DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 218

[200417–0114]

RIN 0648–BJ30

Taking and Importing Marine Mammals; Taking Marine Mammals Incidental to the U.S. Navy Training and Testing Activities in the Northwest Training and Testing (NWTT) Study Area

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

ACTION: Proposed rule; request for comments and information.

SUMMARY: NMFS has received a request from the U.S. Navy (Navy) to take marine mammals incidental to training and testing activities conducted in the Northwest Training and Testing (NWTT) 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 LOAs. Agency responses to public comments will be provided in the notice of the final decision. The Navy's activities qualify as military readiness activities pursuant to the MMPA, as amended by the National Defense Authorization Act for Fiscal Year 2004 (2004 NDAA).

DATES: Comments and information must be received no later than July 17, 2020.

ADDRESSES: You may submit comments on this document, identified by NOAA–NMFS–2020–0055, by any of the following methods:

- *Electronic submission:* Submit all electronic public comments via the Federal e-Rulemaking Portal. Go to *www.regulations.gov/#!docketDetail;D=NOAA-NMFS-2020-0055,* click the ''Comment Now!'' icon, complete the required fields, and enter or attach your comments.
- *Mail:* Submit written comments to Jolie Harrison, Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service, 1315 East-West Highway, Silver Spring, MD 20910.

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

A copy of the Navy's application and other supporting documents and documents cited herein may be obtained online at: *www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-military-readiness-activities.* In case of problems accessing these documents, please use the contact listed here (see **FOR FURTHER INFORMATION CONTACT**).

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

SUPPLEMENTARY INFORMATION:

Purpose of Regulatory Action

These proposed regulations, issued under the authority of the MMPA (16 U.S.C. 1361 *et seq.*), would provide the framework for authorizing the take of marine mammals incidental to the Navy's training and testing activities (which qualify as military readiness activities) from the use of sonar and other transducers, in-water detonations, and potential vessel strikes based on Navy movement in the NWTT Study Area. The Study Area includes air and water space off the coast of Washington, Oregon, and northern California; in the Western Behm Canal, Alaska; and portions of waters of the Strait of Juan de Fuca and Puget Sound, including Navy pierside and harbor locations in Puget Sound (see Figure 1–1 of the Navy's rulemaking/LOA application).

NMFS received an application from the Navy requesting seven-year regulations and authorizations to incidentally take individuals of multiple species of marine mammals (''Navy's rulemaking/LOA application'' or ''Navy's application''). Take is anticipated to occur by Level A harassment and Level B harassment as well as a very small number of serious injuries or mortalities incidental to the Navy's training and testing activities.

Background

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

An authorization for incidental takings shall be granted if NMFS finds that the taking will have a negligible impact on the species or stocks and will not have an unmitigable adverse impact on the availability of the species or stocks for taking for subsistence uses (where relevant). Further, NMFS must prescribe the permissible methods of taking and other means of effecting the least practicable adverse impact on the affected species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of such species or stocks for taking for certain subsistence uses (referred to in this rule as ''mitigation measures''); and requirements pertaining to the monitoring and reporting of such takings. The MMPA defines ''take'' to mean to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal. The *Preliminary Analysis and Negligible Impact Determination* section below discusses the definition of ''negligible impact.''

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

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

Summary and Background of Request

On March 11, 2019, NMFS received an application from the Navy for authorization to take marine mammals by Level A harassment and Level B harassment incidental to training and testing activities (which qualify as military readiness activities) from the use of sonar and other transducers and in-water detonations in the NWTT Study Area over a seven-year period beginning when the current authorization expires. In addition, the Navy requested incidental take authorization by serious injury or mortality for up to three takes of large whales from vessel strikes over the seven-year period. We received revised applications on June 6, 2019 and June 21, 2019 which provided revisions in the take number estimates and vessel strike analysis and Navy's rulemaking/LOA application was found to be adequate and complete. On August 6, 2019 (84 FR 38225), we published a notice of receipt (NOR) of application in the **Federal Register**, requesting comments and information related to the Navy's request for 30 days. We reviewed and considered all comments and information received on the NOR in development of this proposed rule. On October 4, 2019, the Navy submitted an amendment to its application which incorporated new Southern Resident killer whale offshore density information, and on December 19, 2019, the Navy submitted an amendment to its application which incorporated revised testing activity numbers.

The following types of training and testing, which are classified as military readiness activities pursuant to the MMPA, as amended by the 2004 NDAA, would be covered under the regulations and LOAs (if authorized): Anti-submarine warfare (sonar and other transducers, underwater detonations), mine warfare (sonar and other transducers, underwater detonations), surface warfare (underwater detonations), and other testing and training (sonar and other transducers). The activities would not include pile driving/removal or use of air guns.

This would be the third time NMFS has promulgated incidental take regulations pursuant to the MMPA relating to similar military readiness activities in the NWTT Study Area, following those effective from November 9, 2010 through November 8, 2015 (*75 FR 69275;* November 10, 2010) and from November 9, 2015 through November 8, 2020 (*80 FR 73555;* November 24, 2015).

The Navy's mission is to organize, train, equip, and maintain combat-ready naval forces capable of winning wars, deterring aggression, and maintaining freedom of the seas. This mission is mandated by Federal law (10 U.S.C. 8062), which requires the readiness of the naval forces of the United States. The Navy executes this responsibility in part by training and testing at sea, often in designated operating areas (OPAREA) and testing and training ranges. The Navy must be able to access and utilize these areas and associated sea space and air space in order to develop and maintain skills for conducting naval operations. The Navy's testing activities ensure naval forces are equipped with well-maintained systems that take advantage of the latest technological advances. The Navy's research and acquisition community conducts military readiness activities that involve testing. The Navy tests ships, aircraft, weapons, combat systems, sensors, and related equipment, and conducts scientific research activities to achieve and maintain military readiness.

The Navy has been conducting training and testing activities in the NWTT Study Area for decades, with some activities dating back to at least the early 1900s. The tempo and types of training and testing activities have fluctuated because of the introduction of new technologies, the evolving nature of international events, advances in warfighting doctrine and procedures, and changes in force structure (*e.g.,* organization of ships, submarines, aircraft, weapons, and personnel). Such developments influence the frequency, duration, intensity, and location of required training and testing activities, however the Navy's proposed activities for the period of this proposed rule would be largely a continuation of ongoing activities. In addition to ongoing activities, the Navy is proposing some new training activities such as torpedo exercise—submarine training and unmanned underwater vehicle training.[1] The Navy is also proposing some new testing activities, including: At-sea sonar testing, mine countermeasure and neutralization testing, mine detection and classification testing, kinetic energy weapon testing, propulsion testing, undersea warfare testing, vessel signature evaluation, acoustic and oceanographic research, radar and other system testing, and simulant testing.[2]

The Navy's rulemaking/LOA application reflects the most up-to-date compilation of training and testing activities deemed necessary by senior Navy leadership to accomplish military readiness requirements. The types and numbers of activities included in the proposed rule account for fluctuations in training and testing in order to meet evolving or emergent military readiness requirements. These proposed regulations would cover training and testing activities that would occur for a seven-year period following the expiration of the current MMPA authorization for the NWTT Study Area, which expires on November 8, 2020.

Description of the Specified Activity

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

[1] Some of the activities included here are new to the 2019 NWTT DSEIS/OEIS, but are not new to the Study Area. TORPEX—SUB activity was previously analyzed in 2010 as part of the Sinking Exercise. The Sinking Exercise is no longer conducted in the NWTT Study Area and the TORPEX—SUB activity is now a separate activity included in the NWTT DSEIS/OEIS. Unmanned underwater vehicle activity was analyzed in 2010 as a testing activity, but is now being included as a training activity.

[2] Mine detection and classification testing was analyzed in 2010 in the Inland waters, but was not previously analyzed in the Offshore waters. Vessel signature evaluation testing was analyzed in 2010 as a component to other activities, but is included in the list of new activities because it was not previously identified as an independent activity.

Dates and Duration

The specified activities would occur at any time during the seven-year period of validity of the regulations. The proposed number of training and testing activities are described in the *Detailed Description of the Specified Activities* section (Tables 3 through 4).

Geographical Region

The NWTT Study Area is composed of established maritime operating and warning areas in the eastern North Pacific Ocean region, including areas of the Strait of Juan de Fuca, Puget Sound, and Western Behm Canal in southeastern Alaska. The Study Area includes air and water space within and outside Washington state waters, within Alaska state waters, and outside state waters of Oregon and Northern California (Figure 1). The eastern boundary of the Offshore Area portion of the Study Area is 12 nautical miles (nmi) off the coastline for most of the Study Area, including southern Washington, Oregon, and Northern California. The Offshore Area includes the ocean all the way to the coastline only along that part of the Washington coast that lies beneath the airspace of W–237 and the Olympic Military Operating Area (MOA) and the Washington coastline north of the Olympic MOA. The Study Area includes four existing range complexes and facilities: The Northwest Training Range Complex, the Keyport Range Complex, Carr Inlet Operations Area, and the Southeast Alaska Acoustic Measurement Facility (Western Behm Canal, Alaska). In addition to these range complexes, the Study Area also includes Navy pierside locations where sonar maintenance and testing occurs as part of overhaul, modernization, maintenance, and repair activities at Naval Base Kitsap, Bremerton; Naval Base Kitsap, Bangor; and Naval Station Everett. Additional detail can be found in Chapter 2 of the Navy's rulemaking/ LOA application.

BILLING CODE 3510–22–P

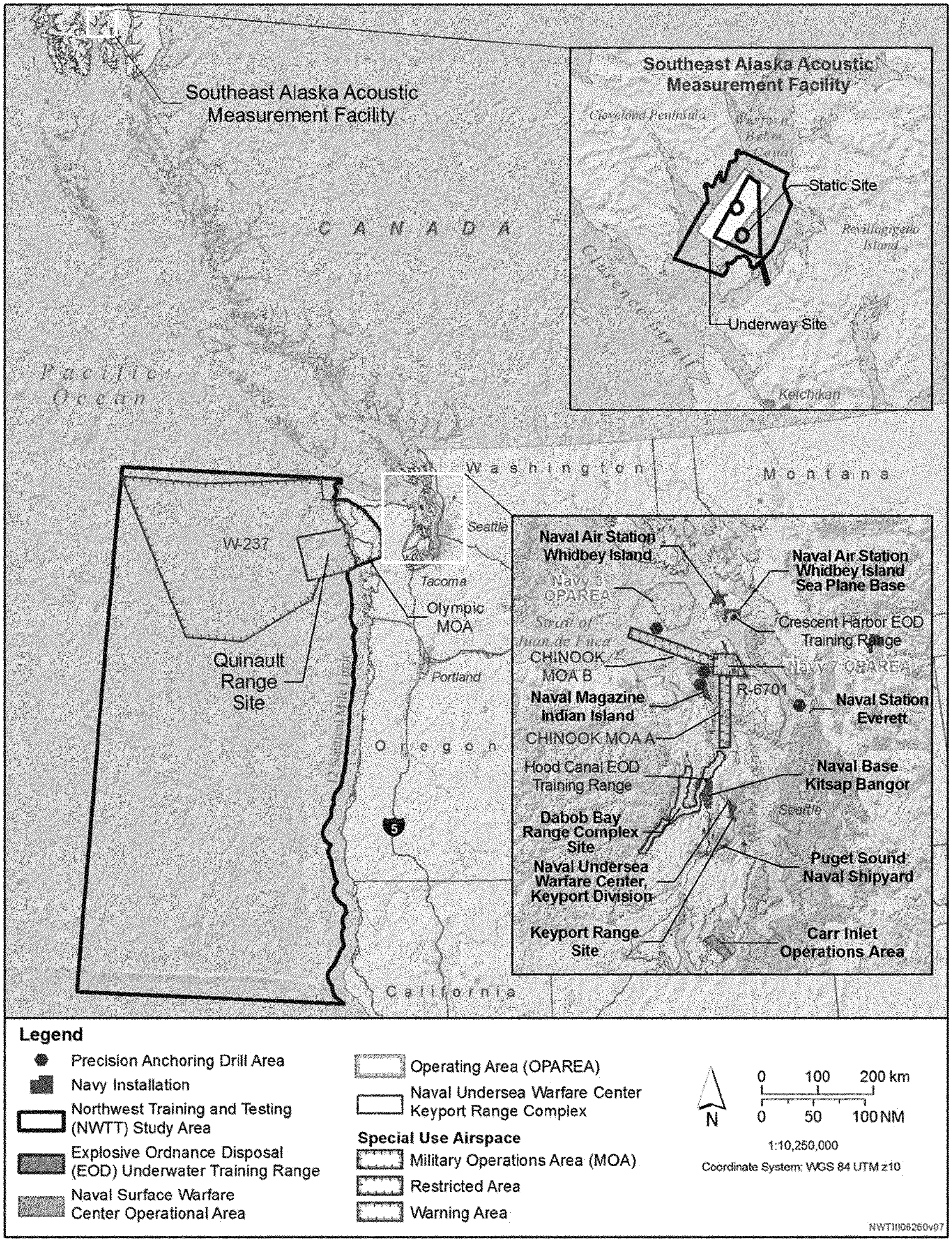

Figure 1 -- Map of the NWTT Study Area (a color version of this map can be found at *https://www.fisheries.noaa.gov/action/incidental-take-authorization-us-navy-northwest-training-and-testing-nwtt-2020*.

BILLING CODE 3510–22–C

Primary Mission Areas

The Navy categorizes many of its training and testing activities into functional warfare areas called primary mission areas. The Navy's proposed activities for NWTT generally fall into the following six primary mission areas: Air warfare; anti-submarine warfare; electronic warfare; expeditionary warfare; mine warfare; and surface warfare. Most activities conducted in NWTT are categorized under one of these primary mission areas; activities that do not fall within one of these areas are listed as ''other activities.'' Each warfare community (surface, subsurface, aviation, and expeditionary warfare) may train in some or all of these primary mission areas. The research and acquisition community also categorizes most, but not all, of its testing activities under these primary mission areas. A description of the sonar, munitions, targets, systems, and other material used during training and testing activities within these primary mission areas is provided in Appendix A (*Navy Activities Descriptions*) of the 2019 NWTT DSEIS/OEIS.

The Navy describes and analyzes the effects of its activities within the 2019 NWTT DSEIS/OEIS. In its assessment, the Navy concluded that sonar and other transducers and underwater detonations were the stressors most likely to result in impacts on marine mammals that could rise to the level of harassment as defined under the MMPA. Therefore, the Navy's rulemaking/LOA application provides the Navy's assessment of potential effects from these stressors in terms of the various warfare mission areas in which they would be conducted. Those mission areas include the following:

- Anti-submarine warfare (sonar and other transducers, underwater detonations);
- expeditionary warfare;
- mine warfare (sonar and other transducers, underwater detonations);
- surface warfare (underwater detonations); and
- other (sonar and other transducers).

The Navy's training and testing activities in air warfare and electronic warfare do not involve sonar and other transducers, underwater detonations, or any other stressors that could result in harassment, serious injury, or mortality of marine mammals. Therefore, the activities in air warfare and electronic warfare are not discussed further in this proposed rule, but are analyzed fully in the 2019 NWTT DSEIS/OEIS.

Anti-Submarine Warfare

The mission of anti-submarine warfare is to locate, neutralize, and defeat hostile submarine forces that threaten Navy surface forces. Anti-submarine warfare can involve various assets such as aircraft, ships, and submarines which all search for hostile submarines. These forces operate together or independently to gain early warning and detection, and to localize, track, target, and attack submarine threats.

Anti-submarine warfare training addresses basic skills such as detecting and classifying submarines, as well as evaluating sounds to distinguish between enemy submarines and friendly submarines, ships, and marine life. More advanced training integrates the full spectrum of anti-submarine warfare, from detecting and tracking a submarine to attacking a target using either exercise torpedoes (*i.e.,* torpedoes that do not contain a warhead), or simulated weapons. These integrated anti-submarine warfare training exercises are conducted in coordinated, at-sea training events involving submarines, ships, and aircraft.

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

Mine Warfare

The mission of mine warfare is to detect, classify, and avoid or neutralize (disable) mines to protect Navy ships and submarines and to maintain free access to ports and shipping lanes. Mine warfare also includes training and testing in offensive mine laying to gain control of or deny the enemy access to sea space. Naval mines can be laid by ships, submarines, or aircraft.

Mine warfare training includes exercises in which ships, aircraft, submarines, underwater vehicles, unmanned vehicles, or marine mammal detection systems search for mine shapes. Personnel train to destroy or disable mines by attaching underwater explosives to or near the mine or using remotely operated vehicles to destroy the mine. Towed influence mine sweep systems mimic a particular ship's magnetic and acoustic signature, which would trigger a real mine, causing it to explode.

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

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

Surface Warfare

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

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

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

Other Activities

The Navy conducts other training and testing activities in the Study Area that fall outside of the primary mission areas, but support overall readiness. Surface ship crews conduct Maritime Security Operations events, including maritime security escorts for Navy vessels such as Fleet Ballistic Missile Submarines; Visit, Board, Search, and Seizure; Maritime Interdiction Operations; Force Protection; Anti-Piracy Operations, Acoustic Component Testing, Cold Water Support, and Hydrodynamic and Maneuverability testing. Anti-terrorism/Force-protection training will occur as small boat attacks against moored ships at one of the Navy's piers inside Puget Sound. Pierside and at-sea maintenance of ship and submarine sonar is required for systems upkeep and systems evaluation.

Description of Stressors

The Navy uses a variety of sensors, platforms, weapons, and other devices, including ones used to ensure the safety of Sailors, to meet its mission. Training and testing with these systems may introduce acoustic (sound) energy or shock waves from explosives into the environment. The proposed training and testing activities were evaluated to identify 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 marine mammals and their habitat (including prey species) within the NWTT Study Area. Each description contains a list of activities that may generate the stressor. Stressor/resource interactions that were determined to have de minimis or no impacts (*e.g.,* vessel noise, aircraft noise, weapons noise, and explosions in air) were not carried forward for analysis in the Navy's rulemaking/LOA application. No Major Training Exercises (MTEs) or Sinking Exercise (SINKEX) events are proposed in the NWTT Study Area. NMFS reviewed the Navy's analysis and conclusions on de minimis sources and finds them complete and supportable.

Acoustic Stressors

Acoustic stressors include acoustic signals emitted into the water for a specific purpose, such as sonar, other transducers (devices that convert energy from one form to another—in this case, into sound waves), incidental sources of broadband sound produced as a byproduct of vessel movement, aircraft transits, and use of weapons or other deployed objects. Explosives also produce broadband sound but are characterized separately from other acoustic sources due to their unique hazardous characteristics. Characteristics of each of these sound sources are described in the following sections.

In order to better organize and facilitate the analysis of approximately 300 sources of underwater sound used in training and testing activities by the Navy, including sonar and other transducers and explosives, a series of source classifications, or source bins, were developed. The source classification bins do not include the broadband noise produced incidental to vessel and aircraft transits and weapons firing. Noise produced from vessel, aircraft, and weapons firing activities are not carried forward because those activities were found to have de minimis or no impacts, as stated above.

The use of source classification bins provides the following benefits:

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

Sonar and Other Transducers

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

The Navy employs a variety of sonars and other transducers to obtain and transmit information about the undersea environment. Some examples are mid-frequency hull-mounted sonars used to find and track enemy submarines; high-frequency small object detection sonars used to detect mines; high-frequency underwater modems used to transfer data over short ranges; and extremely high-frequency (greater than 200 kilohertz (kHz)) doppler sonars used for navigation, like those used on commercial and private vessels. The characteristics of these sonars and other transducers, such as source level, beam width, directivity, and frequency, depend on the purpose of the source. Higher frequencies can carry more information or provide more information about objects off which they reflect, but attenuate more rapidly. Lower frequencies attenuate less rapidly, so they 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 2019 NWTT DSEIS/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 Study Area.

The sound sources and platforms typically used in naval activities analyzed in the Navy's rulemaking/LOA application are described in Appendix A (*Navy Activities Descriptions*) of the 2019 NWTT DSEIS/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 anti-submarine warfare training and testing would impart the greatest amount of acoustic energy of any category of sonar and other transducers analyzed in this proposed rule. Types of sonars used to detect potential 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 anti-submarine warfare 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. Anti-submarine warfare sonars can be wide-ranging in a search mode or highly directional in a track mode.

Most anti-submarine warfare 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 anti-submarine warfare activities would typically be used beyond 12 nmi from shore. Exceptions include use of dipping sonar by helicopters, pierside testing and 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 as 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 temporary minefields close to strategic ports and harbors, or at targets of opportunity such as navigation buoys. 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 NWTT 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 NWTT 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. As detailed below, classes are further sorted by bins based on the frequency or bandwidth; source level; and, when warranted, the application in which the source would be used. Unless stated otherwise, a reference distance of 1 meter (m) is used for sonar and other transducers.

- Frequency of the non-impulsive acoustic source:
  - Low-frequency sources operate below 1 kHz;
  - Mid-frequency sources operate at and above 1 kHz, up to and including 10 kHz;
  - High-frequency sources operate above 10 kHz, up to and including 100 kHz; and
  - Very-high-frequency sources operate above 100 kHz but below 200 kHz.
- Sound pressure level:
  - Greater than 160 decibels (dB) referenced to 1 micropascal (re: 1 µPa), but less than 180 dB re: 1 µPa;
  - Equal to 180 dB re: 1 µPa and up to 200 dB re: 1 µPa; and
  - 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 Study Area are shown in Table 1. While general parameters or source characteristics are shown in the table, actual source parameters are classified.

TABLE 1—SONAR AND OTHER TRANSDUCERS QUANTITATIVELY ANALYZED IN THE NWTT STUDY AREA

Source class category	Bin	Description
Low-Frequency (LF): Sources that produce signals less than 1 kHz.	LF4	LF sources equal to 180 dB and up to 200 dB.
	LF5	LF sources less than 180 dB.
Mid-Frequency (MF): Tactical and non-tactical sources that produce signals between 1 and 10 kHz.	MF1	Hull-mounted surface ship sonars (*e.g.,* AN/SQS–53C and AN/SQS–60).
	MF1K	Kingfisher mode associated with MF1 sonars.

