *Explosive Mine Countermeasure and Neutralization Activities.* (i) Number of Lookouts and Observation Platform—(A) One lookout positioned on a vessel or in an aircraft when using up to 0.1–5 lb net explosive weight charges.

(B) Two lookouts (one in an aircraft and one on a small boat) when using up to 6–650 lb net explosive weight charges.

(ii) Mitigation Zone and Requirements—(A) 600 yd around the detonation site for activities using 0.1–5 lb net explosive weight, or

(B) 2,100 yd around the detonation site for activities using 6–650 lb net explosive weight (including high explosive target mines):

(C) Prior to the start of the activity (*e.g.,* when maneuvering on station; typically, 10 min when the activity involves aircraft that have fuel constraints, or 30 min when the activity involves aircraft that are not typically fuel constrained), the Navy shall observe for floating vegetation and marine mammals; if resource is observed, the Navy shall not commence detonations.

(D) During the activity, the Navy shall observe for marine mammals; if resource is observed, the Navy shall cease detonations.

(E) To allow a sighted marine mammal to leave the mitigation zone, the Navy shall not recommence detonations until one of the recommencement conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to detonation site; or the mitigation zone has been clear from any additional sightings for 10 min when the activity involves aircraft that have fuel constraints, or 30 min when the activity involves aircraft that are not typically fuel constrained. After completion of the activity, the Navy shall observe for marine mammals and sea turtles (typically 10 min when the activity involves aircraft that have fuel constraints, or 30 min. when the activity involves aircraft that are not typically fuel constrained); if any injured or dead resources are observed, the Navy shall follow established incident reporting procedures.

(13) *Explosive Mine Neutralization Activities Involving Navy Divers.* (i) Number of Lookouts and Observation Platform—(A) Two lookouts (two small boats with one Lookout each, or one Lookout on a small boat and one in a rotary-wing aircraft) when implementing the smaller mitigation zone.

(B) Four lookouts (two small boats with two Lookouts each), and a pilot or member of an aircrew shall serve as an additional Lookout if aircraft are used during the activity, when implementing the larger mitigation zone.

(ii) Mitigation Zone and Requirements—(A) The Navy shall not set time-delay firing devices (0.1–20 lb net explosive weight) to exceed 10 min.

(B) 500 yd around the detonation site during activities under positive control using 0.1–20 lb net explosive weight, or

(C) 1,000 yd around the detonation site during all activities using time-delay fuses (0.1–20 lb net explosive weight) and during activities under positive control using 21–60 lb net explosive weight charges:

(D) Prior to the start of the activity (*e.g.,* when maneuvering on station for activities under positive control; 30 min for activities using time-delay firing devices), the Navy shall observe for floating vegetation and marine mammals; if resource is observed, the Navy shall not commence detonations or fuse initiation.

(E) During the activity, the Navy shall observe for marine mammals; if resource is observed, the Navy shall cease detonations or fuse initiation. All divers placing the charges on mines shall support the Lookouts while performing their regular duties and shall report all marine mammal sightings to their supporting small boat or Range Safety Officer. To the maximum extent practicable depending on mission requirements, safety, and environmental conditions, boats shall position themselves near the mid-point of the mitigation zone radius (but outside of the detonation plume and human safety zone), shall position themselves on opposite sides of the detonation location (when two boats are used), and shall travel in a circular pattern around the detonation location with one Lookout observing inward toward the detonation site and the other observing outward toward the perimeter of the mitigation zone. If used, aircraft shall travel in a circular pattern around the detonation location to the maximum extent practicable.

(F) To allow a sighted marine mammal to leave the mitigation zone, the Navy shall not recommence detonations or fuse initiation until one of the recommencement conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the detonation site; or the mitigation zone has been clear from any additional sightings for 10 min during activities under positive control with aircraft that have fuel constraints, or 30 min. during activities under positive control with aircraft that are not typically fuel constrained and during activities using time-delay firing devices. After completion of an activity using time-delay firing devices, the Navy shall observe for marine mammals for 30 min; if any injured or dead resources are observed, the Navy follow established incident reporting procedures.

(14) *Maritime Security Operations—Anti-Swimmer Grenades.* (i) Number of Lookouts and Observation Platform—One lookout positioned on the small boat conducting the activity.

(ii) Mitigation Zone and Requirements—200 yd around the intended detonation location.

(A) Prior to the start of the activity (*e.g.,* when maneuvering on station), the Navy shall observe for floating vegetation and marine mammals; if resource is observed, the Navy shall not commence detonations.