TABLE 1—SONAR AND OTHER TRANSDUCERS QUANTITATIVELY ANALYZED IN THE NWTT STUDY AREA—Continued

Source class category	Bin	Description
	MF2	Hull-mounted surface ship sonars (*e.g.,* AN/SQS–56).
	MF3	Hull-mounted submarine sonars (*e.g.,* AN/BQQ–10).
	MF4	Helicopter-deployed dipping sonars (*e.g.,* AN/AQS–22).
	MF5	Active acoustic sonobuoys (*e.g.,* DICASS).
	MF6	Underwater sound signal devices (*e.g.,* MK 84 SUS).
	MF9	Sources (equal to 180 dB and up to 200 dB) not otherwise binned.
	MF10	Active sources (greater than 160 dB, but less than 180 dB) not otherwise binned.
	MF11	Hull-mounted surface ship sonars with an active duty cycle greater than 80%.
	MF12	Towed array surface ship sonars with an active duty cycle greater than 80%.
High-Frequency (HF): Tactical and non-tactical sources that produce signals between 10 and 100 kHz.	HF1	Hull-mounted submarine sonars (*e.g.,* AN/BQQ–10).
	HF3	Other hull-mounted submarine sonars (classified).
	HF4	Mine detection, classification, and neutralization sonar (*e.g.,* AN/SQS–20).
	HF5	Active sources (greater than 200 dB) not otherwise binned.
	HF6	Sources (equal to 180 dB and up to 200 dB) not otherwise binned.
	HF8	Hull-mounted surface ship sonars (*e.g.,* AN/SQS–61).
	HF9	Weapon-emulating sonar source.
Very High-Frequency (VHF): Tactical and non-tactical sources that produce signals greater than 100 kHz but less than 200 kHz.	VHF1	Active sources greater than 200 dB.
	VHF2	Active sources with a source level less than 200 dB.
Anti-Submarine Warfare (ASW): Tactical sources (*e.g.,* active sonobuoys and acoustic countermeasures systems) used during ASW training and testing activities.	ASW1	MF systems operating above 200 dB.
	ASW2	MF Multistatic Active Coherent sonobuoy (*e.g.,* AN/SSQ–125).
	ASW3	MF towed active acoustic countermeasure systems (*e.g.,* AN/SLQ–25).
	ASW4	MF expendable active acoustic device countermeasures (*e.g.,* MK 3).
	ASW5 [1]	MF sonobuoys with high duty cycles.
Torpedoes (TORP): Active acoustic signals produced by torpedoes.	TORP1	Lightweight torpedo (*e.g.,* MK 46, MK 54, or Anti-Torpedo Torpedo).
	TORP2	Heavyweight torpedo (*e.g.,* MK 48).
	TORP3	Heavyweight torpedo (*e.g.,* MK 48).
Looking Sonar (FLS): Forward or upward looking object avoidance sonars used for ship navigation and safety.	FLS2	HF sources with short pulse lengths, narrow beam widths, and focused beam patterns.
Acoustic Modems (M): Sources used to transmit data	M3	MF acoustic modems (greater than 190 dB).
Synthetic Aperture Sonars (SAS): Sonars used to form high-resolution images of the seafloor.	SAS2	HF SAS systems.
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.

[1] Formerly ASW2 in the 2015–2020 (Phase II) rulemaking.

Explosive Stressors

The near-instantaneous rise from ambient to an extremely high peak pressure is what makes an explosive shock wave potentially damaging. Farther from an explosive, the peak pressures decay and the explosive waves propagate as an impulsive, broadband sound. Several parameters influence the effect of an explosive: The weight of the explosive in the warhead, the type of explosive material, the boundaries and characteristics of the propagation medium, and the detonation depth in water. The net explosive weight, which is the explosive power of a charge expressed as the equivalent weight of trinitrotoluene (TNT), accounts for the first two parameters. The effects of these factors are explained in Appendix D (*Acoustic and Explosive Concepts*) of the 2019 NWTT DSEIS/OEIS. The activities analyzed in the Navy's rulemaking/LOA application that use explosives are described in Appendix A (*Navy Activities Descriptions*) of the 2019 NWTT DSEIS/OEIS. Explanations of the terminology and metrics used when describing explosives are provided in Appendix D (*Acoustic and Explosive Concepts*) of the 2019 NWTT DSEIS/OEIS.

Explosives in Water

Explosive detonations during training and testing activities are associated with high-explosive munitions, including, but not limited to, bombs, missiles, naval gun shells, torpedoes, mines, demolition charges, and explosive sonobuoys. Explosive detonations during training and testing involving the use of high-explosive munitions, including bombs, missiles, and naval gun shells, could occur in the air or 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. Detonations would typically occur in waters greater than 200 ft in depth, and greater than 50 nmi from shore, with the exception of mine countermeasure and neutralization testing proposed in the Offshore Area, and existing mine warfare areas in Inland Waters (*i.e.,* Crescent Harbor and Hood Canal Explosive Ordnance Disposal Training Ranges). Mine countermeasure and neutralization testing is a new proposed testing activity that would occur closer to shore than other in-water explosive activities analyzed in the 2015 NWTT Final EIS/OEIS for the Offshore Area of the NWTT Study Area. This activity would occur in waters 3 nmi or greater from shore in the Quinault Range Site (outside the Olympic Coast National Marine Sanctuary), or 12 nmi or greater from shore elsewhere in the Offshore Area. Two of the three events would involve the use of explosives, and would typically occur in water depths shallower than 1,000 ft. The two multi-day events (1–10 days per event) would include up to 36 E4 explosives (>2.5–5 lb net explosive weight) and 5 E7 explosives (>20–60 lb net explosive weight). 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 discussed above and as described for acoustic source classification bins in Section 1.4.1 (Acoustic Stressors) of the Navy's rulemaking/LOA application.

Explosives detonated in water are binned by net explosive weight. The bins of explosives that are proposed for use in the Study Area are shown in Table 2 below.

TABLE 2—EXPLOSIVE SOURCES QUANTITATIVELY ANALYZED THAT COULD BE USED UNDERWATER OR AT THE WATER SURFACE IN THE STUDY AREA

Bin	Net explosive weight (lb)	Example explosive source	Modeled detonation depths (ft)
E1	0.1–0.25	Medium-caliber projectiles	0.3, 60.
E2	>0.25–0.5	Medium-caliber projectiles	0.3.
E3	>0.5–2.5	Explosive Ordnance Disposal Mine Neutralization	33, 60.
E4	>2.5–5	Mine Countermeasure and Neutralization	197, 262, 295, 394.
E5	>5–10	Large-caliber projectile	0.3.
E7	>20–60	Mine Countermeasure and Neutralization	33, 98, 230, 295.
E8	>60–100	Lightweight torpedo	150.
E10	>250–500	1,000 lb bomb	0.3.
E11	>500–650	Heavyweight torpedo	300, 656.

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

Propagation of explosive pressure waves in water is highly dependent on environmental characteristics such as bathymetry, bottom type, water depth, temperature, and salinity, which affect how the pressure waves are reflected, refracted, or scattered; the potential for reverberation; and interference due to multi-path propagation. In addition, absorption greatly affects the distance over which higher-frequency components of explosive broadband noise can propagate. Appendix D (*Acoustic and Explosive Concepts*) of the 2019 NWTT DSEIS/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 Study Area.

Explosive Fragments

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

Other Stressor—Vessel Strike

NMFS also considered the chance that a vessel utilized in training or testing activities could strike a marine mammal. Vessel strikes have the potential to result in incidental take from serious injury and/or mortality. Vessel strikes are not specific to any particular training or testing activity, but rather are a limited, sporadic, and incidental result of Navy vessel movement during training and testing activities within a Study Area. Vessel strikes from commercial, recreational, and military vessels are known to seriously injure and occasionally kill cetaceans (Abramson *et al.,* 2011; Berman-Kowalewski *et al.,* 2010; Calambokidis, 2012; Douglas *et al.,* 2008; Laggner, 2009; Lammers *et al.,* 2003; Van der Hoop *et al.,* 2012; Van der Hoop *et al.,* 2013), although reviews of the literature on ship strikes mainly involve collisions between commercial vessels and whales (Jensen and Silber, 2003; Laist *et al.,* 2001). Vessel speed, size, and mass are all important factors in determining both the potential likelihood and impacts of a vessel strike to marine mammals (Conn and Silber, 2013; Gende *et al.,* 2011; Silber *et al.,* 2010; Vanderlaan and Taggart, 2007; Wiley *et al.,* 2016). For large vessels, speed and angle of approach can influence the severity of a strike.

Navy vessels transit at speeds that are optimal for fuel conservation and to meet training and testing requirements. Vessels used as part of the proposed Specified Activities include ships, submarines, unmanned vessels, and boats ranging in size from small, 22 ft (7 m) rigid hull inflatable boats to aircraft carriers with lengths up to 1,092 ft (333 m). The average speed of large Navy ships ranges between 10 and 15 knots (kn) and submarines generally operate at speeds in the range of 8 to 13 kn, while a few specialized vessels can travel at faster speeds. Small craft (for purposes of this analysis, less than 60 ft (18 m) in length) have much more variable speeds (0 to 50+ kn, dependent on the activity), but generally range from 10 to 14 kn. From unpublished Navy data, average median speed for large Navy ships in the other Navy ranges from 2011–2015 varied from 5 to 10 kn with variations by ship class and location (*i.e.,* slower speeds close to the coast). Similar patterns would occur in the NWTT Study Area. A full description of Navy vessels that are used during training and testing activities can be found in Chapter 2 (*Description of Proposed Action and Alternatives*) of the 2019 NWTT DSEIS/OEIS.

While these speeds are representative of most events, some vessels need to temporarily operate outside of these parameters for certain times or during certain activities. For example, to produce the required relative wind speed over the flight deck, an aircraft carrier engaged in flight operations must adjust its speed through the water accordingly. Conversely, there are other instances, such as launch and recovery of a small rigid hull inflatable boat; vessel boarding, search, and seizure training events; or retrieval of a target when vessels will be dead in the water or moving slowly ahead to maintain steerage.

Large Navy vessels (greater than 60 ft (18 m) in length) within the offshore areas of range complexes and testing ranges operate differently from commercial vessels in ways that may reduce potential whale collisions. Surface ships operated by or for the Navy have multiple personnel assigned to stand watch at all times, when a ship or surfaced submarine is moving through the water (underway). A primary duty of personnel standing watch on surface ships is to detect and report all objects and disturbances sighted in the water that may indicate a threat to the vessel and its crew, such as debris, a periscope, surfaced submarine, or surface disturbance. Per vessel safety requirements, personnel standing watch also report any marine mammals sighted in the path of the vessel as a standard collision avoidance procedure. All vessels proceed at a safe speed so they can take proper and effective action to avoid a collision with any sighted object or disturbance, and can be stopped within a distance appropriate to the prevailing circumstances and conditions.

Detailed Description of Proposed Activities

Proposed Training and Testing Activities

The training and testing activities that the Navy proposes to conduct in the NWTT Study Area are summarized in Table 3 (training) and Table 4 (testing). The tables are organized according to primary mission areas and include the activity name, associated stressor(s) of Navy's activities, description and duration of the activity, sound source bin, the areas where the activities are conducted in the NWTT Study Area, and the number of activities. Under the ''Annual # of Events'' column, events show either a single number or a range of numbers to indicate the maximum number of times that activity could occur during any single year. The ''7-Year # of Events'' is the maximum number of times an activity would occur over the 7-year period of proposed regulations. For further information regarding the primary platform used (*e.g.,* ship or aircraft type) see Appendix A (*Training and Testing Activities Descriptions*) of the 2019 NWTT DSEIS/OEIS.

The Navy's proposed activities reflect a representative year of training and testing to account for the natural fluctuation of training and testing cycles and deployment schedules that generally prevents the maximum level of activities from occurring year after year in any 7-year period. As shown in the tables of activities, the number of some activities may vary from year to year, and the level of variability can differ by activity. Still, the annual analysis assumes a ''maximum'' year. For the purposes of this request, the Navy assumes that some unit-level training would be conducted using synthetic means (*e.g.,* simulators). Additionally, the request assumes that some unit-level active sonar training and some testing will be completed during other scheduled activities.

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

Stressor category	Activity	Description	Typical duration	Source bin	Location	Annual # of events	7-Year # of events
		Anti-Submarine Warfare					
Acoustic; Explosive	Torpedo Exercise—Submarine (TORPEX—Sub).	Submarine crews search for, track, and detect submarines. Event would include one MK–48 torpedo used during this event.	8 hours	TORP2	Offshore Area >12 nmi from land.	0–2	5
Acoustic	Tracking Exercise—Helicopter (TRACKEX—Helo).	Helicopter crews search for, track, and detect submarines.	2–4 hours	MF4, MF5	Offshore Area >12 nmi from land.	0–2	5
Acoustic	Tracking Exercise—Maritime Patrol Aircraft (TRACKEX—MPA).	Maritime patrol aircraft crews search for, track, and detect submarines.	2–8 hours	ASW2, ASW5, MF5, TORP1.	Offshore Area >12 nmi from land.	373	2,611
Acoustic	Tracking Exercise—Ship (TRACKEX—Ship).	Surface ship crews search for, track, and detect submarines.	2–4 hours	ASW3, MF1, MF11.	Offshore Area	62	434
Acoustic	Tracking Exercise—Submarine (TRACKEX—Sub).	Submarine crews search for, track, and detect submarines.	8 hours	HF1, MF3	Offshore Area	75–100	595
		Mine Warfare					
Acoustic	Civilian Port Defense—Homeland Security Anti-Terrorism/Force Protection Exercises.	Maritime security personnel train to protect civilian ports and harbors against enemy efforts to interfere with access to those ports.	Multiple days	HF4, SAS2.	Inland Waters	0–1	5

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

Stressor category	Activity	Description	Typical duration	Source bin	Location	Annual # of events	7-Year # of events
Explosive	Mine Neutralization—Explosive Ordnance Disposal (EOD).	Personnel disable threat mines using explosive charges.	Up to 4 hours	E3	Crescent Harbor EOD Training Range, Hood Canal EOD Training Range.	12	84
		Surface Warfare					
Explosive	Bombing Exercise (Air-to-Surface) (BOMBEX [A–S]).	Fixed-wing aircrews deliver bombs against surface targets.	1 hour	E10	Offshore Area (W–237) >50 nmi from land.	*0–2	5
Explosive	Gunnery Exercise (Surface-to-Surface)—Ship (GUNEX [S–S]—Ship).	Surface ship crews fire large- and medium-caliber guns at surface targets.	Up to 3 hours	E1, E2, E5	Offshore Area >50 nmi from land.	*90	504
Explosive	Missile Exercise (Air-to-Surface) (MISSILEX [A–S]).	Fixed-wing aircrews simulate firing precision-guided missiles, using captive air training missiles (CATMs) against surface targets. Some activities include firing a missile with a high-explosive (HE) warhead.	2 hours	E10	Offshore Area (W–237) >50 nmi from land.	0–2	5
		Other Training					
Acoustic	Submarine Sonar Maintenance.	Maintenance of submarine sonar and other system checks are conducted pierside or at sea.	Up to 1 hour	LF5, MF3	NBK Bangor, NBK Bremerton, and Offshore Area >12 nmi from land.	26	182
Acoustic	Surface Ship Sonar Maintenance.	Maintenance of surface ship sonar and other system checks are conducted pierside or at sea.	Up to 4 hours	MF1	NBK Bremerton, NS Everett, and Offshore Area >12 nmi from land.	25	175
Acoustic	Unmanned Underwater Vehicle Training.	Unmanned underwater vehicle certification involves training with unmanned platforms to ensure submarine crew proficiency. Tactical development involves training with various payloads for multiple purposes to ensure that the systems can be employed effectively in an operational environment.	Up to 24 hours.	FLS2, M3	Inland Waters, Offshore Area.	60	420

*(Counts only the explosive events).

TABLE 4—PROPOSED TESTING ACTIVITIES ANALYZED FOR THE SEVEN-YEAR PERIOD IN THE NWTT STUDY AREA

Stressor category	Activity	Description	Typical duration	Source bin	Location	Annual # of events	7-Year # of events
		Naval Sea Systems Command Testing Activities					
Anti-Submarine Warfare:							
Acoustic	Anti-Submarine Warfare Testing.	Ships and their supporting platforms (rotary-wing aircraft and unmanned aerial systems) detect, localize, and prosecute submarines.	4–8 hours of active sonar use.	ASW1, ASW2, ASW3, ASW5, MF1K, MF4, MF5, MF10, MF11, MF12, TORP1.	Offshore Area	44	308
Acoustic	At-Sea Sonar Testing.	At-sea testing to ensure systems are fully functional in an open ocean environment.	From 4 hours to 11 days.	ASW3, HF1, HF5, M3, MF3. ASW3, HF5, TORP1.	Offshore Area Inland Waters (DBRC).	4 4–6	28 34
Acoustic	Countermeasure Testing.	Countermeasure testing involves the testing of systems that will detect, localize, and track incoming weapons, including marine vessel targets. Countermeasures may be systems to obscure the vessel's location or systems to rapidly detect, track, and counter incoming threats. Testing includes surface ship torpedo defense systems and marine vessel stopping payloads.	From 4 hours to 6 days.	ASW3, ASW4, HF8, MF1, TORP2. ASW3, ASW4 ASW4	Offshore Area (QRS). Inland Waters (DBRC, Keyport Range Site). Western Behm Canal, AK.	14 29 1	98 203 5

TABLE 4—PROPOSED TESTING ACTIVITIES ANALYZED FOR THE SEVEN-YEAR PERIOD IN THE NWTT STUDY AREA—Continued

Stressor category	Activity	Description	Typical duration	Source bin	Location	Annual # of events	7-Year # of events
Acoustic	Pierside-Sonar Testing.	Pierside testing to ensure systems are fully functional in a controlled pierside environment prior to at-sea test activities.	Up to 3 weeks	ASW3, HF3, MF1, MF2, MF3, MF9, MF10, MF12.	Inland Waters (NS Everett, NBK Bangor, NBK Bremerton).	88–99	635
Acoustic	Submarine Sonar Testing/Maintenance.	Pierside, moored, and underway testing of submarine systems occurs periodically following major maintenance periods and for routine maintenance.	Up to 3 weeks	HF6, MF9	Western Behm Canal, AK.	1–2	10
Acoustic; Explosive	Torpedo (Explosive) Testing.	Air, surface, or submarine crews employ explosive and non-explosive torpedoes against artificial targets.	1–2 hours during daylight only.	E8, E11, ASW3, HF1, HF6, MF1, MF3, MF4, MF5, MF6, TORP1, TORP2.	Offshore Area >50 nmi from land.	4	28
Acoustic	Torpedo (Non-explosive) Testing.	Air, surface, or submarine crews employ non-explosive torpedoes against targets, submarines, or surface vessels.	Up to 2 weeks	ASW3, ASW4, HF1, HF5, HF6, MF1, MF3, MF4, MF5, MF6, MF9, MF10, TORP1, TORP2.	Offshore Area	22	154
				HF6, LF4, TORP1, TORP2, TORP3.	Inland Waters (DBRC).	61	427
Mine Warfare:							
Acoustic; Explosive	Mine Countermeasure and Neutralization Testing.	Air, surface, and subsurface vessels neutralize threat mines and mine-like objects.	1–10 days	E4, E7, HF4	Offshore Area	3	15
				HF4	Inland Waters	3	13
Acoustic	Mine Detection and Classification Testing.	Air, surface, and subsurface vessels and systems detect and classify mines and mine-like objects. Vessels also assess their potential susceptibility to mines and mine-like objects.	Up to 24 days	BB1, BB2, LF4	Offshore Area (QRS).	1	7
				BB1, BB2, HF4, LF4.	Inland Waters (DBRC, Keyport Range Site).	42	294
Unmanned Systems:							
Acoustic	Unmanned Underwater Vehicle Testing.	Testing involves the production or upgrade of unmanned underwater vehicles. This may include testing of mission capabilities (*e.g.,* mine detection), evaluating the basic functions of individual platforms, or conducting complex events with multiple vehicles.	Typically 1–2 days, up to multiple months.	FLS2, HF5, TORP1, VHF1.	Offshore Area (QRS).	38–39	269
				DS3, FLS2, HF5, HF9, M3, SAS2, VHF1, TORP1.	Inland Waters (DBRC, Keyport Range Site, Carr Inlet).	371–379	2,615
Vessel Evaluation:							
Acoustic	Undersea Warfare Testing.	Ships demonstrate capability of countermeasure systems and underwater surveillance, weapons engagement, and communications systems. This tests ships' ability to detect, track, and engage undersea targets.	Up to 10 days	ASW3, ASW4, HF4, MF1, MF4, MF5, MF6, MF9, TORP1, TORP2.	Offshore Area	1–12	27
Other Testing:							
Acoustic	Acoustic and Oceanographic Research.	Research using active transmissions from sources deployed from ships, aircraft, and unmanned underwater vehicles. Research sources can be used as proxies for current and future Navy systems.	Up to 14 days	LF4, MF9	Offshore Area (QRS).	1	7
					Inland Waters (DBRC, Keyport Range Site).	3	21
Acoustic	Acoustic Component Testing.	Various surface vessels, moored equipment, and materials are tested to evaluate performance in the marine environment.	1 day to multiple months.	HF3, HF6, LF5, MF9.	Western Behm Canal, AK.	13–18	99
Acoustic	Cold Water Support	Fleet training for divers in a cold water environment, and other diver training related to Navy divers supporting range/test site operations and maintenance.	8 hours	HF6	Inland Waters (Keyport Range Site, DBRC, Carr Inlet).	4	28
					Western Behm Canal, AK.	1	7

TABLE 4—PROPOSED TESTING ACTIVITIES ANALYZED FOR THE SEVEN-YEAR PERIOD IN THE NWTT STUDY AREA—Continued

Stressor category	Activity	Description	Typical duration	Source bin	Location	Annual # of events	7-Year # of events
Acoustic	Post-Refit Sea Trial	Following periodic maintenance periods or repairs, sea trials are conducted to evaluate submarine propulsion, sonar systems, and other mechanical tests.	8 hours	HF9, M3, MF10	Inland Waters (DBRC).	30	210
Acoustic	Semi-Stationary Equipment Testing.	Semi-stationary equipment (*e.g.,* hydrophones) is deployed to determine functionality.	From 10 minutes to multiple days.	HF6, HF9, LF4, MF9, VHF2.	Inland Waters (DBRC, Keyport Range Site).	120	840
				HF6, HF9	Western Behm Canal, AK.	2–3	12
Naval Air Systems Command Testing Activities							
Anti-Submarine Warfare: Acoustic; Explosive	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.	4–8 flight hours.	E1, E3, ASW2, ASW5, MF5, MF6.	Offshore Area	8	56

Summary of Acoustic and Explosive Sources Analyzed for Training and Testing

Tables 5 through 8 show the acoustic and explosive source classes, bins, and quantity used in either hours or counts associated with the Navy's proposed training and testing activities over a seven-year period in the NWTT Study Area that were analyzed in the Navy's rulemaking/LOA application. Table 5 describes the acoustic source classes (*i.e.,* low-frequency (LF), mid-frequency (MF), and high-frequency (HF)) and numbers that could occur over seven years under the proposed training activities. Acoustic source bin use in the proposed activities would vary annually. The seven-year totals for the proposed training activities take into account that annual variability.