(B) During the activity, the Navy shall observe for marine mammals; if resource is observed, the Navy shall cease detonations.

(C) To allow a sighted marine mammal to leave the mitigation zone, the Navy shall not recommence detonations until one of the recommencement conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended detonation location; the mitigation zone has been clear from any additional sightings for 30 min; or the intended detonation location has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting.

(15) *Line Charge Testing.* (i) Number of Lookouts and Observation Platform—One lookout positioned on a vessel.

(ii) Mitigation Zone and Requirements—900 yd around the intended detonation location.

(A) Prior to the start of the activity (*e.g.,* when maneuvering on station), the Navy shall observe for floating vegetation and marine mammals; if resource is observed, the Navy shall not commence detonations.

(B) During the activity, the Navy shall observe for marine mammals; if resource is observed, the Navy shall cease detonations.

(C) To allow a sighted marine mammal to leave the mitigation zone, the Navy shall not recommence detonations until one of the recommencement conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended detonation location; or the mitigation zone has been clear from any additional sightings for 30 min.

(16) *Ship Shock Trials.* (i) Number of Lookouts and Observation Platform—(A) A minimum of ten lookouts or trained marine species observers (or a combination thereof) positioned either in an aircraft or on multiple vessels (*i.e.,* a Marine Animal Response Team boat and the test ship).

(B) If aircraft are used, Lookouts or trained marine species observers shall be in an aircraft and on multiple vessels.

(C) If aircraft are not used, a sufficient number of additional Lookouts or trained marine species observers shall be used to provide vessel-based visual observation comparable to that achieved by aerial surveys.

(ii) Mitigation Zone and Requirements—3.5 nmi around the ship hull.

(A) The Navy shall not conduct ship shock trials in the Jacksonville Operating Area during North Atlantic right whale calving season from November 15 through April 15.

(B) The Navy develops detailed ship shock trial monitoring and mitigation plans approximately one-year prior to an event and shall continue to provide these to NMFS for review and approval.

(C) Pre-activity planning shall include selection of one primary and two secondary areas where marine mammal populations are expected to be the lowest during the event, with the primary and secondary locations located more than 2 nmi from the western boundary of the Gulf Stream for events in the Virginia Capes Range Complex or Jacksonville Range Complex.

(D) If it is determined during pre-activity surveys that the primary area is environmentally unsuitable (*e.g.,* observations of marine mammals or presence of concentrations of floating vegetation), the shock trial could be moved to a secondary site in accordance with the detailed mitigation and monitoring plan provided to NMFS.

(E) Prior to the detonation (at the primary shock trial location) in intervals of 5 hrs, 3 hrs, 40 min, and immediately before the detonation, the Navy shall observe for floating vegetation and marine mammals; if resource is observed, the Navy shall not trigger the detonation.

(F) During the activity, the Navy shall observe for marine mammals, large schools of fish, jellyfish aggregations, and flocks of seabirds; if resource is observed, the Navy shall cease triggering the detonation.

(G) To allow a sighted marine mammal to leave the mitigation zone, the Navy shall not recommence the triggering of a detonation until one of the recommencement conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the ship hull; or the mitigation zone has been clear from any additional sightings for 30 min. After completion of each detonation, the Navy shall observe for marine mammals; if any injured or dead resources are observed, the Navy shall follow established incident reporting procedures and halt any remaining detonations until the Navy can consult with NMFS and review or adapt the mitigation, if necessary. After completion of the ship shock trial, the Navy shall conduct additional observations during the following two days (at a minimum) and up to seven days (at a maximum); if any injured or dead resources are observed, the Navy shall follow established incident reporting procedures.

(17) *Vessel Movement.* The mitigation shall not be applied if: The vessel's safety is threatened; the vessel is restricted in its ability to maneuver (*e.g.,* during launching and recovery of aircraft or landing craft, during towing activities, when mooring, etc.); or the vessel is operated autonomously.

(i) Number of Lookouts and Observation Platform—One lookout on the vessel that is underway.

(ii) Mitigation Zone and Requirements—(A) 500 yd around whales—When underway, the Navy shall observe for marine mammals; if a whale is observed, the Navy shall maneuver to maintain distance.

(B) 200 yd around all other marine mammals (except bow-riding dolphins and pinnipeds hauled out on man-made navigational structures, port structures, and vessels)—When underway, the Navy shall observe for marine mammals; if a marine mammal other than a whale, bow-riding dolphin, or hauled-out pinniped is observed, the Navy shall maneuver to maintain distance.

(18) *Towed In-water Devices.* Mitigation applies to devices that are towed from a manned surface platform or manned aircraft. The mitigation shall not be applied if the safety of the towing platform is threatened.

(i) Number of Lookouts and Observation Platform—One lookout positioned on a manned towing platform.

(ii) Mitigation Zone and Requirements—250 yd around marine mammals. When towing an in-water device, the Navy shall observe for marine mammals; if resource is observed, the Navy shall maneuver to maintain distance.

(19) *Small-, Medium-, and Large-Caliber Non-Explosive Practice Munitions.* Mitigation applies to activities using a surface target.

(i) Number of Lookouts and Observation Platform—One Lookout positioned on the platform conducting the activity. Depending on the activity, the Lookout could be the same as the one described for Weapons Firing Noise in paragraph (a)(5)(i) of this section.

(ii) Mitigation Zone and Requirements—200 yd around the intended impact location.

(A) Prior to the start of the activity (*e.g.,* when maneuvering on station), the Navy shall observe for floating vegetation and marine mammals; if resource is observed, the Navy shall not commence firing.

(B) During the activity, the Navy shall observe for marine mammals; if resource is observed, the Navy shall cease firing.

(C) To allow a sighted marine mammal to leave the mitigation zone, the Navy shall not recommence firing until one of the recommencement conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended impact location; the mitigation zone has been clear from any additional sightings for 10 min for aircraft-based firing or 30 min for vessel-based firing; or for activities using a mobile target, the intended impact location has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting.

(20) *Non-Explosive Missiles and Rockets.* Aircraft-deployed non-explosive missiles and rockets. Mitigation applies to activities using a surface target.

(i) Number of Lookouts and Observation Platform—One Lookout positioned in an aircraft.

(ii) Mitigation Zone and Requirements—900 yd around the intended impact location.

(A) Prior to the start of the activity (*e.g.,* during a fly-over of the mitigation zone), the Navy shall observe for floating vegetation and marine mammals; if resource is observed, the Navy shall not commence firing.

(B) During the activity, the Navy shall observe for marine mammals; if resource is observed, the Navy shall cease firing.

(C) To allow a sighted marine mammal to leave the mitigation zone, the Navy shall not recommence firing until one of the recommencement conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended impact location; or the mitigation zone has been clear from any additional sightings for 10 min when the activity involves aircraft that have fuel constraints, or 30 min when the activity involves aircraft that are not typically fuel constrained.

(21) *Non-Explosive Bombs and Mine Shapes.* Non-explosive bombs and non-explosive mine shapes during mine laying activities.

(i) Number of Lookouts and Observation Platform—One Lookout positioned in an aircraft.

(ii) Mitigation Zone and Requirements—1,000 yd around the intended target.

(A) Prior to the start of the activity (*e.g.,* when arriving on station), the Navy shall observe for floating vegetation and marine mammals; if resource is observed, the Navy shall not commence bomb deployment or mine laying. During approach of the target or intended minefield location, the Navy shall observe for marine mammals; if resource is observed, the Navy shall cease bomb deployment or mine laying. To allow a sighted marine mammal to leave the mitigation zone, the Navy shall not recommence bomb deployment or mine laying until one of the recommencement conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended target or minefield location; the mitigation zone has been clear from any additional sightings for 10 min; or for activities using mobile targets, the intended target has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting.

(B) [Reserved]

(b) *Mitigation Areas.* In addition to procedural mitigation, the Navy shall implement mitigation measures within mitigation areas to avoid potential impacts on marine mammals.

(1) *Mitigation Areas off the Northeastern United States* for sonar, explosives, and physical disturbance and strikes.

(i) Mitigation Area Requirements—(A) Northeast North Atlantic Right Whale Mitigation Areas (year-round):

(*1*) The Navy shall minimize the use of low-frequency active sonar, mid-frequency active sonar, and high-frequency active sonar to the maximum extent practicable.

(*2*) The Navy shall not use Improved Extended Echo Ranging sonobuoys (within 3 nmi of the mitigation area), explosive and non-explosive bombs, in-water detonations, and explosive torpedoes.