TABLE 5—ACOUSTIC SOURCE CLASS BINS ANALYZED AND NUMBERS USED FOR SEVEN-YEAR PERIOD FOR TRAINING ACTIVITIES IN THE NWTT STUDY AREA

Source class category	Bin	Description	Unit	Annual	7-Year total
Low-Frequency (LF): Sources that produce signals less than 1 kHz.	LF5	LF sources less than 180 dB	H	1	5
Mid-Frequency (MF): Tactical and non-tactical sources that produce signals between 1 and 10 kHz.	MF1	Hull-mounted surface ship sonars (*e.g.,* AN/SQS–53C and AN/SQS–61).	H	164	1,148
	MF3	Hull-mounted submarine sonars (*e.g.,* AN/BQQ–10).	H	70	490
	MF4	Helicopter-deployed dipping sonars (*e.g.,* AN/AQS–22 and AN/AQS–13).	H	0–1	1
	MF5	Active acoustic sonobuoys (*e.g.,* DICASS)	C	918–926	6,443
	MF11	Hull-mounted surface ship sonars with an active duty cycle greater than 80%.	H	16	112
High-Frequency (HF): Tactical and non-tactical sources that produce signals between 10 and 100 kHz.	HF1	Hull-mounted submarine sonars (*e.g.,* AN/BQQ–10).	H	48	336
	HF4	Mine detection, classification, and neutralization sonar (*e.g.,* AN/SQS–20).	H	0–65	269
Anti-Submarine Warfare (ASW): Tactical sources (*e.g.,* active sonobuoys and acoustic countermeasures systems) used during ASW training and testing activities.	ASW2	MF Multistatic Active Coherent sonobuoy (*e.g.,* AN/SSQ–125).	C	350	2,450
	ASW3	MF towed active acoustic countermeasure systems (*e.g.,* AN/SLQ–25).	H	86	602
	ASW5	MF sonobuoys with high duty cycles	H	50	350
Torpedoes (TORP): Source classes associated with the active acoustic signals produced by torpedoes.	TORP1	Lightweight torpedo (*e.g.,* MK 46, MK 54, or Anti-Torpedo Torpedo).	C	16	112
	TORP2	Heavyweight torpedo (*e.g.,* MK 48)	C	0–2	5
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	240	1,680

TABLE 5—ACOUSTIC SOURCE CLASS BINS ANALYZED AND NUMBERS USED FOR SEVEN-YEAR PERIOD FOR TRAINING ACTIVITIES IN THE NWTT STUDY AREA—Continued

Source class category	Bin	Description	Unit	Annual	7-Year total
Acoustic Modems (M): Systems used to transmit data through the water.	M3	MF acoustic modems (greater than 190 dB)	H	30	210
Synthetic Aperture Sonars (SAS): Sonars in which active acoustic signals are post-processed to form high-resolution images of the seafloor.	SAS2	HF SAS systems	H	0–561	2,353

Notes: H = hours; C = count.

Table 6 describes the acoustic source classes and numbers that could occur over seven years under the proposed testing activities. Acoustic source bin use in the proposed activities would vary annually. The seven-year totals for the proposed testing activities take into account that annual variability.

TABLE 6—ACOUSTIC SOURCE CLASS BINS ANALYZED AND NUMBERS USED FOR SEVEN-YEAR PERIOD FOR TESTING ACTIVITIES IN THE NWTT STUDY AREA

Source class category	Bin	Description	Unit	Annual	7-Year total
Low-Frequency (LF): Sources that produce signals less than 1 kHz.	LF4	LF sources equal to 180 dB and up to 200 dB	H	177	1,239
	LF5	LF sources less than 180 dB	H	0–18	23
Mid-Frequency (MF): Tactical and non-tactical sources that produce signals between 1 and 10 kHz.	MF1	Hull-mounted surface ship sonars (*e.g.,* AN/SQS–53C and AN/SQS–61).	H	20–169	398
	MF1K	Kingfisher mode associated with MF1 sonars	H	48	336
	MF2	Hull-mounted surface ship sonars (*e.g.,* AN/SQS–56).	H	32	224
	MF3	Hull-mounted submarine sonars (*e.g.,* AN/BQQ–10).	H	34–36	239
	MF4	Helicopter-deployed dipping sonars (*e.g.,* AN/AQS–22 and AN/AQS–13).	H	41–50	298
	MF5	Active acoustic sonobuoys (*e.g.,* DICASS)	C	300–673	2,782
	MF6	Active underwater sound signal devices (*e.g.,* MK 84 SUS).	C	60–232	744
	MF9	Active sources (equal to 180 dB and up to 200 dB) not otherwise binned.	H	644–959	5,086
	MF10	Active sources (greater than 160 dB, but less than 180 dB) not otherwise binned.	H	886	6,197
	MF11	Hull-mounted surface ship sonars with an active duty cycle greater than 80 percent.	H	48	336
	MF12	Towed array surface ship sonars with an active duty cycle greater than 80 percent.	H	100	700
High-Frequency (HF): Tactical and non-tactical sources that produce signals between 10 and 100 kHz.	HF1	Hull-mounted submarine sonars (*e.g.,* AN/BQQ–10).	H	10	68
	HF3	Other hull-mounted submarine sonars (classified).	H	1–19	30
	HF4	Mine detection, classification, and neutralization sonar (*e.g.,* AN/SQS–20).	H	1,860–1,868	11,235
	HF5	Active sources (greater than 200 dB) not otherwise binned.	H	352–400	2,608
	HF6	Active sources (equal to 180 dB and up to 200 dB) not otherwise binned.	H	1,705–1,865	12,377
	HF8	Hull-mounted surface ship sonars (*e.g.,* AN/SQS–61).	H	24	168
	HF9	Weapon emulating sonar source	H	257	1,772
Very High-Frequency (VHF): Tactical and non-tactical sources that produce signals greater than 100 kHz but less than 200 kHz.	VHF1	Very high frequency sources greater than 200 dB.	H	320	2,240
	VHF2	Active sources with a frequency greater than 100 kHz, up to 200 kHz with a source level less than 200 dB.	H	135	945
Anti-Submarine Warfare (ASW): Tactical sources (*e.g.,* active sonobuoys and acoustic countermeasures systems) used during ASW training and testing activities.	ASW1	MF systems operating above 200 dB	H	80	560
	ASW2	MF systems operating above 200 dB	C	240	1,680
	ASW3	MF towed active acoustic countermeasure systems (*e.g.,* AN/SLQ–25).	H	487–1,015	4,091

TABLE 6—ACOUSTIC SOURCE CLASS BINS ANALYZED AND NUMBERS USED FOR SEVEN-YEAR PERIOD FOR TESTING ACTIVITIES IN THE NWTT STUDY AREA—Continued

Source class category	Bin	Description	Unit	Annual	7-Year total
	ASW4	MF expendable active acoustic device countermeasures (*e.g.,* MK 3).	C	1,349–1,389	9,442
	ASW5	MF sonobuoys with high duty cycles	H	80	560
Torpedoes (TORP): Source classes associated with the active acoustic signals produced by torpedoes.	TORP1	Lightweight torpedo (*e.g.,* MK 46, MK 54, or Anti-Torpedo Torpedo).	C	298–360	2,258
	TORP2	Heavyweight torpedo (*e.g.,* MK 48)	C	332–372	2,324
	TORP3	Heavyweight torpedo test (*e.g.,* MK 48)	C	6	42
Forward Looking Sonar (FLS): Forward or upward looking object avoidance sonars used for ship navigation and safety.	FLS2	HF sources with short pulse lengths, narrow beam widths, and focused beam patterns.	H	24	168
Acoustic Modems (M): Systems used to transmit data through the water.	M3	MF acoustic modems (greater than 190 dB)	H	1,088	7,616
Synthetic Aperture Sonars (SAS): Sonars in which active acoustic signals are post-processed to form high-resolution images of the seafloor.	SAS2	HF SAS systems	H	1,312	9,184
Broadband Sound Sources (BB): Sonar systems with large frequency spectra, used for various purposes.	BB1	MF to HF mine countermeasure sonar	H	48	336
	BB2	HF to VHF mine countermeasure sonar	H	48	336

Notes: H = hours; C = count.

Table 7 describes the explosive source classes and numbers that could occur over seven years under the proposed training activities. Under the proposed activities bin use would vary annually, and the seven-year totals for the proposed training activities take into account that annual variability.

TABLE 7—EXPLOSIVE SOURCE CLASS BINS ANALYZED AND NUMBERS USED FOR SEVEN-YEAR PERIOD FOR TRAINING ACTIVITIES IN THE NWTT STUDY AREA

Bin	Net explosive weight (lb)	Example explosive source	Annual	7-Year total
E1	0.1–0.25	Medium-caliber projectiles	60–120	672
E2	>0.25–0.5	Medium-caliber projectiles	65–130	728
E3	>0.5–2.5	Explosive Ordnance Disposal Mine Neutralization	6	42
E5	>5–10	Large-caliber projectile	56–112	628
E10	>250–500	1,000 lb bomb	0–4	9

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

Table 8 describes the explosive source classes and numbers that could occur over seven years under the proposed testing activities. Under the proposed activities bin use would vary annually, and the seven-year totals for the proposed testing activities take into account that annual variability.

TABLE 8—EXPLOSIVE SOURCE CLASS BINS ANALYZED AND NUMBERS USED FOR SEVEN-YEAR PERIOD FOR TESTING ACTIVITIES IN THE NWTT STUDY AREA

Bin	Net explosive weight (lb)	Example explosive source	Annual	7-Year total
E1	0.1–0.25	SUS buoy	8	56
E3	>0.5–2.5	Explosive sonobuoy	72	504
E4	>2.5–5	Mine Countermeasure and Neutralization	36	180
E7	>20–60	Mine Countermeasure and Neutralization	5	25
E8	>60–100	Lightweight torpedo	4	28
E11	>500–650	Heavyweight torpedo	4	28

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

Vessel Movement

Vessels used as part of the proposed activities include ships, submarines, unmanned vessels, and boats ranging in size from small, 22 ft rigid hull inflatable boats to aircraft carriers with lengths up to 1,092 ft. Large ships greater than 60 ft generally operate at speeds in the range of 10–15 kn for fuel conservation. Submarines generally operate at speeds in the range of 8–13 kn in transits and less than those speeds for certain tactical maneuvers. Small craft (for purposes of this discussion—less than 60 ft in length) have much more variable speeds (dependent on the mission). While these speeds are representative of most events, some vessels need to temporarily operate outside of these parameters. For example, to produce the required relative wind speed over the flight deck, an aircraft carrier engaged in flight operations must adjust its speed through the water accordingly. Conversely, there are other instances, such as launch and recovery of a small rigid hull inflatable boat; vessel boarding, search, and seizure training events; or retrieval of a target when vessels will be dead in the water or moving slowly ahead to maintain steerage.

The number of military vessels used in the NWTT Study Area varies based on military training and testing requirements, deployment schedules, annual budgets, and other unpredictable factors. Many training and testing activities involve the use of vessels. These activities could be widely dispersed throughout the NWTT Study Area, but would be typically conducted near naval ports, piers, and range areas. Training and testing activities involving vessel movements occur intermittently and are variable in duration, ranging from a few hours to up to two weeks. There is no seasonal differentiation in military vessel use. Large vessel movement primarily occurs with the majority of the traffic flowing between the installations and the Operating Areas (OPAREAS). Smaller support craft would be more concentrated in the coastal waters in the areas of naval installations, ports, and ranges. The number of activities that include the use of vessels for training events is lower (approximately 10 percent) than the number for testing activities. Testing can occur jointly with a training event, in which case that testing activity could be conducted from a training vessel.

Additionally, a variety of smaller craft will be operated within the NWTT Study Area. Small craft types, sizes, and speeds vary. During training and testing, speeds generally range from 10–14 kn; however, vessels can and will, on occasion, operate within the entire spectrum of their specific operational capabilities. In all cases, the vessels/craft will be operated in a safe manner consistent with the local conditions.

Standard Operating Procedures

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

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

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

Because standard operating procedures are essential to safety and mission success, the Navy considers them to be part of the proposed Specified Activities, and has included them in the environmental analysis. Standard operating procedures that are recognized as having a potential benefit to marine mammals during training and testing activities are noted below and discussed in more detail within the 2019 NWTT DSEIS/OEIS.

- Vessel Safety;
- Weapons Firing Procedures;
- Target Deployment Safety; and
- Towed In-Water Device Safety.

Standard operating procedures (which are implemented regardless of their secondary benefits) are different from mitigation measures (which are designed entirely for the purpose of avoiding or reducing environmental impacts). Information on mitigation measures is provided in the *Proposed Mitigation* section below. Additional information on standard operating procedures is presented in Section 2.3.3 (Standard Operating Procedures) in the 2019 NWTT DSEIS/OEIS.

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

Marine mammal species and their associated stocks that have the potential to occur in the NWTT Study Area are presented in Table 9 along with an abundance estimate, an associated coefficient of variation value, and best and minimum abundance estimates. The Navy requests authorization to take individuals of 29 marine mammal species by Level A harassment and Level B harassment incidental to training and testing activities from the use of sonar and other transducers and in-water detonations. In addition, the Navy requests authorization for three takes of large whales by serious injury or mortality from vessel strikes over the seven-year period. Currently, the Southern Resident killer whale has critical habitat designated under the Endangered Species Act (ESA) in the NWTT Study Area (described below). However, NMFS has recently published two proposed rules, proposing new or revised ESA-designated critical habitat for humpback whales (84 FR 54354; October 9, 2019) and Southern Resident killer whales (84 FR 49214; September 19, 2019).

Information on the status, distribution, abundance, population trends, habitat, and ecology of marine mammals in the NWTT Study Area may be found in Chapter 4 of the Navy's rulemaking/LOA application. NMFS has reviewed this information and found it to be accurate and complete. Additional information on the general biology and ecology of marine mammals is included in the 2019 NWTT DSEIS/OEIS. Table 9 incorporates data from the U.S. Pacific and the Alaska Marine Mammal Stock Assessment Reports (SARs; Carretta *et al.,* 2019; Muto *et al.,* 2019) and the most recent revised data in the draft SARs (see *https://www.fisheries.noaa.gov/national/marine-mammal-protection/draft-marine-mammal-stock-assessment-reports*); as well as incorporates the best available science, including monitoring data from the Navy's marine mammal research efforts.

Species Not Included in the Analysis

The species carried forward for analysis (and described in Table 9 below) are those likely to be found in the NWTT Study Area based on the most recent data available, and do not include species that may have once inhabited or transited the area but have not been sighted in recent years (*e.g.,* species which were extirpated from factors such as 19th and 20th century commercial exploitation). Several species that may be present in the northwest Pacific Ocean have an extremely low probability of presence in the NWTT Study Area. These species are considered extralimital (not anticipated to occur in the Study Area) or rare (occur in the Study Area sporadically, but sightings are rare). These species/stocks include the Eastern North Pacific stock of Bryde's whale (*Balaenoptera edeni*), Eastern North Pacific stock of North Pacific right whale (*Eubalaena japonica*), false killer whale (*Pseudorca crassidens*), long-beaked common dolphin (*Delphinus capensis*), Western U.S. stock of Steller sea lion (*Eumetopias jubatus*), and Alaska stock of Cuvier's beaked whale (*Ziphius cavirostris*). Despite rare stranding or sighting reports, the Study Area is outside the normal range of the Eastern North Pacific stock of Bryde's whale and the California stock of the long-beaked common dolphin. The Study Area is also outside the normal range of the false killer whale's distribution in the Pacific Ocean. The Eastern North Pacific stock of North Pacific right whale is estimated to have an abundance of 31 individuals (Muto *et al.,* 2020) and is anticipated to be extremely rare in the Study Area. The Western U.S. stock of Steller sea lions is considered rare in the Offshore Area of the Study Area, and is not expected to occur in the Inland Waters portion of the Study Area. In Western Behm Canal, there is a low probability of juvenile male Steller sea lion occurrence from the Western U.S. stock, however these individuals are anticipated to be very rare. Finally, the Alaska stock of Cuvier's beaked whales is not expected to occur in either the Offshore Area or Inland Waters of the NWTT Study Area, and are considered extralimital in Western Behm Canal as this area does not overlap with their range of distribution. NMFS agrees with the Navy's assessment that these species are unlikely to occur in the NWTT Study Area and they are not discussed further.

TABLE 9—MARINE MAMMAL OCCURRENCE WITHIN THE NWTT STUDY AREA

Common name	Scientific name	Stock	ESA/MMPA status; strategic (Y/N)[1]	Stock abundance (CV, N_{min}, most recent abundance survey)[2]	PBR	Annual M/SI[3]	Occurrence		
							Offshore area	Inland waters	Western Behm Canal
Order Cetartiodactyla—Cetacea—Superfamily Mysticeti (baleen whales)									
Family Eschrichtiidae:									
Gray whale	*Eschrichtius robustus*	Eastern North Pacific	-, -, N	26.960 (0.05, 25,849, 2016).	801	139	Seasonal	Seasonal	
Family Balaenopteridae (rorquals):									
Blue whale	*Balaenoptera musculus*	Eastern North Pacific	E, D, S	1,496 (0.44, 1,050, 2014)	1.2	≥19.4	Seasonal.		
Fin whale	*Balaenoptera physalus*	Northeast Pacific	E, D, S	3,168 (0.26, 2,554, 2013)[4]	5.1	0.4			Rare.
		CA/OR/WA	E, D, S	9,029 (0.12, 8,127, 2014)	81	≥43.5	Seasonal	Rare	
Humpback whale	*Megaptera novaeangliae*	Central North Pacific	T/E,[5] D, S	10,103 (0.3, 7,891, 2006)	83	25	Regular	Regular	Regular.
		CA/OR/WA	T/E,[5] D, S	2,900 (0.05, 2,784, 2014)	16.7	≥42.1	Regular	Regular	Regular.
Minke whale	*Balaenoptera acutorostrata*	Alaska	-, -, N	UNK	UND	0			Rare.
		CA/OR/WA	-, -, N	636 (0.72, 369, 2014)	3.5	≥1.3	Regular	Seasonal.	
Sei whale	*Balaenoptera borealis*	Eastern North Pacific	E, D, S	519 (0.4, 374, 2014)	0.75	≥0.2	Regular		
Superfamily Odontoceti (toothed whales, dolphins, and porpoises)									
Family Physeteridae:									
Sperm whale	*Physeter macrocephalus*	CA/OR/WA	E, D, S	1.997 (0.57, 1,270, 2014)	2.5	0.4	Rare.		
Family Kogiidae:									
Dwarf sperm whale	*Kogia sima*	CA/OR/WA	-, -, N	UNK	UND	0	Rare.		
Pygmy sperm whale	*Kogia breviceps*	CA/OR/WA	-, -, N	4,111 (1.12, 1,924, 2014)	19.2	0	Regular.		
Family Ziphiidae (beaked whales):									
Baird's beaked whale	*Berardius bairdii*	CA/OR/WA	-, -, N	2,697 (0.6, 1,633, 2014)	16	0	Regular.		
Cuvier's beaked whale	*Ziphius cavirostris*	CA/OR/WA	-, -, N	3,274 (0.67, 2,059, 2014)	21	< 0.1	Regular.		
Mesoplodont beaked whales.	*Mesoplodon* species	CA/OR/WA	-, -, N	3,044 (0.54, 1,967, 2014)	20	0.1	Regular.		
Family Delphinidae:									
Common bottlenose dolphin.	*Tursiops truncatus*	CA/OR/WA Offshore	-, -, N	1,924 (0.54, 1,255, 2014)	11	≥1.6	Regular.		
Killer whale	*Orcinus orca*	Eastern North Pacific Alaskan Resident.	-, -, N	2,347 (UNK, 2,347, 2012)[6]	24	1			Regular.
		Eastern North Pacific Northern Resident.	-, -, N	302 (UNK, 302, 2018)[6]	2.2	0.2	Seasonal	Seasonal	
		West Coast Transient	-, -, N	243 (UNK, 243, 2009)	2.4	0	Regular	Regular	Regular.
		Eastern North Pacific Offshore.	-, -, N	300 (0.1, 276, 2012)	2.8	0	Regular		Regular.
		Eastern North Pacific Southern Resident.	E, D, Y	75 (NA, 75, 2018)	0.13	0	Seasonal	Regular	
Northern right whale dolphin.	*Lissodelphus borealis*	CA/OR/WA	-, -, N	26,556 (0.44, 18,608, 2014).	179	3.8	Regular.		
Pacific white-sided dolphin.	*Lagenorhynchus obliquidens.*	North Pacific	-, -, N	26,880 (UNK, NA, 1990)	UND	0			Regular.
		CA/OR/WA	-, -, N	26,814 (0.28, 21,195, 2014).	191	7.5	Regular	Regular	
Risso's dolphin	*Grampus griseus*	CA/OR/WA	-, -, N	6,336 (0.32, 4,817, 2014)	46	≥3.7	Regular	Rare	
Short-beaked common dolphin.	*Delphinus delphis*	CA/OR/WA	-, -, N	969,861 (0.17, 839,325, 2014).	8,393	ε40	Regular	Rare	
Short-finned pilot whale	*Globicephala macrorhynchus.*	CA/OR/WA	-, -, N	836 (0.79, 466, 2014)	4.5	1.2	Regular	Rare	
Striped dolphin	*Stenella coeruleoalba*	CA/OR/WA	-, -, N	29,211 (0.2, 24,782, 2014)	238	≥0.8	Regular.		
Family Phocoenidae (porpoises):									
Dall's porpoise	*Phocoenoides dalli*	Alaska	-, -, N	83,400 (0.097, NA, 1991)	UND	38			Regular.

TABLE 9—MARINE MAMMAL OCCURRENCE WITHIN THE NWTT STUDY AREA—Continued

Common name	Scientific name	Stock	ESA/ MMPA status; strategic (Y/N) [1]	Stock abundance (CV, N_{min}, most recent abundance survey) [2]	PBR	Annual M/SI [3]	Occurrence		
							Offshore area	Inland waters	Western Behm Canal
		CA/OR/WA	-, -, N	25,750 (0.45, 17,954, 2014).	172	0.3	Regular	Regular	
Harbor porpoise	*Phocoena phocoena*	Southeast Alaska	-, -, Y	1,354 (0.12, 1,224, 2012)	12	34			Regular.
		Northern OR/WA Coast	-, -, N	21,487 (0.44, 15, 123, 2011).	151	≥3	Regular.		
		Northern CA/Southern OR	-, -, N	35,769 (0.52, 23,749, 2011).	475	≥0.6	Regular.		
		Washington Inland Waters	-, -, N	11,233 (0.37, 8,308, 2015)	66	≥7.2		Regular	
Order Carnivora—Superfamily Pinnipedia									
Family Otariidae (eared seals and sea lions):									
California sea lion	*Zalophus californianus*	U.S.	-, -, N	257,606 (NA, 233,515, 2014).	14,011	≥321	Seasonal	Regular	
Guadalupe fur seal	*Arctocephalus townsendi*	Mexico to California	T, D, Y	34,187 (NA, 31,109, 2013)	1,062	≥3.8	Seasonal.		
Northern fur seal	*Callorhinus ursinus*	Eastern Pacific	-, D, Y	620,660 (0.2, 525,333, 2016).	11,295	399	Regular		Seasonal.
		California	-, -, N	14,050 (NA, 7,524, 2013)	451	1.8	Regular.		
Steller sea lion	*Eumetopias jubatus*	Eastern U.S.	-, -, N	43,201 (NA, 43,201, 2017) [7].	2,592	113	Regular	Seasonal	Regular.
Family Phocidae (earless seals):									
Harbor seal	*Phoca vitulina*	Southeast Alaska (Clarence Strait).	-, -, N	27,659 (UNK, 24,854, 2015).	746	40			Regular.
		OR/WA Coast	-, -, N	UNK	UND	10.6	Regular	Seasonal	
		California	-, -, N	30,968 (0.157, 27,348, 2012).	1,641	43	Regular.		
		Washington Northern Inland Waters.	-, -, N	UNK	UND	9.8	Seasonal	Regular	
		Hood Canal	-, -, N	UNK	UND	0.2	Seasonal	Regular	
		Southern Puget Sound	-, -, N	UNK	UND	3.4	Seasonal	Regular	
Northern Elephant seal	*Mirounga angustirostris*	California	-, -, N	179,000 (NA, 81,368, 2010).	4,882	8.8	Regular	Regular	Seasonal.

[1] Endangered Species Act (ESA) status: Endangered (E), Threatened (T)/MMPA status: Depleted (D). A dash (-) indicates that the species is not listed under the ESA or designated as depleted under the MMPA. Under the MMPA, a strategic stock is one for which the level of direct human-caused mortality exceeds potential biological removal (PBR) or which is determined to be declining and likely to be listed under the ESA within the foreseeable future. Any species or stock listed under the ESA is automatically designated under the MMPA as depleted and as a strategic stock.

[2] NMFS marine mammal stock assessment reports online at: *https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessments.* CV is coefficient of variation; N_{min} is the minimum estimate of stock abundance. In some cases, CV is not applicable. For the Eastern North Pacific Southern Resident stock of killer whales Nbest/N_{min} are based on a direct count of individually identifiable animals. The population size of the U.S. stock of California sea lion was estimated from a 1975–2014 time series of pup counts (Lowry *et al.* 2017), combined with mark-recapture estimates of survival rates (DeLong *et al.* 2017, Laake *et al.* 2018). The population size of the Mexico to California stock of Guadalupe fur seals was estimated from pup count data collected in 2013 and a range of correction factors applied to pup counts to account for uncounted age classes and pre-census pup mortality (García-Aguilar *et al.* 2018). The population size of the California stock of Northern fur seals was estimated from pup counts multiplied by an expansion factor (San Miguel Island) and maximum pup, juvenile, and adult counts (Farrallon Islands) at rookeries. The population size of the Eastern U.S. stock of Steller sea lions was estimated from pup counts and non-pup counts at rookeries in Southeast Alaska, British Columbia, Oregon, and California. The population size of the California stock of Northern Elephant seals was estimated from pup counts at rookeries multiplied by the inverse of the expected ratio of pups to total animals (McCann, 1985; Lowry *et al.,* 2014).

[3] These values, found in NMFS' SARs, represent annual levels of human-caused mortality and serious injury (M/SI) from all sources combined (*e.g.,* commercial fisheries, ship strike). Annual M/SI often cannot be determined precisely and is in some cases presented as a minimum value or range. A CV associated with estimated mortality due to commercial fisheries is presented in some cases.

[4] SAR reports this stock abundance assessment as provisional and notes that it is an underestimate for the entire stock because it is based on surveys which covered only a small portion of the stock's range.

[5] Humpback whales in the Central North Pacific stock and the CA/OR/WA stock are from three Distinct Population Segments (DPSs) based on animals identified in breeding areas in Hawaii, Mexico, and Central America. Both stocks and all three DPSs co-occur in the NWTT Study Area.

[6] Stock abundance estimate is based on counts of individual animals identified from photo-identification catalogues. Surveys for abundance estimates of these stocks are conducted infrequently.

[7] Stock abundance estimate is the best estimate counts, which have not been corrected to account for animals at sea during abundance surveys.

Note—Unknown (UNK); Undetermined (UND); Not Applicable (NA); California (CA); Oregon (OR); Washington (WA).

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

Critical Habitat

Currently, only the distinct population segment (DPS) of Southern Resident killer whale (SRKW) has ESA-designated critical habitat in the NWTT Study Area. NMFS has recently published two proposed rules, however, proposing new or revised ESA-designated critical habitat for SRKW (84 FR 49214; September 19, 2019) and humpback whales (84 FR 54354; October 9, 2019).

NMFS designated critical habitat for the SRKW DPS on November 29, 2006 (71 FR 69054) in inland waters of Washington State. Based on the natural history of the SRKWs and their habitat needs, NMFS identified physical or biological features essential to the conservation of the SRKW DPS: (1) Water quality to support growth and development; (2) prey species of sufficient quantity, quality, and availability to support individual growth, reproduction and development, as well as overall population growth; and (3) passage conditions to allow for migration, resting, and foraging. ESA-designated critical habitat consists of three areas: (1) The Summer Core Area in Haro Strait and waters around the San Juan Islands; (2) Puget Sound; and (3) the Strait of Juan de Fuca, which comprise approximately 2,560 square miles (mi^2) (6,630 square kilometers (km^2)) of marine habitat. In designating critical habitat, NMFS considered economic impacts and impacts to national security, and concluded the benefits of exclusion of 18 military sites, comprising approximately 112 mi^2 (291 km^2), outweighed the benefits of inclusion because of national security impacts.

On January 21, 2014, NMFS received a petition requesting revisions to the SRKW critical habitat designation. The petition requested NMFS revise critical habitat to include ''inhabited marine waters along the West Coast of the United States that constitute essential foraging and wintering areas,'' specifically the region between Cape Flattery, Washington and Point Reyes, California extending from the coast to a distance of 47.2 mi (76 km) offshore.

The petition also requested NMFS adopt a fourth essential habitat feature in both current and expanded critical habitat relating to in-water sound levels. On September 19, 2019 (84 FR 54354), NMFS published a proposed rule proposing to revise the critical habitat designation for the SRKW DPS by designating six new areas (using the same essential features determined in 2006) along the U.S. West Coast. Specific new areas proposed along the U.S. West Coast include 15,626.6 mi^2 (40,472.7 km^2) of marine waters between the 6.1 m (20 ft) depth contour and the 200 m (656.2 ft) depth contour from the U.S. international border with Canada south to Point Sur, California.

On March 15, 2018, several non-governmental organizations filed a lawsuit seeking court-ordered deadlines for the issuance of proposed and final rules to designate ESA critical habitat for the Central American, Mexico, and Western North Pacific DPSs of humpback whales. In 2018, NMFS convened a critical habitat review team to assess and evaluate information in support of critical habitat designation for these DPSs. On October 9, 2019 (84 FR 54354), NMFS published a proposed rule proposing ESA-designated critical habitat areas located off the coasts of California, Oregon, Washington, and Alaska, including areas within the NWTT Study Area. Based on consideration of national security and economic impacts, NMFS also proposed to exclude multiple areas from the designation for each DPS.

Biologically Important Areas

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

BIAs off the West Coast of the continental United States with the potential to overlap portions of the NWTT Study Area include the following feeding and migration areas: Northern Puget Sound Feeding Area for gray whales (March–May); Northwest Feeding Area for gray whales (May–November); Northbound Migration Phase A for gray whales (January–July); Northbound Migration Phase B for gray whales (March–July); Northern Washington Feeding Area for humpback whales (May–November); Stonewall and Heceta Bank Feeding Area for humpback whales (May–November); and Point St. George Feeding Area for humpback whales (July–November) (Calambokidis *et al.,* 2015).

When comparing the geographic area of the NWTT Study Area with the BIAs off the West Coast of the continental United States, there is no direct spatial overlap between the Study Area and four of the offshore gray whale feeding areas—Grays Harbor, WA; Depoe Bay, OR; Cape Blanco and Orford Reef, OR; and Pt. St. George, CA. The NWTT Study Area does overlap with the Northwest WA gray whale feeding area and the Northern Puget Sound gray whale feeding area. There is no overlap of the gray whale migration corridor BIAs and the NWTT Study Area, with the exception of a portion of the Northwest coast of Washington approximately from Pacific Beach and extending north to the Strait of Juan de Fuca. The offshore Northern WA humpback whale feeding area is located entirely within the NWTT Study Area boundaries. The humpback whale feeding area at Stonewall and Hecta Bank only partially overlaps with the Study Area, and the feeding area at Point St. George has extremely limited overlap with the Study Area. All proposed activities occurring in the Offshore Area of the Study Area could potentially occur in these BIAs, except activities limited to greater than 50 nmi from shore (as described in the *Proposed Mitigation Measures* section). To mitigate impacts to marine mammals in these BIAs, the Navy would implement several procedural mitigation measures and mitigation areas (described in the *Proposed Mitigation Measures* section).

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 or regulate activities that could destroy, cause the loss of, or injure sanctuary resources pursuant to the regulations for that sanctuary and other applicable law (15 CFR part 922). NMSs are managed on a site-specific basis, and each sanctuary has site-specific regulations. Most, but not all, sanctuaries have site-specific regulatory exemptions from the prohibitions for certain military activities. Separately, section 304(d) of the NMSA requires Federal agencies to consult with the Office of National Marine Sanctuaries whenever their activities are likely to destroy, cause the loss of, or injure a sanctuary resource. One NMS, the Olympic Coast NMS managed by the Office of National Marine Sanctuaries, is located within the offshore portion of the NWTT Study Area (for a map of the location of this NMS see Chapter 6 of the 2019 NWTT DSEIS/OEIS and Figure 6–1).

The Olympic Coast NMS includes 3,188 mi^2 of marine waters and submerged lands off the Olympic Peninsula coastline. The sanctuary extends 25–50 mi. (40.2–80.5 km) seaward, covering much of the continental shelf and portions of three major submarine canyons. The boundaries of the sanctuary as defined in the Olympic Coast NMS regulations (15 CFR part 922, subpart O) extend from Koitlah Point, due north to the United States/Canada international boundary, and seaward to the 100-fathom isobath (approximately 180 m in depth). The seaward boundary of the sanctuary follows the 100-fathom isobath south to a point due west of Copalis River, and cuts across the tops of Nitinat, Juan de Fuca, and the Quinault Canyons. The shoreward boundary of the sanctuary is at the mean lower low-water line when adjacent to American Indian lands and state lands, and includes the intertidal areas to the mean higher high-water line when adjacent to federally managed lands. When adjacent to rivers and streams, the sanctuary boundary cuts across the mouths but does not extend up river or up stream. The Olympic Coast NMS includes many types of productive marine habitats including kelp forests, subtidal reefs, rocky and sand intertidal zones, submarine canyons, rocky deep-sea habitat, and plankton-rich upwelling zones. These habitats support the Sanctuary's rich biodiversity which includes 29 species of marine mammals that reside in or migrate through the Sanctuary (Office of National Marine Sanctuaries 2008). Additional information on the Olympic Coast NMS can be found at *https://olympiccoast.noaa.gov.*

Unusual Mortality Events (UMEs)

An 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. Three UMEs with ongoing investigations in the NWTT Study Area that inform our analysis are discussed below. The California sea lion UME in

California is still open, but will be closed soon. The Guadalupe fur seal UME in California and the gray whale UME along the west coast of North America are active and involve ongoing investigations.

California Sea Lion UME

From January 2013 through September 2016, a greater than expected number of young malnourished California sea lions (*Zalophus californianus*) stranded along the coast of California. Sea lions stranding from an early age (6–8 months old) through two years of age (hereafter referred to as juveniles) were consistently underweight without other disease processes detected. Of the 8,122 stranded juveniles attributed to the UME, 93 percent stranded alive (n = 7,587, with 3,418 of these released after rehabilitation) and 7 percent (n = 531) stranded dead. Several factors are hypothesized to have impacted the ability of nursing females and young sea lions to acquire adequate nutrition for successful pup rearing and juvenile growth. In late 2012, decreased anchovy and sardine recruitment (CalCOFI data, July 2013) may have led to nutritionally stressed adult females. Biotoxins were present at various times throughout the UME, and while they were not detected in the stranded juvenile sea lions (whose stomachs were empty at the time of stranding), biotoxins may have impacted the adult females' ability to support their dependent pups by affecting their cognitive function (*e.g.,* navigation, behavior towards their offspring). Therefore, the role of biotoxins in this UME, via its possible impact on adult females' ability to support their pups, is unclear. The proposed primary cause of the UME was malnutrition of sea lion pups and yearlings due to ecological factors. These factors included shifts in distribution, abundance and/or quality of sea lion prey items around the Channel Island rookeries during critical sea lion life history events (nursing by adult females, and transitioning from milk to prey by young sea lions). These prey shifts were most likely driven by unusual oceanographic conditions at the time due to the ''Warm Water Blob'' and El Niño. This investigation will soon be closed. Please refer to: *https://www.fisheries.noaa.gov/national/marine-life-distress/2013-2017-california-sea-lion-unusual-mortality-event-california* for more information on this UME.

Guadalupe Fur Seal UME

Increased strandings of Guadalupe fur seals began along the entire coast of California in January 2015 and were eight times higher than the historical average (approximately 10 seals/yr). Strandings have continued since 2015 and remained well above average through 2019. Numbers by year are as follows: 2015 (98), 2016 (76), 2017 (62), 2018 (45), 2019 (116), 2020 (3 as of March 6, 2020). The total number of Guadalupe fur seals stranding in California from January 1, 2015, through March 6, 2020, in the UME is 400. Additionally, strandings of Guadalupe fur seals became elevated in the spring of 2019 in Washington and Oregon; subsequently, strandings for seals in these two states have been added to the UME starting from January 1, 2019. The current total number of strandings in Washington and Oregon is 94 seals, including 91 in 2019 and 3 in 2020 of 3/6/2020. Strandings are seasonal and generally peak in April through June of each year. The Guadalupe fur seal strandings have been mostly weaned pups and juveniles (1–2 years old) with both live and dead strandings occurring. Current findings from the majority of stranded animals include primary malnutrition with secondary bacterial and parasitic infections. The California portion of this UME was occurring in the same area as the 2013–2016 California sea lion UME. This investigation is ongoing. Please refer to: *https://www.fisheries.noaa.gov/national/marine-life-distress/2015-2019-guadalupe-fur-seal-unusual-mortality-event-california* for more information on this UME.

Gray Whale UME

Since January 1, 2019, elevated gray whale strandings have occurred along the west coast of North America, from Mexico to Canada. As of March 13, 2020, there have been a total of 264 strandings along the coasts of the United States, Canada, and Mexico, with 129 of those strandings occurring along the U.S. coast. Of the strandings on the U.S. coast, 48 have occurred in Alaska, 35 in Washington, 6 in Oregon, and 40 in California. Partial necropsy examinations conducted on a subset of stranded whales have shown evidence of poor to thin body condition. 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. Please refer to: *https://www.fisheries.noaa.gov/national/marine-life-distress/2019-gray-whale-unusual-mortality-event-along-west-coast* for more information on this UME.

Marine Mammal Hearing

Hearing is the most important sensory modality for marine mammals underwater, and exposure to anthropogenic sound can have deleterious effects. To appropriately assess the potential effects of exposure to sound, it is necessary to understand the frequency ranges marine mammals are able to hear. Current data indicate that not all marine mammal species have equal hearing capabilities (*e.g.,* Richardson *et al.,* 1995; Wartzok and Ketten, 1999; Au and Hastings, 2008). To reflect this, Southall *et al.* (2007) recommended that marine mammals be divided into functional hearing groups based on directly measured or estimated hearing ranges on the basis of available behavioral response data, audiograms derived using auditory evoked potential techniques, anatomical modeling, and other data. Note that no direct measurements of hearing ability have been successfully completed for mysticetes (*i.e.,* low-frequency cetaceans). Subsequently, NMFS (2018) described generalized hearing ranges for these marine mammal hearing groups. Generalized hearing ranges were chosen based on the approximately 65 dB threshold from the normalized composite audiograms, with the exception for lower limits for low-frequency cetaceans where the lower bound was deemed to be biologically implausible and the lower bound from Southall *et al.* (2007) retained. The functional groups and the associated frequencies are indicated below (note that these frequency ranges correspond to the range for the composite group, with the entire range not necessarily reflecting the capabilities of every species within that group):

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

• Pinnipeds in water; Otariidae (eared seals): Generalized hearing is estimated to occur between 60 Hz and 39 kHz.

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

For more details concerning these groups and associated frequency ranges, please see NMFS (2018) for a review of the available information.

Potential Effects of Specified Activities on Marine Mammals and Their Habitat

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

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

Other potential impacts to marine mammals from training and testing activities in the NWTT Study Area were analyzed in the 2019 NWTT DSEIS/OEIS, in consultation with NMFS as a cooperating agency, and determined to be unlikely to result in marine mammal take. This includes serious injury or mortality from explosives. Therefore, the Navy has not requested authorization for take of marine mammals incidental to other components of their proposed Specified Activities, and we agree that incidental take is unlikely to occur from those components. In this proposed rule, NMFS analyzes the potential effects on marine mammals from the activity components that may cause the take of marine mammals: Exposure to acoustic or explosive stressors including non-impulsive (sonar and other transducers) and impulsive (explosives) stressors and vessel movement.

For the purpose of MMPA incidental take authorizations, NMFS' effects assessments serve four primary purposes: (1) To determine whether the specified activities would have a negligible impact on the affected species or stocks of marine mammals (based on whether it is likely that the activities would adversely affect the species or stocks through effects on annual rates of recruitment or survival); (2) to determine whether the specified activities would have an unmitigable adverse impact on the availability of the species or stocks for subsistence uses; (3) to prescribe the permissible methods of taking (*i.e.,* Level B harassment (behavioral harassment and temporary threshold shift (TTS)), Level A harassment (permanent threshold shift (PTS) and non-auditory injury), serious injury, or mortality), including identification of the number and types of take that could occur by harassment, serious injury, or mortality, and to prescribe other means of effecting the least practicable adverse impact on the species or stocks and their habitat (*i.e.,* mitigation measures); and (4) to prescribe requirements pertaining to monitoring and reporting.

In this section, NMFS provides a description of the ways marine mammals may be generally affected by these activities in the form of mortality, physical trauma, sensory impairment (permanent and temporary threshold shifts and acoustic masking), physiological responses (particular stress responses), behavioral disturbance, or habitat effects. Explosives 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 Harassment and Level B Harassment, and quantifies those effects that rise to the level of a take. The *Preliminary Analysis and Negligible Impact Determination* section assesses whether the proposed authorized take would have a negligible impact on the affected species and stocks.

Potential Effects of Underwater Sound

Anthropogenic sounds cover a broad range of frequencies and sound levels and can have a range of highly variable impacts on marine life, from none or minor to potentially severe responses, depending on received levels, duration of exposure, behavioral context, and various other factors. The potential effects of underwater sound from active acoustic sources can possibly result in one or more of the following: Temporary or permanent hearing impairment, non-auditory physical or physiological effects, behavioral disturbance, stress, and masking (Richardson *et al.,* 1995; Gordon *et al.,* 2004; Nowacek *et al.,* 2007; Southall *et al.,* 2007; Götz *et al.,* 2009, Southall *et al.,* 2019a). The degree of effect is intrinsically related to the signal characteristics, received level, distance from the source, and duration of the sound exposure. In general, sudden, high level sounds can cause hearing loss, as can longer exposures to lower level sounds. Temporary or permanent loss of hearing can occur after exposure to noise, and occurs almost exclusively for noise within an animal's hearing range. Note that in the following discussion, we refer in many cases to a review article concerning studies of noise-induced hearing loss conducted from 1996–2015 (*i.e.,* Finneran, 2015). For study-specific citations, please see that work. We first describe general manifestations of acoustic effects before providing discussion specific to the Navy's activities.

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

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

Acoustic Sources

Direct Physiological Effects

Non-impulsive sources of sound can cause direct physiological effects including noise-induced loss of hearing sensitivity (or ''threshold shift''), nitrogen decompression, acoustically-induced bubble growth, and injury due to sound-induced acoustic resonance. Only noise-induced hearing loss is anticipated to occur due to the Navy's activities. Acoustically-induced (or mediated) bubble growth and other pressure-related physiological impacts are addressed briefly below, but are not expected to result from the Navy's activities. Separately, an animal's behavioral reaction to an acoustic exposure might lead to physiological effects that might ultimately lead to injury or death, which is discussed later in the *Stranding* subsection.