(*3*) For activities using non-explosive torpedoes, the Navy shall conduct activities during daylight hours in Beaufort sea state 3 or less. The Navy shall use three Lookouts (one positioned on a vessel and two in an aircraft during dedicated aerial surveys) to observe the vicinity of the activity. An additional Lookout shall be positioned on the submarine, when surfaced. Immediately prior to the start of the activity, Lookouts shall observe for floating vegetation and marine mammals; if the resource is observed, the activity shall not commence. During the activity, Lookouts shall observe for marine mammals; if observed, the activity shall cease. To allow a sighted marine mammal to leave the area, the Navy shall not recommence the activity until one of the recommencement conditions has been met: The animal is observed exiting the vicinity of the activity; the animal is thought to have exited the vicinity of the activity based on a determination of its course, speed, and movement relative to the activity location; or the area has been clear from any additional sightings for 30 min. During transits and normal firing, ships shall maintain a speed of no more than 10 knots. During submarine target firing, ships shall maintain speeds of no more than 18 knots. During vessel target firing, ship speeds may exceed 18 knots for brief periods of time (*e.g.,* 10–15 min).

(*4*) For all activities, before vessel transits, the Navy shall conduct a web query or email inquiry to the National Oceanographic and Atmospheric Administration Northeast Fisheries Science Center's North Atlantic Right Whale Sighting Advisory System to obtain the latest North Atlantic right whale sighting information. Vessels shall use the obtained sightings information to reduce potential interactions with North Atlantic right whales during transits. Vessels shall implement speed reductions after they observe a North Atlantic right whale, if they are within 5 nmi of a sighting reported to the North Atlantic Right Whale Sighting Advisory System within the past week, and when operating at night or during periods of reduced visibility.

(B) Gulf of Maine Planning Awareness Mitigation Area (year-round):

(*1*) The Navy shall not plan major training exercises (Composite Training Unit Exercises or Fleet Exercises/Sustainment Exercises), and shall not conduct more than 200 hrs of hull-mounted mid-frequency active sonar per year.

(*2*) If the Navy needs to conduct major training exercises or more than 200 hrs of hull-mounted mid-frequency active sonar per year for national security, it shall provide NMFS with advance notification and include the information in any associated training or testing activities or monitoring reports.

(C) Northeast Planning Awareness Mitigation Areas (year-round):

(*1*) The Navy shall avoid planning major training exercises (Composite Training Unit Exercises or Fleet Exercises/Sustainment Exercises) to the maximum extent practicable.

(*2*) The Navy shall not conduct more than four major training exercises per year (all or a portion of the exercise).

(*3*) If the Navy needs to conduct additional major training exercises for national security, it shall provide NMFS with advance notification and include the information in any associated training activity or monitoring reports.

(ii) [Reserved]

(2) *Mitigation Areas off the Mid-Atlantic and Southeastern United States* for sonar, explosives, and physical disturbance and strikes.

(i) Mitigation Area Requirements—(A) Southeast North Atlantic Right Whale Mitigation Area (November 15 through April 15):

(*1*) The Navy shall not conduct: Low-frequency active sonar (except as noted below), mid-frequency active sonar (except as noted below), high-frequency active sonar, missile and rocket activities (explosive and non-explosive), small-, medium-, and large-caliber gunnery activities, Improved Extended Echo Ranging sonobuoy activities, explosive and non-explosive bombing activities, in-water detonations, and explosive torpedo activities.

(*2*) To the maximum extent practicable, the Navy shall minimize the use of: Helicopter dipping sonar, low-frequency active sonar and hull-mounted mid-frequency active sonar used for navigation training, and low-frequency active sonar and hull-mounted mid-frequency active sonar used for object detection exercises.

(*3*) Before transiting or conducting training or testing activities, the Navy shall initiate communication with the Fleet Area Control and Surveillance Facility, Jacksonville to obtain Early Warning System North Atlantic right whale sightings data. The Fleet Area Control and Surveillance Facility, Jacksonville shall advise vessels of all reported whale sightings in the vicinity to help vessels and aircraft reduce potential interactions with North Atlantic right whales. Commander Submarine Force, Atlantic shall coordinate any submarine operations that may require approval from the Fleet Area Control and Surveillance Facility, Jacksonville. Vessels shall use the obtained sightings information to reduce potential interactions with North Atlantic right whales during transits. Vessels shall implement speed reductions after they observe a North Atlantic right whale, if they are within 5 nmi of a sighting reported within the past 12 hrs, or when operating at night or during periods of poor visibility. To the maximum extent practicable, vessels shall minimize north-south transits.

(B) Mid-Atlantic Planning Awareness Mitigation Areas (year-round):

(*1*) The Navy shall avoid planning major training exercises (Composite Training Unit Exercises or Fleet Exercises/Sustainment Exercises) to the maximum extent practicable.