Hearing Loss—Threshold Shift

Marine mammals exposed to high-intensity sound, or to lower-intensity sound for prolonged periods, can experience hearing threshold shift, which is the loss of hearing sensitivity at certain frequency ranges after cessation of sound (Finneran, 2015). Threshold shift can be permanent (PTS), in which case the loss of hearing sensitivity is not fully recoverable, or temporary (TTS), in which case the animal's hearing threshold would recover over time (Southall *et al.,* 2007). TTS can last from minutes or hours to days (*i.e.,* there is recovery back to baseline/pre-exposure levels), can occur within a specific frequency range (*i.e.,* an animal might only have a temporary loss of hearing sensitivity within a limited frequency band of its auditory range), and can be of varying amounts (*e.g.,* an animal's hearing sensitivity might be reduced by only 6 dB or reduced by 30 dB). While there is no simple functional relationship between TTS and PTS or other auditory injury (*e.g.,* neural degeneration), as TTS increases, the likelihood that additional exposure sound pressure level (SPL) or duration will result in PTS or other injury also increases (see also the 2019 NWTT DSEIS/OEIS for additional discussion). Exposure thresholds for the occurrence of PTS or other auditory injury can therefore be defined based on a specific amount of TTS; that is, although an exposure has been shown to produce only TTS, we assume that any additional exposure may result in some PTS or other injury. The specific upper limit of TTS is based on experimental data showing amounts of TTS that have not resulted in PTS or injury. In other words, we do not need to know the exact functional relationship between TTS and PTS or other injury, we only need to know the upper limit for TTS before some PTS or injury is possible. In severe cases of PTS, there can be total or partial deafness, while in most cases the animal has an impaired ability to hear sounds in specific frequency ranges (Kryter, 1985).

When PTS occurs, there is physical damage to the sound receptors in the ear (*i.e.,* tissue damage), whereas TTS represents primarily tissue fatigue and is reversible (Southall *et al.,* 2007). PTS is permanent (*i.e.,* there is incomplete recovery back to baseline/pre-exposure levels), but also can occur in a specific frequency range and amount as mentioned above for TTS. In addition, other investigators have suggested that TTS is within the normal bounds of physiological variability and tolerance and does not represent physical injury (*e.g.,* Ward, 1997). Therefore, NMFS does not consider TTS to constitute auditory injury.

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

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

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

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

- The method used to test hearing may affect the resulting amount of measured TTS, with neurophysiological measures producing larger amounts of TTS compared to psychophysical measures (Finneran *et al.,* 2007; Finneran, 2015).
- The amount of TTS varies with the hearing test frequency. As the exposure SPL increases, the frequency at which the maximum TTS occurs also increases (Kastelein *et al.,* 2014b). For high-level exposures, the maximum TTS typically occurs one-half to one octave above the exposure frequency (Finneran *et al.,* 2007; Mooney *et al.,* 2009a; Nachtigall *et al.,* 2004; Popov *et al.,* 2011; Popov *et al.,* 2013; Schlundt *et al.,* 2000). The overall spread of TTS from tonal exposures can therefore extend over a large frequency range (*i.e.,* narrowband exposures can produce broadband (greater than one octave) TTS).
- The amount of TTS increases with exposure SPL and duration and is correlated with SEL, especially if the range of exposure durations is relatively small (Kastak *et al.,* 2007; Kastelein *et al.,* 2014b; Popov *et al.,* 2014). As the exposure duration increases, however, the relationship between TTS and SEL begins to break down. Specifically, duration has a more significant effect on TTS than would be predicted on the basis of SEL alone (Finneran *et al.,* 2010a; Kastak *et al.,* 2005; Mooney *et al.,* 2009a). This means if two exposures have the same SEL but different durations, the exposure with the longer duration (thus lower SPL) will tend to produce more TTS than the exposure with the higher SPL and shorter duration. In most acoustic impact assessments, the scenarios of interest involve shorter duration exposures than the marine mammal experimental data from which impact thresholds are derived; therefore, use of SEL tends to over-estimate the amount of TTS. Despite this, SEL continues to be used in many situations because it is relatively simple, more accurate than SPL alone, and lends itself easily to scenarios involving multiple exposures with different SPL.
- Gradual increases of TTS may not be directly observable with increasing exposure levels, before the onset of PTS (Reichmuth *et al.,* 2019). Similarly, PTS can occur without measurable behavioral modifications (Reichmuth *et al.,* 2019).
- The amount of TTS depends on the exposure frequency. Sounds at low frequencies, well below the region of best sensitivity, are less hazardous than those at higher frequencies, near the region of best sensitivity (Finneran and Schlundt, 2013). The onset of TTS—defined as the exposure level necessary to produce 6 dB of TTS (*i.e.,* clearly above the typical variation in threshold measurements)—also varies with exposure frequency. At low frequencies, onset-TTS exposure levels are higher compared to those in the region of best sensitivity.
- TTS can accumulate across multiple exposures, but the resulting TTS will be less than the TTS from a single, continuous exposure with the same SEL (Finneran *et al.,* 2010a; Kastelein *et al.,* 2014b; Kastelein *et al.,* 2015b; Mooney *et al.,* 2009b). This means that TTS predictions based on the total, cumulative SEL will overestimate the amount of TTS from intermittent exposures such as sonars and impulsive sources.
- The amount of observed TTS tends to decrease with increasing time following the exposure; however, the relationship is not monotonic (*i.e.,* increasing exposure does not always increase TTS). The time required for complete recovery of hearing depends on the magnitude of the initial shift; for relatively small shifts recovery may be complete in a few minutes, while large shifts (*e.g.,* approximately 40 dB) may require several days for recovery. Under many circumstances TTS recovers linearly with the logarithm of time (Finneran *et al.,* 2010a, 2010b; Finneran and Schlundt, 2013; Kastelein *et al.,* 2012a; Kastelein *et al.,* 2012b; Kastelein *et al.,* 2013a; Kastelein *et al.,* 2014b; Kastelein *et al.,* 2014c; Popov *et al.,* 2011; Popov *et al.,* 2013; Popov *et al.,* 2014). This means that for each doubling of recovery time, the amount of TTS will decrease by the same amount (*e.g.,* 6 dB recovery per doubling of time).

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

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

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

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

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

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

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

Although theoretical predictions suggest the possibility for acoustically mediated bubble growth, there is considerable disagreement among scientists as to its likelihood (Piantadosi and Thalmann, 2004; Evans and Miller, 2003; Cox *et al.,* 2006; Rommel *et al.,* 2006). Crum and Mao (1996) hypothesized that received levels would have to exceed 190 dB in order for there to be the possibility of significant bubble growth due to supersaturation of gases in the blood (*i.e.,* rectified diffusion). Work conducted by Crum *et al.* (2005) demonstrated the possibility of rectified diffusion for short duration signals, but at SELs and tissue saturation levels that are highly improbable to occur in diving marine mammals. To date, energy levels (ELs) predicted to cause in vivo bubble formation within diving cetaceans have not been evaluated (NOAA, 2002b). Jepson *et al.* (2003, 2005) and Fernandez *et al.* (2004, 2005, 2012) concluded that in vivo bubble formation, which may be exacerbated by deep, long-duration, repetitive dives may explain why beaked whales appear to be relatively vulnerable to MF/HF sonar exposures. It has also been argued that traumas from some beaked whale strandings are consistent with gas emboli and bubble-induced tissue separations (Jepson *et al.,* 2003); however, there is no conclusive evidence of this (Rommel *et al.,* 2006). Based on examination of sonar-associated strandings, Bernaldo de Quiros *et al.* (2019) list diagnostic features, the presence of all of which suggest gas and fat embolic syndrome for beaked whales stranded in association with sonar exposure.

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

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

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

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

Injury Due to Sonar-Induced Acoustic Resonance

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

Physiological Stress

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

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

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

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

Relationships between these physiological mechanisms, animal behavior, and the costs of stress responses are well-studied through controlled experiments in both laboratory and free-ranging animals (for examples see, Holberton *et al.,* 1996; Hood *et al.,* 1998; Jessop *et al.,* 2003; Krausman *et al.,* 2004; Lankford *et al.,* 2005; Reneerkens *et al.,* 2002; Thompson and Hamer, 2000). However, it should be noted (and as is described in additional detail in the 2019 NWTT DSEIS/OEIS) that our understanding of the functions of various stress hormones (for example, cortisol), is based largely upon observations of the stress response in terrestrial mammals. Atkinson *et al.,* 2015 note that the endocrine response of marine mammals to stress may not be the same as that of terrestrial mammals because of the selective pressures marine mammals faced during their evolution in an ocean environment. For example, due to the necessity of breath-holding while diving and foraging at depth, the physiological role of epinephrine and norepinephrine (the catecholamines) in marine mammals might be different than in other mammals.

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

Acoustically induced stress in marine mammals is not well understood. There are ongoing efforts to improve our understanding of how stressors impact marine mammal populations (*e.g.,* King *et al.,* 2015; New *et al.,* 2013a; New *et al.,* 2013b; Pirotta *et al.,* 2015a), however little data exist on the consequences of sound-induced stress response (acute or chronic). Factors potentially affecting a marine mammal's response to a stressor include the individual's life history stage, sex, age, reproductive status, overall physiological and behavioral plasticity, and whether they are naïve or experienced with the sound (*e.g.,* prior experience with a stressor may result in a reduced response due to habituation (Finneran and Branstetter, 2013; St. Aubin and Dierauf, 2001a)). Stress responses due to exposure to anthropogenic sounds or other stressors and their effects on marine mammals have been reviewed (Fair and Becker, 2000; Romano *et al.,* 2002b) and, more rarely, studied in wild populations (*e.g.,* Romano *et al.,* 2002a). For example, Rolland *et al.* (2012) found that noise reduction from reduced ship traffic in the Bay of Fundy was associated with decreased stress in North Atlantic right whales. These and other studies lead to a reasonable expectation that some marine mammals will experience physiological stress responses upon exposure to acoustic stressors and that it is possible that some of these would be classified as ''distress.'' In addition, any animal experiencing TTS would likely also experience stress responses (NRC, 2003).

Other research has also investigated the impact from vessels (both whale-watching and general vessel traffic noise), and demonstrated impacts do occur (Bain, 2002; Erbe, 2002; Lusseau, 2006; Williams *et al.,* 2006; Williams *et al.,* 2009; Noren *et al.,* 2009; Read *et al.,* 2014; Rolland *et al.,* 2012; Skarke *et al.,* 2014; Williams *et al.,* 2013; Williams *et al.,* 2014a; Williams *et al.,* 2014b; Pirotta *et al.,* 2015). This body of research has generally investigated impacts associated with the presence of chronic stressors, which differ significantly from the proposed Navy training and testing vessel activities in the NWTT Study Area. For example, in an analysis of energy costs to killer whales, Williams *et al.* (2009) suggested that whale-watching in Canada's Johnstone Strait resulted in lost feeding opportunities due to vessel disturbance, which could carry higher costs than other measures of behavioral change might suggest. Ayres *et al.* (2012) reported on research in the Salish Sea (Washington state) involving the measurement of southern resident killer whale fecal hormones to assess two potential threats to the species recovery: Lack of prey (salmon) and impacts to behavior from vessel traffic. Ayres *et al.* (2012) suggested that the lack of prey overshadowed any population-level physiological impacts on southern resident killer whales from vessel traffic. In a conceptual model developed by the Population Consequences of Acoustic Disturbance (PCAD) working group, serum hormones were identified as possible indicators of behavioral effects that are translated into altered rates of reproduction and mortality (NRC, 2005). The Office of Naval Research hosted a workshop (Effects of Stress on Marine Mammals Exposed to Sound) in 2009 that focused on this topic (ONR, 2009). Ultimately, the PCAD working group issued a report (Cochrem, 2014) that summarized information compiled from 239 papers or book chapters relating to stress in marine mammals and concluded that stress responses can last from minutes to hours and, while we typically focus on adverse stress responses, stress response is part of a natural process to help animals adjust to changes in their environment and can also be either neutral or beneficial.

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

Despite the limited amount of data available on sound-induced stress responses for marine mammals exposed to anthropogenic sounds, studies of other marine animals and terrestrial animals would also lead us to expect that some marine mammals experience physiological stress responses and, perhaps, physiological responses that would be classified as ''distress'' upon exposure to high-frequency, mid-frequency, and low-frequency sounds. For example, Jansen (1998) reported on the relationship between acoustic exposures and physiological responses that are indicative of stress responses in humans (*e.g.,* elevated respiration and increased heart rates). Jones (1998) reported on reductions in human performance when faced with acute, repetitive exposures to acoustic disturbance. Trimper *et al.* (1998) reported on the physiological stress responses of osprey to low-level aircraft noise while Krausman *et al.* (2004) reported on the auditory and physiological stress responses of endangered Sonoran pronghorn to military overflights. However, take due to aircraft noise is not anticipated as a result of the Navy's activities. Smith *et al.* (2004a, 2004b) identified noise-induced physiological transient stress responses in hearing-specialist fish (*i.e.,* goldfish) that accompanied short- and long-term hearing losses. Welch and Welch (1970) reported physiological and behavioral stress responses that accompanied damage to the inner ears of fish and several mammals.

Auditory Masking

Sound can disrupt behavior through masking, or interfering with, an animal's ability to detect, recognize, or discriminate between acoustic signals of interest (*e.g.,* those used for intraspecific communication and social interactions, prey detection, predator avoidance, or navigation) (Richardson *et al.,* 1995; Erbe and Farmer, 2000; Tyack, 2000; Erbe *et al.,* 2016). Masking occurs when the receipt of a sound is interfered with by another coincident sound at similar frequencies and at similar or higher intensity, and may occur whether the sound is natural (*e.g.,* snapping shrimp, wind, waves, precipitation) or anthropogenic (*e.g.,* shipping, sonar, seismic exploration) in origin. As described in detail in the 2019 NWTT DSEIS/OEIS, the ability of a noise source to mask biologically important sounds depends on the characteristics of both the noise source and the signal of interest (*e.g.,* signal-to-noise ratio, temporal variability, direction), in relation to each other and to an animal's hearing abilities (*e.g.,* sensitivity, frequency range, critical ratios, frequency discrimination, directional discrimination, age, or TTS hearing loss), and existing ambient noise and propagation conditions. Masking these acoustic signals can disturb the behavior of individual animals, groups of animals, or entire populations. Masking can lead to behavioral changes including vocal changes (*e.g.,* Lombard effect, increasing amplitude, or changing frequency), cessation of foraging, and leaving an area, to both signalers and receivers, in an attempt to compensate for noise levels (Erbe *et al.,* 2016).

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

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

Richardson *et al.* (1995b) argued that the maximum radius of influence of an industrial noise (including broadband low-frequency sound transmission) on a marine mammal is the distance from the source to the point at which the noise can barely be heard. This range is determined by either the hearing sensitivity (including critical ratios, or the lowest signal-to-noise ratio in which animals can detect a signal, Finneran and Branstetter, 2013; Johnson *et al.,* 1989; Southall *et al.,* 2000) of the animal or the background noise level present. Industrial masking is most likely to affect some species' ability to detect communication calls and natural sounds (*i.e.,* surf noise, prey noise, *etc.;* Richardson *et al.,* 1995).

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

The echolocation calls of toothed whales are subject to masking by high-frequency sound. Human data indicate low-frequency sound can mask high-frequency sounds (*i.e.,* upward masking). Studies on captive odontocetes by Au *et al.* (1974, 1985, 1993) indicate that some species may use various processes to reduce masking effects (*e.g.,* adjustments in echolocation call intensity or frequency as a function of background noise conditions). There is also evidence that the directional hearing abilities of odontocetes are useful in reducing masking at the high-frequencies these cetaceans use to echolocate, but not at the low-to-moderate frequencies they use to communicate (Zaitseva *et al.,* 1980). A study by Nachtigall and Supin (2008) showed that false killer whales adjust their hearing to compensate for ambient sounds and the intensity of returning echolocation signals.

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

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

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

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

Impaired Communication

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

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

Marine mammals are also known to make vocal changes in response to anthropogenic noise. In cetaceans, vocalization changes have been reported from exposure to anthropogenic noise sources such as sonar, vessel noise, and seismic surveying (see the following for examples: Gordon *et al.,* 2003; Di Iorio and Clark, 2010; Hatch *et al.,* 2012; Holt *et al.,* 2008; Holt *et al.,* 2011; Lesage *et al.,* 1999; McDonald *et al.,* 2009; Parks *et al.,* 2007, Risch *et al.,* 2012, Rolland *et al.,* 2012), as well as changes in the natural acoustic environment (Dunlop *et al.,* 2014). Vocal changes can be temporary, or can be persistent. For example, model simulation suggests that the increase in starting frequency for the North Atlantic right whale upcall over the last 50 years resulted in increased detection ranges between right whales. The frequency shift, coupled with an increase in call intensity by 20 dB, led to a call detectability range of less than 3 km to over 9 km (Tennessen and Parks, 2016). Holt *et al.* (2008) measured killer whale call source levels and background noise levels in the one to 40 kHz band and reported that the whales increased their call source levels by one dB SPL for every one dB SPL increase in background noise level. Similarly, another study on St. Lawrence River belugas reported a similar rate of increase in vocalization activity in response to passing vessels (Scheifele *et al.,* 2005). Di Iorio and Clark (2010) showed that blue whale calling rates vary in association with seismic sparker survey activity, with whales calling more on days with surveys than on days without surveys. They suggested that the whales called more during seismic survey periods as a way to compensate for the elevated noise conditions.

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

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

Masking Due to Sonar and Other Transducers

The functional hearing ranges of mysticetes, odontocetes, and pinnipeds underwater overlap the frequencies of the sonar sources used in the Navy's low-frequency active sonar (LFAS)/mid-frequency active sonar (MFAS)/high-frequency active sonar (HFAS) training and testing exercises. Additionally, almost all affected species' vocal repertoires span across the frequencies of these sonar sources used by the Navy. The closer the characteristics of the masking signal to the signal of interest, the more likely masking is to occur. Masking by low-frequency or mid-frequency active sonar (LFAS and MFAS) with relatively low-duty cycles is not anticipated (or would be of very short duration) for most cetaceans as sonar signals occur over a relatively short duration and narrow bandwidth (overlapping with only a small portion of the hearing range). LFAS could overlap in frequency with mysticete vocalizations, however LFAS does not overlap with vocalizations for most marine mammal species. For example, in the presence of LFAS, humpback whales were observed to increase the length of their songs (Fristrup *et al.,* 2003; Miller *et al.,* 2000), potentially due to the overlap in frequencies between the whale song and the LFAS. While dolphin whistles and MFAS are similar in frequency, masking is not anticipated (or would be of very short duration) due to the low-duty cycle of most sonars.

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

Masking Due to Vessel Noise

Masking is more likely to occur in the presence of broadband, relatively continuous noise sources such as vessels. Several studies have shown decreases in marine mammal communication space and changes in behavior as a result of the presence of vessel noise. For example, right whales were observed to shift the frequency content of their calls upward while reducing the rate of calling in areas of increased anthropogenic noise (Parks *et al.,* 2007) as well as increasing the amplitude (intensity) of their calls (Parks, 2009; Parks *et al.,* 2011). Fournet *et al.* (2018) observed that humpback whales in Alaska responded to increasing ambient sound levels (natural and anthropogenic) by increasing the source levels of their calls (non-song vocalizations). Clark *et al.* (2009) also observed that right whales communication space decreased by up to 84 percent in the presence of vessels (Clark *et al.,* 2009). Cholewiak *et al.* (2018) also observed loss in communication space in Stellwagen National Marine Sanctuary for North Atlantic right whales, fin whales, and humpback whales with increased ambient noise and shipping noise. Gabriele *et al.* (2018) modeled the effects of vessel traffic sound on communication space in Glacier Bay National Park in Alaska and found that typical summer vessel traffic in the Park causes losses of communication space to singing whales (reduced by 13–28 percent), calling whales (18–51 percent), and roaring seals (32–61 percent), particularly during daylight hours and even in the absence of cruise ships. Dunlop (2019) observed that an increase in vessel noise reduced modelled communication space and resulted in significant reduction in group social interactions in Australian humpback whales. However, communication signal masking did not fully explain this change in social behavior in the model, indicating there may also be an additional effect of the physical presence of the vessel on social behavior (Dunlop, 2019). Although humpback whales off Australia did not change the frequency or duration of their vocalizations in the presence of ship noise, their source levels were lower than expected based on source level changes to wind noise, potentially indicating some signal masking (Dunlop, 2016). Multiple delphinid species have also been shown to increase the minimum or maximum frequencies of their whistles in the presence of anthropogenic noise and reduced communication space (for examples see: Holt *et al.,* 2008; Holt *et al.,* 2011; Gervaise *et al.,* 2012; Williams *et al.,* 2013; Hermannsen *et al.,* 2014; Papale *et al.,* 2015; Liu *et al.,* 2017).

Behavioral Response/Disturbance

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

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

Ellison *et al.* (2012) outlined an approach to assessing the effects of sound on marine mammals that incorporates contextual-based factors. The authors recommend considering not just the received level of sound, but also the activity the animal is engaged in at the time the sound is received, the nature and novelty of the sound (*i.e.,* is this a new sound from the animal's perspective), and the distance between the sound source and the animal. They submit that this ''exposure context,'' as described, greatly influences the type of behavioral response exhibited by the animal. Forney *et al.* (2017) also point out that an apparent lack of response (*e.g.,* no displacement or avoidance of a sound source) may not necessarily mean there is no cost to the individual or population, as some resources or habitats may be of such high value that animals may choose to stay, even when experiencing stress or hearing loss. Forney *et al.* (2017) recommend considering both the costs of remaining in an area of noise exposure such as TTS, PTS, or masking, which could lead to an increased risk of predation or other threats or a decreased capability to forage, and the costs of displacement, including potential increased risk of vessel strike, increased risks of predation or competition for resources, or decreased habitat suitable for foraging, resting, or socializing. This sort of contextual information is challenging to predict with accuracy for ongoing activities that occur over large spatial and temporal expanses. However, distance is one contextual factor for which data exist to quantitatively inform a take estimate, and the method for predicting Level B harassment in this rule does consider distance to the source. Other factors are often considered qualitatively in the analysis of the likely consequences of sound exposure, where supporting information is available.

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

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

Flight Response

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

Response to Predator

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

Alteration of Diving or Movement

Changes in dive behavior can vary widely. They may consist of increased or decreased dive times and surface intervals as well as changes in the rates of ascent and descent during a dive (*e.g.,* Frankel and Clark, 2000; Ng and Leung, 2003; Nowacek *et al.;* 2004; Goldbogen *et al.,* 2013a, 2013b). Variations in dive behavior may reflect interruptions in biologically significant activities (*e.g.,* foraging) or they may be of little biological significance. Variations in dive behavior may also expose an animal to potentially harmful conditions (*e.g.,* increasing the chance of ship-strike) or may serve as an avoidance response that enhances survivorship. The impact of a variation in diving resulting from an acoustic exposure depends on what the animal is doing at the time of the exposure and the type and magnitude of the response.

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

Foraging

Disruption of feeding behavior can be difficult to correlate with anthropogenic sound exposure, so it is usually inferred by observed displacement from known foraging areas, the appearance of secondary indicators (*e.g.,* bubble nets or sediment plumes), or changes in dive behavior. As for other types of behavioral response, the frequency, duration, and temporal pattern of signal presentation, as well as differences in species sensitivity, are likely contributing factors to differences in response in any given circumstance (*e.g.,* Croll *et al.,* 2001; Harris *et al.,* 2017; Madsen *et al.,* 2006a; Nowacek *et al.;* 2004; Yazvenko *et al.,* 2007). A determination of whether foraging disruptions incur fitness consequences would require information on or estimates of the energetic requirements of the affected individuals and the relationship between prey availability, foraging effort and success, and the life history stage of the animal.

Noise from seismic surveys was not found to impact the feeding behavior in western grey whales off the coast of Russia (Yazvenko *et al.,* 2007). Visual tracking, passive acoustic monitoring, and movement recording tags were used to quantify sperm whale behavior prior to, during, and following exposure to air gun arrays at received levels in the range 140–160 dB at distances of 7–13 km, following a phase-in of sound intensity and full array exposures at 1–13 km (Madsen *et al.,* 2006a; Miller *et al.,* 2009). Sperm whales did not exhibit horizontal avoidance behavior at the surface. However, foraging behavior may have been affected. The sperm whales exhibited 19 percent less vocal (buzz) rate during full exposure relative to post exposure, and the whale that was approached most closely had an extended resting period and did not resume foraging until the air guns had ceased firing. The remaining whales continued to execute foraging dives throughout exposure; however, swimming movements during foraging dives were six percent lower during exposure than control periods (Miller *et al.,* 2009). These data raise concerns that air gun surveys may impact foraging behavior in sperm whales, although more data are required to understand whether the differences were due to exposure or natural variation in sperm whale behavior (Miller *et al.,* 2009).

Balaenopterid whales exposed to moderate low-frequency signals similar to the ATOC sound source demonstrated no variation in foraging activity (Croll *et al.,* 2001), whereas five out of six North Atlantic right whales exposed to an acoustic alarm interrupted their foraging dives (Nowacek *et al.,* 2004). Although the received SPLs were similar in the latter two studies, the frequency, duration, and temporal pattern of signal presentation were different. These factors, as well as differences in species sensitivity, are likely contributing factors to the differential response. Blue whales exposed to mid-frequency sonar in the Southern California Bight were less likely to produce low frequency calls usually associated with feeding behavior (Melcón *et al.,* 2012). However, 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 behavioral response studies 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 were generally brief, of low to moderate severity, and highly dependent on exposure context (Southall *et al.,* 2011; Southall *et al.,* 2012b, Southall *et al.,* 2019b). Information on or estimates of the energetic requirements of the individuals and the relationship between prey availability, foraging effort and success, and the life history stage of the animal will help better inform a determination of whether foraging disruptions incur fitness consequences. Surface feeding blue whales did not show a change in behavior in response to mid-frequency simulated and real sonar sources with received levels between 90 and 179 dB re: 1 μPa, but deep feeding and non-feeding whales showed temporary reactions including cessation of feeding, reduced initiation of deep foraging dives, generalized avoidance responses, and changes to dive behavior. The behavioral responses they observed were generally brief, of low to moderate severity, and highly dependent on exposure context (behavioral state, source-to-whale horizontal range, and prey availability) (DeRuiter *et al.,* 2017; Goldbogen *et al.,* 2013b; Sivle *et al.,* 2015). Goldbogen *et al.* (2013b) indicate that disruption of feeding and displacement could impact individual fitness and health. However, for this to be true, we would have to assume that an individual whale could not compensate for this lost feeding opportunity by either immediately feeding at another location, by feeding shortly after cessation of acoustic exposure, or by feeding at a later time. There is no indication this is the case, particularly since unconsumed prey would likely still be available in the environment in most cases following the cessation of acoustic exposure.

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

Breathing

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

Social Relationships

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

Vocalizations (Also See *Auditory Masking* Section)

Vocal changes in response to anthropogenic noise can occur across the repertoire of sound production modes used by marine mammals, such as whistling, echolocation click production, calling, and singing. Changes in vocalization behavior that may result in response to anthropogenic noise can occur for any of these modes and may result from a need to compete with an increase in background noise or may reflect an increased vigilance or a startle response. For example, in the presence of potentially masking signals (low-frequency active sonar), humpback whales have been observed to increase the length of their songs (Miller *et al.,* 2000; Fristrup *et al.,* 2003). A similar compensatory effect for the presence of low-frequency vessel noise has been suggested for right whales; right whales have been observed to shift the frequency content of their calls upward while reducing the rate of calling in areas of increased anthropogenic noise (Parks *et al.,* 2007; Roland *et al.,* 2012). Killer whales off the northwestern coast of the United States have been observed to increase the duration of primary calls once a threshold in observing vessel density (*e.g.,* whale watching) was reached, which has been suggested as a response to increased masking noise produced by the vessels (Foote *et al.,* 2004; NOAA, 2014b). In contrast, both sperm and pilot whales potentially ceased sound production during the Heard Island feasibility test (Bowles *et al.,* 1994), although it cannot be absolutely determined whether the inability to acoustically detect the animals was due to the cessation of sound production or the displacement of animals from the area.

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

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

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

Avoidance

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

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

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

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

Maybaum (1993) conducted sound playback experiments to assess the effects of MFAS on humpback whales in Hawaiian waters. Specifically, she exposed focal pods to sounds of a 3.3-kHz sonar pulse, a sonar frequency sweep from 3.1 to 3.6 kHz, and a control (blank) tape while monitoring behavior, movement, and underwater vocalizations. The two types of sonar signals differed in their effects on the humpback whales, but both resulted in avoidance behavior. The whales responded to the pulse by increasing their distance from the sound source and responded to the frequency sweep by increasing their swimming speeds and track linearity. In the Caribbean, sperm whales avoided exposure to mid-frequency submarine sonar pulses, in the range of 1,000 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 at 1–2 kHz every 10 seconds for 10 minutes; Source B: with a 1.0 second upsweep 197 dB at 6–7 kHz every 10 seconds for 10 minutes). When exposed to Source A, a tagged whale and the group it was traveling with did not appear to avoid the source. When exposed to Source B, the tagged whales along with other whales that had been carousel feeding, where killer whales cooperatively herd fish schools into a tight ball towards the surface and feed on the fish which have been stunned by tailslaps, and subsurface feeding (Simila, 1997) ceased feeding during the approach of the sonar and moved rapidly away from the source. When exposed to Source B, Kvadsheim *et al.* (2007) reported that a tagged killer whale seemed to try to avoid further exposure to the sound field by the following behaviors: Immediately swimming away (horizontally) from the source of the sound; engaging in a series of erratic and frequently deep dives that seemed to take it below the sound field; or swimming away while engaged in a series of erratic and frequently deep dives. Although the sample sizes in this study are too small to support statistical analysis, the behavioral responses of the killer whales were consistent with the results of other studies.

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

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

The studies that address responses of low-frequency cetaceans to non-pulse sounds include data gathered in the field and related to several types of sound sources (of varying similarity to active sonar) 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, 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 active sonar) 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 active sonar) 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 existed 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 re: 1µ Pa). 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 MFAS transmission. The response to such stimuli appears to involve the beaked whale increasing the distance between it and the sound source. Overall the results from the 2007–2008 study showed a change in diving behavior of the Blainville's beaked whale to playback of MFAS and predator sounds (Boyd *et al.,* 2008; Southall *et al.,* 2009; Tyack *et al.,* 2011).

Stimpert *et al.* (2014) tagged a Baird's beaked whale, which was subsequently exposed to simulated MFAS. Received levels of sonar on the tag increased to a maximum of 138 dB re: 1 µPa, 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 were presented for the 2010–2011 field season (Southall *et al.,* 2011; DeRuiter *et al.,* 2013b). DeRuiter *et al.* (2013b) presented results from two Cuvier's beaked whales that were tagged and exposed to simulated MFAS during the 2010 and 2011 field seasons of the southern California behavioral response study. The 2011 whale was also incidentally exposed to MFAS from a distant naval exercise. Received levels from the MFAS signals from the controlled and incidental exposures were calculated as 84–144 and 78–106 dB re: 1 µPa rms, respectively. Both whales showed responses to the controlled exposures, ranging from initial orientation changes to avoidance responses characterized by energetic fluking and swimming away from the source. However, the authors did not detect similar responses to incidental exposure to distant naval sonar exercises at comparable received levels, indicating that context of the exposures (*e.g.,* source proximity, controlled source ramp-up) may have been a significant factor. Specifically, this result suggests that caution is needed when using marine mammal response data collected from smaller, nearer sound sources to predict at what received levels animals may respond to larger sound sources that are significantly farther away—as the distance of the source appears to be an important contextual variable and animals may be less responsive to sources at notably greater distances. Cuvier's beaked whale responses suggested particular sensitivity to sound exposure as consistent with results for Blainville's beaked whale. Similarly, beaked whales exposed to sonar during British training exercises stopped foraging (DSTL, 2007), and preliminary results of controlled playback of sonar may indicate feeding/foraging disruption of killer whales and sperm whales (Miller *et al.,* 2011).

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

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

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

Southall *et al.* (2016) indicates that results from Tyack *et al.* (2011), Miller *et al.* (2015), Stimpert *et al.* (2014), and DeRuiter *et al.* (2013) beaked whale studies demonstrate clear, strong, and pronounced but varied behavioral changes including avoidance with associated energetic swimming and cessation of individual foraging dives at quite low received levels (~100 to 135 dB re: 1 Pa) for exposures to simulated or active MF military sonars (1–8 kHz) with sound sources approximately 2–5 km away. Similar responses by beaked whales to sonar have been documented by Stimpert *et al.,* 2014, Falcone *et al.,* 2017, DiMarzio *et al.,* 2018, and Joyce *et al.,* 2019. However, there are a number of variables influencing response or non-response including source distance (close vs. far), received sound levels, and other contextual variables such as other sound sources (*e.g.,* vessels, *etc.*) (Manzano-Roth *et al.,* 2016, Falcone *et al.,* 2017, Harris *et al.,* 2018). Wensveen *et al.* (2019) found northern bottlenose whales to avoid sonar out to distances of 28 km, but these distances are well in line with those observed on Navy ranges (Manzano-Roth *et al.,* 2016; Joyce *et al.,* 2019) where the animals return once the sonar has ceased. Furthermore, beaked whales have also shown response to other non-sonar anthropogenic sounds such as commercial shipping and echosounders (Soto *et al.,* 2006, Pirotta *et al.,* 2012, Cholewiak *et al.,* 2017). Pirotta *et al.* (2012) documented broadband ship noise causing a significant change in beaked whale behavior up to at least 5.2 km away from the vessel. Even though beaked whales appear to be sensitive to anthropogenic sounds, the level of response at the population level does not appear to be significant based on over a decade of research at two heavily used Navy training areas in the Pacific (Falcone *et al.,* 2012, Schorr *et al.,* 2014, DiMarzio *et al.,* 2018, Schorr *et al.,* 2019). With the exception of seasonal patterns, DiMarzio *et al.* (2018) did not detect any changes in annual Cuvier's beaked whale abundance estimates in Southern California derived from passive acoustic echolocation detections over nine years (2010–2018). Similar results for Blainville's beaked whales abundance estimates over several years was documented in Hawaii (Henderson *et al.,* 2016;, DiMarzio *et al.,* 2018). Visually, there have been documented repeated sightings in southern California of the same individual Cuvier's beaked whales over 10 years, sightings of mother-calf pairs, and recently sightings of the same mothers with their second calf (Falcone *et al.,* 2012; Schorr *et al.,* 2014; Schorr *et al.,* 2019; Schorr, unpublished data).

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

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

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

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

Orientation

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

Continued Pre-Disturbance Behavior and Habituation

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

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

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

Explosive Sources

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

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

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

Further Potential Effects of Behavioral Disturbance on Marine Mammal Fitness

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

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

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

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

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

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

Vigilance is normally an adaptive behavior that helps animals determine the presence or absence of predators, assess their distance from conspecifics, or to attend cues from prey (Bednekoff and Lima, 1998; Treves, 2000). Despite those benefits, however, vigilance has a cost of time; when animals focus their attention on specific environmental cues, they are not attending to other activities such as foraging or resting. These effects have generally not been demonstrated for marine mammals, but studies involving fish and terrestrial animals have shown that increased vigilance may substantially reduce feeding rates (Saino, 1994; Beauchamp and Livoreil, 1997; Fritz *et al.,* 2002; Purser and Radford, 2011). Animals will spend more time being vigilant, which may translate to less time foraging or resting, when disturbance stimuli approach them more directly, remain at closer distances, have a greater group size (*e.g.,* multiple surface vessels), or when they co-occur with times that an animal perceives increased risk (*e.g.,* when they are giving birth or accompanied by a calf). An example of this concept with terrestrial species involved bighorn sheep and Dall's sheep, which dedicated more time being vigilant, and less time resting or foraging, when aircraft made direct approaches over them (Frid, 2001; Stockwell *et al.,* 1991). Vigilance has also been documented in pinnipeds at haul-out sites where resting may be disturbed when seals become alerted and/or flush into the water due to a variety of disturbances, which may be anthropogenic (noise and/or visual stimuli) or due to other natural causes such as other pinnipeds (Richardson *et al.,* 1995; Southall *et al.,* 2007; VanBlaricom, 2010; and Lozano and Hente, 2014).

Chronic disturbance can cause population declines through reduction of fitness (*e.g.,* decline in body condition) and subsequent reduction in reproductive success, survival, or both (*e.g.,* Harrington and Veitch, 1992; Daan *et al.,* 1996; Bradshaw *et al.,* 1998). For example, Madsen (1994) reported that pink-footed geese (*Anser brachyrhynchus*) in undisturbed habitat gained body mass and had about a 46 percent reproductive success rate compared with geese in disturbed habitat (being consistently scared off the fields on which they were foraging) which did not gain mass and had a 17 percent reproductive success rate. Similar reductions in reproductive success have been reported for mule deer (*Odocoileus hemionus*) disturbed by all-terrain vehicles (Yarmoloy *et al.,* 1988), caribou (*Rangifer tarandus caribou*) disturbed by seismic exploration blasts (Bradshaw *et al.,* 1998), and caribou disturbed by low-elevation military jet fights (Luick *et al.,* 1996, Harrington and Veitch, 1992). Similarly, a study of elk (*Cervus elaphus*) that were disturbed experimentally by pedestrians concluded that the ratio of young to mothers was inversely related to disturbance rate (Phillips and Alldredge, 2000). However, Ridgway *et al.* (2006) reported that increased vigilance in bottlenose dolphins exposed to sound over a five-day period in open-air, open-water enclosures in

San Diego Bay did not cause any sleep deprivation or stress effects such as changes in cortisol or epinephrine levels.

The primary mechanism by which increased vigilance and disturbance appear to affect the fitness of individual animals is by disrupting an animal's time budget and, as a result, reducing the time they might spend foraging and resting (which increases an animal's activity rate and energy demand while decreasing their caloric intake/energy). An example of this concept with terrestrial species involved a study of grizzly bears (*Ursus horribilis*) that reported that bears disturbed by hikers reduced their energy intake by an average of 12 kilocalories/min (50.2 × 103 kiloJoules/min), and spent energy fleeing or acting aggressively toward hikers (White *et al.,* 1999).

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

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

Stone (2015a) reported data from at-sea observations during 1,196 airgun surveys from 1994 to 2010. When large arrays of airguns (considered to be 500 in^3 or more) were firing, lateral displacement, more localized avoidance, or other changes in behavior were evident for most odontocetes. However, significant responses to large arrays were found only for the minke whale and fin whale. Behavioral responses observed included changes in swimming or surfacing behavior, with indications that cetaceans remained near the water surface at these times. Cetaceans were recorded as feeding less often when large arrays were active. Monitoring of gray whales during an air gun survey included recording whale movements and respirations pre-, during-, and post-seismic survey (Gailey *et al.,* 2016). Behavioral state and water depth were the best 'natural' predictors of whale movements and respiration and, after considering natural variation, none of the response variables were significantly associated with survey or vessel sounds.

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

Since New *et al.* (2014), several publications have described models developed to examine the long-term effects of environmental or anthropogenic disturbance of foraging on various life stages of selected species (sperm whale, Farmer *et al.* (2018); California sea lion, McHuron *et al.* (2018); and blue whale, Pirotta, *et al.* (2018a)). These models continue to add to refinement to the approaches to the population consequences of disturbance (PCOD) framework. Such models also help identify what data inputs require further investigation. Pirotta *et al.*

(2018b) provides a review of the PCOD framework with details on each step of the process and approaches to applying real data or simulations to achieve each step.

Stranding and Mortality

The definition for a stranding under title IV of the MMPA is that (A) a marine mammal is dead and is (i) on a beach or shore of the United States; or (ii) in waters under the jurisdiction of the United States (including any navigable waters); or (B) a marine mammal is alive and is (i) on a beach or shore of the United States and is unable to return to the water; (ii) on a beach or shore of the United States and, although able to return to the water, is in need of apparent medical attention; or (iii) in the waters under the jurisdiction of the United States (including any navigable waters), but is unable to return to its natural habitat under its own power or without assistance (see MMPA section 410(3)). This definition is useful for considering stranding events even when they occur beyond lands and waters under the jurisdiction of the United States.

Marine mammal strandings have been linked to a variety of causes, such as illness from exposure to infectious agents, biotoxins, or parasites; starvation; unusual oceanographic or weather events; or anthropogenic causes including fishery interaction, ship strike, entrainment, entrapment, sound exposure, or combinations of these stressors sustained concurrently or in series. Historically, the cause or causes of most strandings have remained unknown (Geraci *et al.,* 1976; Eaton, 1979, Odell *et al.,* 1980; Best, 1982), but the development of trained, professional stranding response networks and improved analyses have led to a greater understanding of marine mammal stranding causes (Simeone and Moore 2017).

Numerous studies suggest that the physiology, behavior, habitat, social relationships, age, or condition of cetaceans may cause them to strand or might predispose them to strand when exposed to another phenomenon. These suggestions are consistent with the conclusions of numerous other studies that have demonstrated that combinations of dissimilar stressors commonly combine to kill an animal or dramatically reduce its fitness, even though one exposure without the other does not produce the same result (Bernaldo de Quiros *et al.,* 2019; Chroussos, 2000; Creel, 2005; DeVries *et al.,* 2003; Fair and Becker, 2000; Foley *et al.,* 2001; Moberg, 2000; Relyea, 2005a; 2005b, Romero, 2004; Sih *et al.,* 2004).

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

In the United States from 2006–2017, there were 19,430 cetacean strandings and 55,833 pinniped strandings (75,263 total) (P. Onens, NMFS, pers comm., 2019). Several mass strandings (strandings that involve two or more individuals of the same species, excluding a single mother-calf pair) that have occurred over the past two decades have been associated with anthropogenic activities that introduced sound into the marine environment such as naval operations and seismic surveys. An in-depth discussion of strandings is in the Navy's Technical Report on Marine Mammal Strandings Associated with U.S. Navy Sonar Activities (U.S. Navy Marine Mammal Program & Space and Naval Warfare Systems Command Center Pacific, 2017).

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

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

Strandings Associated With Impulsive Sound

Silver Strand

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

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

Kyle of Durness, Scotland

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

Gulf of California, Mexico

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

Strandings Associated With Active Sonar

Over the past 21 years, there have been five stranding events coincident with U.S. Navy MF active sonar use in which exposure to sonar is believed to have been a contributing factor: Greece (1996); the Bahamas (2000); Madeira (2000); Canary Islands (2002); and Spain (2006) (Cox *et al.,* 2006; Fernandez, 2006; U.S. Navy Marine Mammal Program & Space and Naval Warfare Systems Command Center Pacific, 2017). These five mass strandings have resulted in about 40 known cetacean deaths consisting mostly of beaked whales and with close linkages to mid-frequency active sonar activity. In these circumstances, exposure to non-impulsive acoustic energy was considered a potential indirect cause of death of the marine mammals (Cox *et al.,* 2006). Only one of these stranding events, the Bahamas (2000), was associated with exercises conducted by the U.S. Navy. Additionally, in 2004, during the Rim of the Pacific (RIMPAC) exercises, between 150 and 200 usually pelagic melon-headed whales occupied the shallow waters of Hanalei Bay, Kauai, Hawaii for over 28 hours. NMFS determined that MFAS was a plausible, if not likely, contributing factor in what may have been a confluence of events that led to the Hanalei Bay stranding. A number of other stranding events coincident with the operation of MFAS, including the death of beaked whales or other species (minke whales, dwarf sperm whales, pilot whales), have been reported; however, the majority have not been investigated to the degree necessary to determine the cause of the stranding. Most recently, the Independent Scientific Review Panel investigating potential contributing factors to a 2008 mass stranding of melon-headed whales in Antsohihy, Madagascar released its final report suggesting that the stranding was likely initially triggered by an industry seismic survey (Southall *et al.,* 2013). This report suggests that the operation of a commercial high-powered 12 kHz multi-beam echosounder during an industry seismic survey was a plausible and likely initial trigger that caused a large group of melon-headed whales to leave their typical habitat and then ultimately strand as a result of secondary factors such as malnourishment and dehydration. The report indicates that the risk of this particular convergence of factors and ultimate outcome is likely very low, but recommends that the potential be considered in environmental planning. Because of the association between tactical mid-frequency active sonar use and a small number of marine mammal strandings, the Navy and NMFS have been considering and addressing the potential for strandings in association with Navy activities for years. In addition to the proposed mitigation measures intended to more broadly minimize impacts to marine mammals, the Navy will abide by the Notification and Reporting Plan, which sets out notification, reporting, and other requirements when dead, injured, or stranded marine mammals are detected in certain circumstances.

Greece (1996)

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

Necropsies of eight of the animals were performed but were limited to basic external examination and sampling of stomach contents, blood, and skin. No ears or organs were collected, and no histological samples were preserved. No significant apparent abnormalities or wounds were found, however examination of photos of the animals, taken soon after their death, revealed that the eyes of at least four of the individuals were bleeding (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 was compiled, and many potential causes were examined including major pollution events, prominent tectonic activity, unusual physical or meteorological events, magnetic anomalies, epizootics, and conventional military activities (International Council for the Exploration of the Sea, 2005a). However, none of these potential causes coincided in time or space with the mass stranding, or could explain its characteristics (International Council for the Exploration of the Sea, 2005a). The robust condition of the animals, plus the recent stomach contents, is inconsistent with pathogenic causes. In addition, environmental causes can be ruled out as there were no unusual environmental circumstances or events before or during this time period and within the general proximity (Frantzis, 2004).