(*2*) The Navy shall not conduct more than four major training exercises per year (all or a portion of the exercise).

(*3*) If the Navy needs to conduct additional major training exercises for national security, it shall provide NMFS with advance notification and include the information in any associated training activity or monitoring reports.

(3) *Mitigation Areas in the Gulf of Mexico for sonar.* (i) Mitigation Area Requirements—(A) Gulf of Mexico Planning Awareness Mitigation Areas (year-round):

(*1*) The Navy shall avoid planning major training exercises (*i.e.,* Composite Training Unit Exercises or Fleet Exercises/Sustainment Exercises) involving the use of active sonar to the maximum extent practicable.

(*2*) The Navy shall not conduct any major training exercises in the Gulf of Mexico Planning Awareness Mitigation Areas under the Proposed Activity.

(*3*) If the Navy needs to conduct additional major training exercises in these areas for national security, it shall provide NMFS with advance notification and include the information in any associated training activity or monitoring reports.

(B) [Reserved]

§ 218.85 Requirements for monitoring and reporting.

(a) The Navy must notify NMFS immediately (or as soon as operational security considerations allow) if the specified activity identified in § 218.80 is thought to have resulted in the mortality or injury of any marine mammals, or in any take of marine mammals not identified in this subpart.

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

(c) Notification of injured, live stranded, or dead marine mammals. The Navy shall abide by the Notification and Reporting Plan, which sets out notification, reporting, and other requirements when dead, injured, or live stranded marine mammals are detected.

(d) Annual AFTT Study Area marine species monitoring report. The Navy shall submit an annual report of the AFTT Study Area monitoring describing the implementation and results from the previous calendar year. Data collection methods shall be standardized across range complexes and study areas to allow for comparison in different geographic locations. The report shall be submitted either 90 days after the calendar year, or 90 days after the conclusion of the monitoring year to be determined by the Adaptive Management process to the Director, Office of Protected Resources, NMFS. Such a report would describe progress of knowledge made with respect to monitoring plan study questions across all Navy ranges associated with the Integrated Comprehensive Monitoring Program. Similar study questions shall be treated together so that progress on each topic shall be summarized across all Navy ranges. The report need not include analyses and content that does not provide direct assessment of cumulative progress on the monitoring plan study questions.

(e) Annual AFTT Study Area training and testing reports. Each year, the Navy shall submit a preliminary report (Quick Look Report) detailing the status of authorized sound sources within 21 days after the anniversary of the date of issuance of each LOA to the Director, Office of Protected Resources, NMFS. Each year, the Navy shall submit a detailed report within 3 months after the anniversary of the date of issuance of each LOA the Director, Office of Protected Resources, NMFS. The annual reports shall contain information on

Major Training Exercises (MTEs), Sinking Exercise (SINKEX) events, and a summary of all sound sources used, as described in paragraph (e)(3) of this section. The analysis in the detailed report shall be based on the accumulation of data from the current year's report and data collected from previous the report. The detailed reports shall contain information identified in paragraphs (e)(1) through (5) of this section.

(1) MTEs—This section shall contain the following information for MTEs conducted in the AFTT Study Area:

(i) Exercise Information (for each MTE):

(A) Exercise designator.

(B) Date that exercise began and ended.

(C) Location.

(D) Number and types of active sonar sources used in the exercise.

(E) Number and types of passive acoustic sources used in exercise.

(F) Number and types of vessels, aircraft, etc., participating in exercise.

(G) Total hours of observation by lookouts.

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

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

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

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

(A) Date/Time/Location of sighting.

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

(C) Number of individuals.

(D) Initial Detection Sensor.

(E) Indication of specific type of platform observation made from (including, for example, what type of surface vessel or testing platform).

(F) Length of time observers maintained visual contact with marine mammal.

(G) Sea state.

(H) Visibility.

(I) Sound source in use at the time of sighting.

(J) Indication of whether animal is <200 yd, 200 to 500 yd, 500 to 1,000 yd, 1,000 to 2,000 yd, or >2,000 yd from sonar source.

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

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

(M) Observed behavior. Lookouts shall report, in plain language and without trying to categorize in any way, the observed behavior of the animals (such as animal closing to bow ride, paralleling course/speed, floating on surface and not swimming, etc.) and if any calves present.

(iii) An evaluation (based on data gathered during all of the MTEs) of the effectiveness of mitigation measures designed to minimize the received level to which marine mammals may be exposed. This evaluation shall identify the specific observations that support any conclusions the Navy reaches about the effectiveness of the mitigation.