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

Bahamas (2000)

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

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

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

Madeira, Portugal (2000)

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

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

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

Even though no definitive causal link can be made between the stranding event and naval exercises, certain conditions may have existed in the exercise area that, in their aggregate, may have contributed to the marine mammal strandings (Freitas, 2004): Exercises were conducted in areas of at least 547 fathoms (1,000 m) depth near a shoreline where there is a rapid change in bathymetry on the order of 547 to 3,281 fathoms (1,000 to 6,000 m) occurring across a relatively short horizontal distance (Freitas, 2004); multiple ships were operating around Madeira, though it is not known if MFAS was used, and the specifics of the sound sources used are unknown (Cox *et al.,* 2006, Freitas, 2004); and exercises took place in an area surrounded by landmasses separated by less than 35 nmi (65 km) and at least 10 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 close 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 the Canary Islands stranding event lead to the hypothesis that the presence of disseminated and widespread gas bubbles and fat emboli were indicative of nitrogen bubble formation, similar to what might be expected in decompression sickness (Jepson *et al.,* 2003; Fernández *et al.,* 2005).

Hanalei Bay (2004)

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

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

Environmental factors, abiotic and biotic, were analyzed for any anomalous occurrences that would have contributed to the animals entering and remaining in Hanalei Bay. The Bay's bathymetry is similar to many other sites within the Hawaiian Island chain and dissimilar to sites that have been associated with mass strandings in other parts of the United States. 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 considers 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, which appear to be similar to observations of melon-headed whales resting normally at Palmyra Island. Additionally, there was no correlation between lunar cycle and the types of behaviors observed in the Brownell *et al.* (2009) examples.

Spain (2006)

The Spanish Cetacean Society reported an atypical mass stranding of four beaked whales that occurred January 26, 2006, on the southeast coast of Spain, near Mojácar (Gulf of Vera) in the Western Mediterranean Sea. According to the report, two of the whales were discovered the evening of January 26 and were found to be still alive. Two other whales were discovered during the day on January 27, but had already died. The first three animals were located near the town of Mojácar and the fourth animal was found dead, a few kilometers north of the first three animals. From January 25–26, 2006, Standing NATO Response Force Maritime Group Two (five of seven ships including one U.S. ship under NATO Operational Control) had conducted active sonar training against a Spanish submarine within 50 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 2001 NMFS/Navy joint report was identified as the cause of the 2000 Bahamas stranding event, the specific mechanisms that led to that stranding (or the others) are not well 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). In a review of the previously published data on the potential impacts of sonar on beaked whales, Bernaldo de Quirós *et al.* (2019) suggested that the effect of mid-frequency active sonar on beaked whales varies among individuals or populations, and that predisposing conditions such as previous exposure to sonar and individual health risk factors may contribute to individual outcomes (such as decompression sickness).

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

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

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

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

Strandings in the NWTT Study Area

Stranded marine mammals are reported along the entire western coast of the United States each year. Marine mammals strand due to natural or anthropogenic causes; the majority of reported type of occurrences in marine mammal strandings in this region include fishery interactions, illness, predation, and vessel strikes (Carretta *et al.,* 2017b; Helker *et al.,* 2017; National Marine Fisheries Service, 2016). Stranding events that are associated with active UMEs on the Northwest Coast of the United States (inclusive of the NWTT Study Area) were previously discussed in the *Description of Marine Mammals and Their Habitat in the Area of the Specified Activities* section.

From 2007–2016, 43,125 marine mammal strandings were confirmed by the West Coast Marine Mammal Stranding Network including 33,569 in California (including areas outside the NWTT Study Area), 3,776 in Oregon, and 5,780 in Washington (10 year Data Summary Report, West Coast Marine Mammal Stranding Network 2017). The most common marine mammal to strand in the NWTT Study Area was pinnipeds, which comprise 94 percent of strandings in California, 90 percent of strandings in Oregon, and 89 percent of strandings in Washington. The next most common group was odontocetes, with harbor porpoises being the most common species. Gray whales were reported to be the most common large whale species to strand on the U.S. West Coast in all states. Where evidence of human interaction can be determined (9 percent as reported in the 10-year summary), the most common source of interaction on the U.S. West Coast was fishery interaction for pinnipeds, small cetaceans and large whales. The Behm Canal portion of the Study Area is a very small portion of the Southeast Regional Subarea of the Alaska Marine Mammal Stranding Network. A 10-year summary report is not available in this region however, in 2019 there were 40 confirmed strandings in the entire Southeast Regional Subarea, and 30 of these strandings were harbor seals or Steller sea lions.

One stranding event has been investigated for a possible link to Navy activities in the NWTT Study Area. Between May 2 and June 2, 2003, approximately 16 strandings involving 15 harbor porpoises and one Dall's porpoise in the Eastern Strait of Juan de Fuca and Haro Strait were reported to the Northwest Marine Mammal Stranding Network. Given that the USS SHOUP was known to have operated sonar in the Haro strait on May 5, 2003, and that behavioral reactions of killer whales were possibly linked to these sonar operations, NMFS undertook an analysis of whether sonar caused the strandings of the porpoises (National Marine Fisheries Service, 2005). NMFS determined that the 2003 strandings and similar harbor porpoise strandings over the following years were normal given a number of factors as described in Huggins *et al.* (2015). The 2015 NWTT FEIS/OEIS includes a comprehensive review of all strandings and the events involving the USS SHOUP on May 5, 2003. Additional information on this event is available in the Navy's Technical Report on Marine Mammal Strandings Associated with U.S. Navy Sonar Activities (U.S. Department of the Navy, 2017b). In the years since the SHOUP incident, annual numbers of stranded porpoises have been comparable (and sometimes higher) and have also shown similar causes of death (when determinable) to the causes of death noted in the SHOUP investigation (Huggins *et al.,* 2015).

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 biologically important habitat for marine mammals. Each of these potential effects was considered in the 2019 NWTT DSEIS/OEIS and was determined by the Navy to have no effect on marine mammal habitat. Based on the information below and the supporting information included in the 2019 NWTT DSEIS/OEIS, NMFS has determined that the proposed training and training activities would not have adverse or long-term impacts on marine mammal habitat.

Effects to Prey

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

Fish utilize the soundscape and components of sound in their environment to perform important functions such as foraging, predator avoidance, mating, and spawning (*e.g.,* Zelick *et al.,* 1999; Fay, 2009). The most likely effects on fishes exposed to loud, intermittent, low-frequency sounds are behavioral responses (*i.e.,* flight or avoidance). Short duration, sharp sounds (such as pile driving or air guns) can cause overt or subtle changes in fish behavior and local distribution. The reaction of fish to acoustic sources depends on the physiological state of the fish, past exposures, motivation (*e.g.,* feeding, spawning, migration), and other environmental factors. Key impacts to fishes may include behavioral responses, hearing damage, barotrauma (pressure-related injuries), and mortality.

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

Hearing capabilities vary considerably between different fish species with data only available for just over 100 species out of the 34,000 marine and freshwater fish species (Eschmeyer and Fong, 2016). In order to better understand acoustic impacts on fishes, fish hearing groups are defined by species that possess a similar continuum of anatomical features which result in varying degrees of hearing sensitivity (Popper and Hastings, 2009a). There are four hearing groups defined for all fish species (modified from Popper *et al.,* 2014) within this analysis and they include: Fishes without a swim bladder (*e.g.,* flatfish, sharks, rays, *etc.*); fishes with a swim bladder not involved in hearing (*e.g.,* salmon, cod, pollock, *etc.*); fishes with a swim bladder involved in hearing (*e.g.,* sardines, anchovy, herring, *etc.*); and fishes with a swim bladder involved in hearing and high-frequency hearing (*e.g.,* shad and menhaden). Most marine mammal fish prey species would not be likely to perceive or hear Navy mid- or high-frequency sonars. While hearing studies have not been done on sardines and northern anchovies, it would not be unexpected for them to possess hearing similarities to Pacific herring (up to 2–5 kHz) (Mann *et al.,* 2005). Currently, less data are available to estimate the range of best sensitivity for fishes without a swim bladder.

In terms of physiology, multiple scientific studies have documented a lack of mortality or physiological effects to fish from exposure to low- and mid-frequency sonar and other sounds (Halvorsen *et al.,* 2012; Jørgensen *et al.,* 2005; Juanes *et al.,* 2017; Kane *et al.,* 2010; Kvadsheim and Sevaldsen, 2005; Popper *et al.,* 2007; Popper *et al.,* 2016; Watwood *et al.,* 2016). Techer *et al.* (2017) exposed carp in floating cages for up to 30 days to low-power 23 and 46 kHz sources without any significant physiological response. Other studies have documented either a lack of TTS in species whose hearing range cannot perceive Navy sonar, or for those species that could perceive sonar-like signals, any TTS experienced would be recoverable (Halvorsen *et al.,* 2012; Ladich and Fay, 2013; Popper and Hastings, 2009a, 2009b; Popper *et al.,* 2014; Smith, 2016). Only fishes that have specializations that enable them to hear sounds above about 2,500 Hz (2.5 kHz) such as herring (Halvorsen *et al.,* 2012; Mann *et al.,* 2005; Mann, 2016; Popper *et al.,* 2014) would have the potential to receive TTS or exhibit behavioral responses from exposure to mid-frequency sonar. In addition, any sonar induced TTS to fish whose hearing range could perceive sonar would only occur in the narrow spectrum of the source (*e.g.,* 3.5 kHz) compared to the fish's total hearing range (*e.g.,* 0.01 kHz to 5 kHz). Overall, Navy sonar sources are much narrower in terms of source frequency compared to a given fish species full hearing range (Halvorsen *et al.,* 2012; Jørgensen *et al.,* 2005; Juanes *et al.,* 2017; Kane *et al.,* 2010; Kvadsheim & Sevaldsen, 2005; Popper *et al.,* 2007; Popper and Hawkins, 2016; Watwood *et al.,* 2016).

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

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

Fish not killed or driven from a location by an explosion might change their behavior, feeding pattern, or distribution. Changes in behavior of fish have been observed as a result of sound produced by explosives, with effect intensified in areas of hard substrate (Wright, 1982). However, Navy explosive use avoids hard substrate to the best extent practical during underwater detonations, or deep-water surface detonations. Stunning from pressure waves could also temporarily immobilize fish, making them more susceptible to predation. The abundances of various fish (and invertebrates) near the detonation point for explosives could be altered for a few hours before animals from surrounding areas repopulate the area. However, these populations would likely be replenished as waters near the detonation point are mixed with adjacent waters. Repeated exposure of individual fish to sounds from underwater explosions is not likely and exposures are expected to be short-term and localized. Long-term consequences for fish populations would not be expected.

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

Long-term consequences for fish populations, including key prey species within the NWTT Study Area, would not be expected.

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

In addition to fish, prey sources such as marine invertebrates could potentially be impacted by sound stressors as a result of the proposed activities. However, most marine invertebrates' ability to sense sounds is very limited. In most cases, marine invertebrates would not respond to impulsive and non-impulsive sounds, although they may detect and briefly respond to nearby low-frequency sounds. These short-term responses would likely be inconsequential to invertebrate populations.

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

Explosions could kill or injure nearby marine invertebrates. Vessels also have the potential to impact marine invertebrates by disturbing the water column or sediments, or directly striking organisms (Bishop, 2008). The propeller wash (water displaced by propellers used for propulsion) from vessel movement and water displaced from vessel hulls can potentially disturb marine invertebrates in the water column and is a likely cause of zooplankton mortality (Bickel *et al.,* 2011). The localized and short-term exposure to explosions or vessels could displace, injure, or kill zooplankton, invertebrate eggs or larvae, and macro-invertebrates. However, mortality or long-term consequences for a few animals is unlikely to have measurable effects on overall populations. Long-term consequences to marine invertebrate populations would not be expected as a result of exposure to sounds of vessels in the NWTT Study Area.

Impacts to benthic communities from impulsive sound generated by active acoustic sound sources are not well documented. (*e.g.,* Andriguetto-Filho *et al.,* 2005; Payne *et al.,* 2007; 2008; Boudreau *et al.,* 2009). There are no published data that indicate whether temporary or permanent threshold shifts, auditory masking, or behavioral effects occur in benthic invertebrates (Hawkins *et al.,* 2014) and some studies showed no short-term or long-term effects of air gun exposure (*e.g.,* Andriguetto-Filho *et al.,* 2005; Payne *et al.,* 2007; 2008; Boudreau *et al.,* 2009). Exposure to air gun signals was found to significantly increase mortality in scallops, in addition to causing significant changes in behavioral patterns during exposure (Day *et al.,* 2017). However, the authors state that the observed levels of mortality were not beyond naturally occurring rates. Explosions and pile driving could potentially kill or injure nearby marine invertebrates; however, mortality or long-term consequences for a few animals is unlikely to have measurable effects on overall populations.

There is little information concerning potential impacts of noise on zooplankton populations. However, one recent study (McCauley *et al.,* 2017) investigated zooplankton abundance, diversity, and mortality before and after exposure to air gun noise, finding that the mortality rate for zooplankton after airgun exposure was two to three times more 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.

Military expended materials resulting from training and testing activities could potentially result in minor long-term changes to benthic habitat, however the impacts of small amount of expended materials are unlikely to have measurable effects on overall populations. Military expended materials may be colonized over time by benthic organisms that prefer hard substrate and would provide structure that could attract some species of fish or invertebrates.

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

Acoustic Habitat

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

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

The term ''listening area'' refers to the region of ocean over which sources of sound can be detected by an animal at the center of the space. Loss of communication space concerns the area over which a specific animal signal (used to communicate with conspecifics in biologically important contexts such as foraging or 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).

The sounds produced during training and testing activities can be widely dispersed or concentrated in small areas for varying periods. Sound produced from training and testing activities in the NWTT Study Area is temporary and transitory. Any anthropogenic noise attributed to training and testing activities in the NWTT 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

Training and testing activities may introduce water quality constituents into the water column. Based on the analysis of the 2019 NWTT DSEIS/OEIS, military expended materials (*e.g.,* undetonated explosive materials) would be released in quantities and at rates that would not result in a violation of any water quality standard or criteria. NMFS has reviewed this analysis and concurs that it reflects the best available science. High-order explosions consume most of the explosive material, creating typical combustion products. For example, in the case of Royal Demolition Explosive, 98 percent of the products are common seawater constituents and the remainder is rapidly diluted below threshold effect level. Explosion by-products associated with high order detonations present no secondary stressors to marine mammals through sediment or water. However, low order detonations and unexploded ordnance present elevated likelihood of impacts on marine mammals.

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

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

Estimated Take of Marine Mammals

This section indicates the number of takes that NMFS is proposing to authorize, which is based on the amount of take that NMFS anticipates could occur or the maximum amount that is reasonably 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 preliminarily agrees that the methods the Navy has put forth described herein to estimate take (including the model, thresholds, and density estimates), and the resulting numbers estimated for authorization, are appropriate and based on the best available science.

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

Proposed authorized takes would primarily be in the form of Level B harassment, as use of the acoustic and explosive sources (*i.e.,* sonar and explosives) is most likely to result in the disruption of natural behavioral patterns to a point where they are abandoned or significantly altered (as defined specifically at the beginning of this section, but referred to generally as behavioral disruption) or TTS for marine mammals. There is also the potential for Level A harassment, in the form of auditory injury to result from exposure to the sound sources utilized in training and testing activities. Lastly, no more than three serious injuries or mortalities total (over the seven-year period) of large whales could potentially occur through vessel collisions. Although we analyze the impacts of these potential serious injuries or mortalities that are proposed for authorization, the proposed mitigation and monitoring measures are expected to minimize the likelihood (*i.e.,* further lower the already low probability) that ship strike (and the associated serious injury or mortality) would occur.

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

Acoustic Thresholds

Using the best available science, NMFS, in coordination with the Navy, has established acoustic thresholds that identify the most appropriate received level of underwater sound above which marine mammals exposed to these sound sources could be reasonably expected to experience a disruption in behavior patterns to a point where they are abandoned or significantly altered, or to incur TTS (equated to Level B harassment) or PTS of some degree (equated to Level A harassment). Thresholds have also been developed to identify the pressure levels above which animals may incur non-auditory injury from exposure to pressure waves from explosive detonation.

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

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

NMFS' Acoustic Technical Guidance (NMFS, 2018) identifies dual criteria to assess auditory injury (Level A harassment) to five different marine mammal groups (based on hearing sensitivity) as a result of exposure to noise from two different types of sources (impulsive or non-impulsive). The Acoustic Technical Guidance also identifies criteria to predict TTS, which is not considered injury and falls into the Level B harassment category. The Navy's planned activity includes the use of non-impulsive (sonar) and impulsive (explosives) sources.

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

TABLE 10—ACOUSTIC THRESHOLDS IDENTIFYING THE ONSET OF TTS AND PTS FOR NON-IMPULSIVE SOUND SOURCES BY FUNCTIONAL HEARING GROUPS

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

Note: SEL thresholds in dB re: 1 $\mu Pa^2 s$.

Based on the best available science, the Navy (in coordination with NMFS) used the acoustic and pressure thresholds indicated in Table 11 to predict the onset of TTS, PTS, tissue damage, and mortality for explosives (impulsive) and other impulsive sound sources.

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

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

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

The criteria used to assess the onset of TTS and PTS due to exposure to sonars (non-impulsive, see Table 10 above) are discussed further in the Navy's rulemaking/LOA application (see Hearing Loss from Sonar and Other Transducers in Chapter 6, Section 6.4.2.1, Methods for Analyzing Impacts from Sonars and Other Transducers). Refer to the ''Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)'' report (U.S. Department of the Navy, 2017c) for detailed information on how the criteria and thresholds were derived. Non-auditory injury (*i.e.,* other than PTS) and mortality from sonar and other transducers is so unlikely as to be discountable under normal conditions for the reasons explained under the *Potential Effects of Specified Activities on Marine Mammals and Their Habitat* section—*Acoustically Mediated Bubble Growth and other Pressure-related Injury* and is therefore not considered further in this analysis.

Behavioral Harassment

Though significantly driven by received level, the onset of Level B harassment by behavioral disturbance from anthropogenic noise exposure is also informed to varying degrees by other factors related to the source (*e.g.,* frequency, predictability, duty cycle), the environment (*e.g.,* bathymetry), and the receiving animals (hearing, motivation, experience, demography, behavioral context) and can be difficult to predict (Ellison *et al.,* 2011; Southall *et al.,* 2007). Based on what the available science indicates and the practical need to use thresholds based on a factor, or factors, that are both predictable and measurable for most activities, NMFS uses generalized acoustic thresholds based primarily on received level (and distance in some cases) to estimate the onset of Level B behavioral harassment.

Sonar

As noted above, the Navy coordinated with NMFS to develop Level B behavioral harassment thresholds specific to their military readiness activities utilizing active sonar. These behavioral response thresholds are used to estimate the number of animals that may exhibit a behavioral response that rises to the level of a take when exposed to sonar and other transducers. The way the criteria were derived is discussed in detail in the ''Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)'' report (U.S. Department of the Navy, 2017c). Developing the Level B harassment behavioral criteria involved multiple steps. All peer-reviewed published behavioral response studies conducted both in the field and on captive animals were examined in order to understand the breadth of behavioral responses of marine mammals to sonar and other transducers. NMFS has carefully reviewed the Navy's Level B behavioral thresholds and establishment of cutoff distances for the species, and agrees that it is the best available science and is the appropriate method to use at this time for determining impacts to marine mammals from sonar and other transducers and for calculating take and to support the determinations made in this proposed rule.

As discussed above, marine mammal responses to sound (some of which are considered disturbances that rise to the level of a take) are highly variable and context specific, *i.e.,* they are affected by differences in acoustic conditions; differences between species and populations; differences in gender, age, reproductive status, or social behavior; and other prior experience of the individuals. This means that there is support for considering alternative approaches for estimating Level B behavioral harassment. Although the statutory definition of Level B harassment for military readiness activities means that a natural behavior pattern of a marine mammal is significantly altered or abandoned, the current state of science for determining those thresholds is somewhat unsettled.

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

In the Navy's acoustic impact analyses during Phase II (the previous phase of Navy testing and training, 2013–2018, see also Navy's ''Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis Technical Report'', 2012), the likelihood of behavioral Level B harassment in response to sonar and other transducers was based on a probabilistic function (termed a behavioral response function—BRF), that related the likelihood (*i.e.,* probability) of a behavioral response (at the level of a Level B harassment) to the received SPL. The BRF was used to estimate the percentage of an exposed population that is likely to exhibit Level B harassment due to altered behaviors or behavioral disturbance at a given received SPL. This BRF relied on the assumption that sound poses a negligible risk to marine mammals if they are exposed to SPL below a certain ''basement'' value. Above the basement exposure SPL, the probability of a response increased with increasing SPL. Two BRFs were used in Navy acoustic impact analyses: BRF1 for mysticetes and BRF2 for other species. BRFs were not used for beaked whales during Phase II analyses. Instead, a step function at an SPL of 140 dB re: 1 μPa was used for beaked whales as the threshold to predict Level B harassment by behavioral disturbance.

Developing the behavioral Level B harassment criteria for Phase III (the current phase of Navy training and testing activities) involved multiple steps: all available behavioral response studies conducted both in the field and on captive animals were examined to understand the breadth of behavioral responses of marine mammals to sonar and other transducers (See also Navy's ''Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III) Technical Report'', 2017). Six behavioral response field studies with observations of 14 different marine mammal species reactions to sonar or sonar-like signals and 6 captive animal behavioral studies with observations of 8 different species reactions to sonar or sonar-like signals were used to provide a robust data set for the derivation of the Navy's Phase III marine mammal behavioral response criteria. All behavioral response research that has been published since the derivation of the Navy's Phase III criteria (c.a. December 2016) has been examined and is consistent with the current behavioral response functions. Marine mammal species were placed into behavioral criteria groups based on their known or suspected behavioral sensitivities to sound. In most cases these divisions were driven by taxonomic classifications (*e.g.,* mysticetes, pinnipeds). The data from the behavioral studies were analyzed by looking for significant responses, or lack thereof, for each experimental session.