(2) SINKEXs. This section shall include the following information for each SINKEX completed that year:

(i) Exercise information (gathered for each SINKEX):

(A) Location.

(B) Date and time exercise began and ended.

(C) Total hours of observation by lookouts before, during, and after exercise.

(D) Total number and types of explosive source bins detonated.

(E) Number and types of passive acoustic sources used in exercise.

(F) Total hours of passive acoustic search time.

(G) Number and types of vessels, aircraft, etc., participating in exercise.

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

(J) Narrative description of sensors and platforms utilized for marine mammal detection and timeline illustrating how marine mammal detection was conducted.

(ii) Individual marine mammal observation (by Navy lookouts) information (gathered for each marine mammal sighting) for each sighting where mitigation was implemented:

(A) Date/Time/Location of sighting.

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

(C) Number of individuals.

(D) Initial detection sensor.

(E) Length of time observers maintained visual contact with marine mammal.

(F) Sea state.

(G) Visibility.

(H) Whether sighting was before, during, or after detonations/exercise, and how many minutes before or after.

(I) Distance of marine mammal from actual detonations—200 yd, 200 to 500 yd, 500 to 1,000 yd, 1,000 to 2,000 yd, or >2,000 yd (or target spot if not yet detonated).

(J) Observed behavior. Lookouts shall report, in plain language and without trying to categorize in any way, the observed behavior of the animal(s) (such as animal closing to bow ride, paralleling course/speed, floating on surface and not swimming etc.), including speed and direction and if any calves present.

(K) Resulting mitigation implementation. Indicate whether explosive detonations were delayed, ceased, modified, or not modified due to marine mammal presence and for how long.

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

(3) Summary of sources used. This section shall include the following information summarized from the authorized sound sources used in all training and testing events:

(i) Total annual hours or quantity (per the LOA) of each bin of sonar or other acoustic sources (pile driving and air gun activities);

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

(4) Geographic information presentation. The reports shall present an annual (and seasonal, where practical) depiction of training and testing events and bin usage (as well as pile driving activities) geographically across the AFTT Study Area.

(5) Sonar exercise notification. The Navy shall submit to NMFS (contact as specified in the LOA) an electronic report within fifteen calendar days after the completion of any MTE indicating:

(i) Location of the exercise;

(ii) Beginning and end dates of the exercise; and

(iii) Type of exercise.

(f) Five-year close-out comprehensive training and testing report. This report shall be included as part of the 2023 annual training and testing report. This report shall provide the annual totals for each sound source bin with a comparison to the annual allowance and the five-year total for each sound source bin with a comparison to the five-year allowance. Additionally, if there were any changes to the sound source allowance, this report shall 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 EIS and final rule determinations. The report shall be submitted three months after the expiration of this subpart to the Director, Office of Protected Resources, NMFS. NMFS shall submit comments on the draft close-out report, if any, within three months of receipt. The report shall 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.

§ 218.86 Letters of Authorization.

(a) To incidentally take marine mammals pursuant to these regulations in this subpart, the Navy must apply for and obtain Letters of Authorization (LOAs) in accordance with § 216.106 of this subpart, conducting the activity identified in § 218.80(c).

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

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

(d) In the event of projected changes to the activity or to mitigation, monitoring, reporting (excluding changes made pursuant to the adaptive management provision of § 218.87(c)(1)) required by an LOA, the Navy must apply for and obtain a modification of LOAs as described in § 218.87.

(e) Each LOA shall set forth:

(1) Permissible methods of incidental taking;

(2) Authorized geographic areas for incidental taking;

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

(4) Requirements for monitoring and reporting.

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

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

§ 218.87 Renewals and modifications of Letters of Authorization.

(a) An LOA issued under §§ 216.106 and 218.86 of this subchapter for the activity identified in § 218.80(c) shall be renewed or modified upon request by the applicant, provided that:

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

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

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

(c) An LOA issued under § 216.106 of this subchapter and § 218.86 for the activity identified in § 218.80(c) may be modified by NMFS under the following circumstances:

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

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

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

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

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

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

(2) Emergencies—If NMFS determines that an emergency exists that poses a significant risk to the well-being of the species or stocks of marine mammals specified in LOAs issued pursuant to § 216.106 of this chapter and § 218.86, an LOA may be modified without prior notice or opportunity for public comment. Notice would be published in the **Federal Register** within thirty days of the action.

§§ 218.88–218.89 [Reserved]

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