The Navy used cutoff distances beyond which the potential of significant behavioral responses (and therefore Level B harassment) is considered to be unlikely (see Table 12 below). These distances were determined by examining all available published field observations of behavioral reactions to sonar or sonar-like signals that included the distance between the sound source and the marine mammal. The longest distance, rounded up to the nearest 5-km increment, was chosen as the cutoff distance for each behavioral criteria group (*i.e.* odontocetes, mysticetes, and beaked whales). For animals within the cutoff distance, behavioral response functions for each behavioral criteria group based on a received SPL as presented in Chapter 6, Section 6.4.2.1 (Methods for Analyzing Impacts from Sonars and other Transducers) of the Navy's rulemaking/LOA application were 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 at 1 m, this cutoff distance is substantially increased (*i.e.,* doubled) from values derived from the literature. The use of multiple platforms and intense sound sources are factors that probably increase responsiveness in marine mammals overall (however, we note that helicopter dipping sonars were considered in the intense sound source group, despite lower source levels, because of data indicating that marine mammals are sometimes more responsive to the less predictable employment of this source). There are currently few behavioral observations under these circumstances; therefore, the Navy conservatively predicted significant behavioral responses that would rise to Level B harassment at farther ranges than shown in Table 12, versus less intense events.

TABLE 12—CUTOFF DISTANCES FOR MODERATE SOURCE LEVEL, SINGLE PLATFORM TRAINING AND TESTING EVENTS AND FOR ALL OTHER EVENTS WITH MULTIPLE PLATFORMS OR SONAR WITH SOURCE LEVELS AT OR EXCEEDING 215 dB RE: 1 μPa AT 1 m.

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

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

The range to received sound levels in 6-dB steps from five representative sonar bins and the percentage of animals that may be taken by Level B harassment under each behavioral response function are shown in Tables 13 through 17. Cells are shaded if the mean range value for the specified received level exceeds the distance cutoff range for a particular hearing group and therefore are not included in the estimated take. See Chapter 6, Section 6.4.2.1 (Methods for Analyzing Impacts from Sonars and Other Transducers) of the Navy's rulemaking/LOA application for further details on the derivation and use of the behavioral response functions, thresholds, and the cutoff distances to identify takes by Level B harassment, which were coordinated with NMFS. As noted previously, NMFS carefully reviewed, and contributed to, the Navy's proposed behavioral Level B harassment thresholds and cutoff distances for each behavioral criteria group, and agrees that these methods represent the best available science at this time for determining impacts to marine mammals from sonar and other transducers.

Table 13 illustrates the maximum likely percentage of exposed individuals taken at the indicated received level and associated range (in which marine mammals would be reasonably expected to experience a disruption in behavior patterns to a point where they are abandoned or significantly altered) for low-frequency active sonar (LFAS).

BILLING CODE 3510–22–P

Table 13 -- Ranges to Estimated Behavioral Level B Harassment Takes for Sonar Bin LF4 Over a Representative Range of Environments Within the NWTT Study Area.

Received Level (dB re: 1 μPa)	Mean Range (meters) with Minimum and Maximum Values in Parentheses	Probability of Behavioral Response for Sonar Bin LF4				
		Odontocete	Mysticete	Pinniped	Beaked Whale	Harbor Porpoise
196	1 (0–1)	100%	100%	100%	100%	100%
190	3 (0–3)	100%	98%	99%	100%	100%
184	6 (0–8)	99%	88%	98%	100%	100%
178	13 (0–30)	97%	59%	92%	100%	100%
172	29 (0–230)	91%	30%	76%	99%	100%
166	64 (0–100)	78%	20%	48%	97%	100%
160	148 (0–310)	58%	18%	27%	93%	100%
154	366 (230–850)	40%	17%	18%	83%	100%
148	854 (300–2,025)	29%	16%	16%	66%	100%
142	1,774 (300–5,025)	25%	13%	15%	45%	100%
136	3,168 (300–8,525)	23%	9%	15%	28%	100%
130	5,167 (300–30,525)	20%	5%	15%	18%	100%
124	7,554 (300–93,775)	17%	2%	14%	14%	100%
118	10,033 (300–100,000*)	12%	1%	13%	12%	0%
112	12,700 (300–100,000*)	6%	0%	9%	11%	0%
106	15,697 (300–100,000*)	3%	0%	5%	11%	0%
100	17,846 (300–100,000*)	1%	0%	2%	8%	0%

* Indicates maximum range to which acoustic model was run, a distance of approximately 100 km 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 12 for behavioral cut-off distances). dB re: 1 μPa = decibels referenced to 1 micropascal, LF = low-frequency

Tables 14 through 16 identify the maximum likely percentage of exposed individuals taken at the indicated received level and associated range for mid-frequency active sonar (MFAS).

Table 14 -- Ranges to Estimated Behavioral Level B Harassment Takes for Sonar Bin MF1 Over a Representative Range of Environments Within the NWTT Study Area.

Received Level (dB re: 1 µPa)	Mean Range (meters) with Minimum and Maximum Values in Parentheses	Probability of Behavioral Response for Sonar Bin MF1				
		Odontocete	Mysticete	Pinniped	Beaked Whale	Harbor Porpoise
196	112 (80–170)	100%	100%	100%	100%	100%
190	262 (80–410)	100%	98%	99%	100%	100%
184	547 (80–1,025)	99%	88%	98%	100%	100%
178	1,210 (80–3,775)	97%	59%	92%	100%	100%
172	2,508 (80–7,525)	91%	30%	76%	99%	100%
166	4,164 (80–16,025)	78%	20%	48%	97%	100%
160	6,583 (80–28,775)	58%	18%	27%	93%	100%
154	10,410 (80–47,025)	40%	17%	18%	83%	100%
148	16,507 (80–63,525)	29%	16%	16%	66%	100%
142	21,111 (80–94,025)	25%	13%	15%	45%	100%
136	26,182 (80–100,000*)	23%	9%	15%	28%	100%
130	31,842 (80–100,000*)	20%	5%	15%	18%	100%
124	34,195 (80–100,000*)	17%	2%	14%	14%	100%
118	36,557 (80–100,000*)	12%	1%	13%	12%	0%
112	38,166 (80–100,000*)	6%	0%	9%	11%	0%
106	39,571 (80–100,000*)	3%	0%	5%	11%	0%
100	41,303 (80–100,000*)	1%	0%	2%	8%	0%

* Indicates maximum range to which acoustic model was run, a distance of approximately 100 km 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 12 for behavioral cut-off distances). dB re: 1 µPa = decibels referenced to 1 micropascal, MF = mid-frequency

Table 15 -- Ranges to Estimated Behavioral Level B Harassment Takes for Sonar Bin MF4 Over a Representative Range of Environments Within the NWTT Study Area.

Received Level (dB re: 1 µPa)	Mean Range (meters) with Minimum and Maximum Values in Parentheses	Probability of Behavioral Response for Sonar Bin MF4				
		Odontocete	Mysticete	Pinniped	Beaked Whale	Harbor Porpoise
196	8 (0–8)	100%	100%	100%	100%	100%
190	16 (0–20)	100%	98%	99%	100%	100%
184	34 (0–40)	99%	88%	98%	100%	100%
178	68 (0–85)	97%	59%	92%	100%	100%
172	155 (120–300)	91%	30%	76%	99%	100%
166	501 (290–975)	78%	20%	48%	97%	100%
160	1,061 (480–2,275)	58%	18%	27%	93%	100%
154	1,882 (525–4,025)	40%	17%	18%	83%	100%
148	2,885 (525–7,525)	29%	16%	16%	66%	100%
142	4,425 (525–14,275)	25%	13%	15%	45%	100%
136	9,902 (525–48,275)	23%	9%	15%	28%	100%
130	20,234 (525–56,025)	20%	5%	15%	18%	100%
124	23,684 (525–91,775)	17%	2%	14%	14%	100%
118	28,727 (525–100,000*)	12%	1%	13%	12%	0%
112	37,817 (525–100,000*)	6%	0%	9%	11%	0%
106	42,513 (525–100,000*)	3%	0%	5%	11%	0%
100	43,367 (525–100,000*)	1%	0%	2%	8%	0%

* Indicates maximum range to which acoustic model was run, a distance of approximately 100 km 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 12 for behavioral cut-off distances). dB re: 1 µPa = decibels referenced to 1 micropascal, MF = mid-frequency

Table 16 -- Ranges to Estimated Behavioral Level B Harassment Takes for Sonar Bin MF5 Over a Representative Range of Environments Within the NWTT Study Area.

Received Level (dB re: 1 µPa)	Mean Range (meters) with Minimum and Maximum Values in Parentheses	Probability of Behavioral Response for Sonar Bin MF5				
		Odontocete	Mysticete	Pinniped	Beaked Whale	Harbor Porpoise
196	0 (0–0)	100%	100%	100%	100%	100%
190	1 (0–3)	100%	98%	99%	100%	100%
184	5 (0–7)	99%	88%	98%	100%	100%
178	14 (0–18)	97%	59%	92%	100%	100%
172	29 (0–35)	91%	30%	76%	99%	100%
166	58 (0–70)	78%	20%	48%	97%	100%
160	127 (0–280)	58%	18%	27%	93%	100%
154	375 (0–1,000)	40%	17%	18%	83%	100%
148	799 (490–1,775)	29%	16%	16%	66%	100%
142	1,677 (600–3,525)	25%	13%	15%	45%	100%
136	2,877 (675–7,275)	23%	9%	15%	28%	100%
130	4,512 (700–12,775)	20%	5%	15%	18%	100%
124	6,133 (700–19,275)	17%	2%	14%	14%	100%
118	7,880 (700–26,275)	12%	1%	13%	12%	0%
112	9,673 (700–33,525)	6%	0%	9%	11%	0%
106	12,095 (700–45,275)	3%	0%	5%	11%	0%
100	18,664 (700–48,775)	1%	0%	2%	8%	0%

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 12 for behavioral cut-off distances). dB re: 1 µPa = decibels referenced to 1 micropascal, MF = mid-frequency

Table 17 identifies the maximum likely percentage of exposed individuals taken at the indicated received level and associated range for high-frequency active sonar (HFAS).

Table 17 -- Ranges to Estimated Behavioral Level B Harassment Takes for Sonar Bin HF4 Over a Representative Range of Environments Within the NWTT Study Area.

Received Level (dB re: 1 µPa)	Mean Range (meters) with Minimum and Maximum Values in Parentheses	Probability of Behavioral Response for Sonar Bin HF4				
		Odontocete	Mysticete	Pinniped	Beaked Whale	Harbor Porpoise
196	4 (0–7)	100%	100%	100%	100%	100%
190	10 (0–16)	100%	98%	99%	100%	100%
184	20 (0–40)	99%	88%	98%	100%	100%
178	42 (0–85)	97%	59%	92%	100%	100%
172	87 (0–270)	91%	30%	76%	99%	100%
166	177 (0–650)	78%	20%	48%	97%	100%
160	338 (25–825)	58%	18%	27%	93%	100%
154	577 (55–1,275)	40%	17%	18%	83%	100%
148	846 (60–1,775)	29%	16%	16%	66%	100%
142	1,177 (60–2,275)	25%	13%	15%	45%	100%
136	1,508 (60–3,025)	23%	9%	15%	28%	100%
130	1,860 (60–3,525)	20%	5%	15%	18%	100%
124	2,202 (60–4,275)	17%	2%	14%	14%	100%
118	2,536 (60–4,775)	12%	1%	13%	12%	0%
112	2,850 (60–5,275)	6%	0%	9%	11%	0%
106	3,166 (60–6,025)	3%	0%	5%	11%	0%
100	3,470 (60–6,775)	1%	0%	2%	8%	0%

Notes: dB re: 1 µPa = decibels referenced to 1 micropascal, HF = high-frequency

BILLING CODE 3510–22–C

Explosives

Phase III explosive criteria for behavioral Level B harassment thresholds for marine mammals is the functional hearing groups' TTS onset threshold (in SEL) minus 5 dB (see Table 18 below and Table 11 for the TTS thresholds for explosives) for events that contain multiple impulses from explosives underwater. This was the same approach as taken in Phase II for explosive analysis. See the ''Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)'' report (U.S. Department of the Navy, 2017c) for detailed information on how the criteria and thresholds were derived. NMFS continues to concur that this approach represents the best available science for determining impacts to marine mammals from explosives.

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

Medium	Functional hearing group	SEL (weighted)
Underwater	Low-frequency cetaceans	163
Underwater	Mid-frequency cetaceans	165
Underwater	High-frequency cetaceans	135
Underwater	Phocids	165
Underwater	Otariids	183

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

Navy's Acoustic Effects Model

The Navy's Acoustic Effects Model calculates sound energy propagation from sonar and other transducers and explosives during naval activities and the sound received by animat dosimeters. Animat dosimeters are virtual representations of marine mammals distributed in the area around the modeled naval activity and each dosimeter records its individual sound ''dose.'' The model bases the distribution of animats over the NWTT 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 sound level received by the animats. The model conducts a statistical analysis based on multiple model runs to compute the estimated effects on animals. The number of animats that exceed the thresholds for effects is tallied to provide an estimate of the number of marine mammals that could be affected.

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

The model estimates the impacts caused by individual training and testing exercises. During any individual modeled event, impacts to individual animats are considered over 24-hour periods. The animats do not represent actual animals, but rather they represent a distribution of animals based on density and abundance data, which allows for a statistical analysis of the number of instances that marine mammals may be exposed to sound levels resulting in an effect. Therefore, the model estimates the number of instances in which an effect threshold was exceeded over the course of a year, but does not estimate the number of individual marine mammals that may be impacted over a year (*i.e.,* some marine mammals could be impacted several times, while others would not experience any impact). A detailed explanation of the Navy's Acoustic Effects Model is provided in the technical report ''Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing'' (U.S. Department of the Navy, 2018).

Sonar and Other Transducers and Explosives

Range to Effects

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

Sonar

The ranges to received sound levels in 6-dB steps from five representative sonar bins and the percentage of the total number of animals that may exhibit a significant behavioral response (and therefore Level B harassment) under each behavioral response function are shown in Tables 13 through 17 above. See Chapter 6, Section 6.4.2.1 (Methods for Analyzing Impacts from Sonars and Other Transducers) of the Navy's rulemaking/LOA application for additional details on the derivation and use of the behavioral response functions, thresholds, and the cutoff distances that are used to identify Level B behavioral harassment.

The ranges to PTS for five representative sonar systems for an exposure of 30 seconds is shown in Table 19 relative to the marine mammal's functional hearing group. This period (30 seconds) was chosen based on examining the maximum amount of time a marine mammal would realistically be exposed to levels that could cause the onset of PTS based on platform (*e.g.,* ship) speed and a nominal animal swim speed of approximately 1.5 m per second. The ranges provided in the table include the average range to PTS, as well as the range from the minimum to the maximum distance at which PTS is possible for each hearing group.

TABLE 19—RANGE TO PERMANENT THRESHOLD SHIFT (METERS) FOR FIVE REPRESENTATIVE SONAR SYSTEMS

Hearing group	Approximate PTS (30 seconds) ranges (meters) [1]				
	Sonar bin HF4	Sonar bin LF4	Sonar bin MF1	Sonar bin MF4	Sonar bin MF5
High-frequency cetaceans	38 (22–85)	0 (0–0)	195 (80–330)	30 (30–40)	9 (8–11)
Low-frequency cetaceans	0 (0–0)	2 (1–3)	67 (60–110)	15 (15–17)	0 (0–0)
Mid-frequency cetaceans	1 (0–3)	0 (0–0)	16 (16–19)	3 (3–3)	0 (0–0)
Otariids	0 (0–0)	0 (0–0)	6 (6–6)	0 (0–0)	0 (0–0)
Phocids	0 (0–0)	0 (0–0)	46 (45–75)	11 (11–12)	0 (0–0)

[1] PTS ranges extend from the sonar or other transducer 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 parentheses.

Notes: HF = high-frequency, LF = low-frequency, MF = mid-frequency, PTS = permanent threshold shift.

The tables below illustrate the range to TTS for 1, 30, 60, and 120 seconds from five representative sonar systems (see Tables 20 through 24).

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

Hearing group	Approximate TTS ranges (meters) [1]			
	Sonar bin LF4			
	1 second	30 seconds	60 seconds	120 seconds
High-frequency cetaceans	0 (0–0)	0 (0–0)	0 (0–0)	1 (0–1)

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

Hearing group	Approximate TTS ranges (meters) [1]			
	Sonar bin LF4			
	1 second	30 seconds	60 seconds	120 seconds
Low-frequency cetaceans	22 (19–30)	32 (25–230)	41 (30–230)	61 (45–100)
Mid-frequency cetaceans	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)
Otariids	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)
Phocids	2 (1–3)	4 (3–4)	4 (4–5)	7 (6–9)

[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 extends from onset-PTS to the distance indicated. The average range to TTS is provided as well as the range from the estimated minimum to the maximum range to TTS in parentheses.
Notes: HF = high-frequency, TTS = temporary threshold shift.

TABLE 21—RANGES TO TEMPORARY THRESHOLD SHIFT (METERS) FOR SONAR BIN MF1 OVER A REPRESENTATIVE RANGE OF ENVIRONMENTS WITHIN THE NWTT STUDY AREA

Hearing group	Approximate TTS ranges (meters) [1]			
	Sonar bin MF1			
	1 second	30 seconds	60 seconds	120 seconds
High-frequency cetaceans	2,466 (80–6,275)	2,466 (80–6,275)	3,140 (80–10,275)	3,740 (80–13,525)
Low-frequency cetaceans	1,054 (80–2,775)	1,054 (80–2,775)	1,480 (80–4,525)	1,888 (80–5,275)
Mid-frequency cetaceans	225 (80–380)	225 (80–380)	331 (80–525)	411 (80–700)
Otariids	67 (60–110)	67 (60–110)	111 (80–170)	143 (80–250)
Phocids	768 (80–2,025)	768 (80–2,025)	1,145 (80–3,275)	1,388 (80–3,775)

[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 extends from onset-PTS to the distance indicated. The average range to TTS is provided as well as the range from the estimated minimum to the maximum range to TTS in parentheses. Ranges for 1 second and 30 second periods are identical for Bin MF1 because this system nominally pings every 50 seconds; therefore, these periods encompass only a single ping.
Notes: MF = mid-frequency, TTS = temporary threshold shift.

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

Hearing group	Approximate TTS ranges (meters) [1]			
	Sonar bin MF4			
	1 second	30 seconds	60 seconds	120 seconds
High-frequency cetaceans	279 (220–600)	647 (420–1,275)	878 (500–1,525)	1,205 (525–2,275)
Low-frequency cetaceans	87 (85–110)	176 (130–320)	265 (190–575)	477 (290–975)
Mid-frequency cetaceans	22 (22–25)	35 (35–45)	50 (45–55)	71 (70–85)
Otariids	8 (8–8)	15 (15–17)	19 (19–23)	25 (25–30)
Phocids	66 (65–80)	116 (110–200)	173 (150–300)	303 (240–675)

[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 extends from onset-PTS to the distance indicated. The average range to TTS is provided as well as the range from the estimated minimum to the maximum range to TTS in parentheses.
Notes: MF = mid-frequency, TTS = temporary threshold shift.

TABLE 23—RANGES TO TEMPORARY THRESHOLD SHIFT (METERS) FOR SONAR BIN MF5 OVER A REPRESENTATIVE RANGE OF ENVIRONMENTS WITHIN THE NWTT STUDY AREA

Hearing group	Approximate TTS ranges (meters) [1]			
	Sonar bin MF5			
	1 second	30 seconds	60 seconds	120 seconds
High-frequency cetaceans	115 (110–180)	115 (110–180)	174 (150–390)	292 (210–825)
Low-frequency cetaceans	11 (10–13)	11 (10–13)	17 (16–19)	24 (23–25)
Mid-frequency cetaceans	6 (0–9)	6 (0–9)	12 (11–14)	18 (17–22)
Otariids	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)

TABLE 23—RANGES TO TEMPORARY THRESHOLD SHIFT (METERS) FOR SONAR BIN MF5 OVER A REPRESENTATIVE RANGE OF ENVIRONMENTS WITHIN THE NWTT STUDY AREA—Continued

Hearing group	Approximate TTS ranges (meters) [1] Sonar bin MF5 1 second	30 seconds	60 seconds	120 seconds
Phocids	9 (8–11)	9 (8–11)	15 (14–17)	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 extends from onset-PTS to the distance indicated. The average range to TTS is provided as well as the range from the estimated minimum to the maximum range to TTS in parentheses.
Notes: MF = mid-frequency, TTS = temporary threshold shift.

TABLE 24—RANGES TO TEMPORARY THRESHOLD SHIFT (METERS) FOR SONAR BIN HF4 OVER A REPRESENTATIVE RANGE OF ENVIRONMENTS WITHIN THE NWTT STUDY AREA

Hearing group	Approximate TTS Ranges (meters) [1] Sonar bin HF4 1 second	30 seconds	60 seconds	120 seconds
High-frequency cetaceans	236 (60–675)	387 (60–875)	503 (60–1,025)	637 (60–1,275)
Low-frequency cetaceans	2 (0–3)	3 (1–6)	5 (3–8)	8 (5–12)
Mid-frequency cetaceans	12 (7–20)	21 (12–40)	29 (17–60)	43 (24–90)
Otariids	0 (0–0)	0 (0–0)	0 (0–0)	1 (0–1)
Phocids	3 (0–5)	6 (4–10)	9 (5–15)	14 (8–25)

[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 extends from onset-PTS to the distance indicated. The average range to TTS is provided as well as the range from the estimated minimum to the maximum range to TTS in parentheses.
Notes: HF = high-frequency, 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, Section 6.5.2 (Impacts from Explosives) of the Navy's rulemaking/LOA application and the ''Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)'' report (U.S. Department of the Navy, 2017c)) and the explosive propagation calculations from the Navy Acoustic Effects Model (see Chapter 6, Section 6.5.2.2 (Impact Ranges for Explosives) of the Navy's rulemaking/LOA application). The range to effects are shown for a range of explosive bins, from E1 (up to 0.25 lb net explosive weight) to E11 (greater than 500 lb to 650 lb net explosive weight) (Tables 25 through 31). Ranges are determined by modeling the distance that noise from an explosion would need to propagate to reach exposure level thresholds specific to a hearing group that would cause behavioral response (to the degree of Level B behavioral harassment), TTS, PTS, and non-auditory injury. NMFS has reviewed the range distance to effect data provided by the Navy and concurs with the analysis. Range to effects is important information in not only predicting impacts from explosives, but also in verifying the accuracy of model results against real-world situations and determining adequate mitigation ranges to avoid higher level effects, especially physiological effects to marine mammals. For additional information on how ranges to impacts from explosions were estimated, see the technical report ''Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing'' (U.S. Navy, 2018).

Tables 25 through 29 show the minimum, average, and maximum ranges to onset of auditory and likely behavioral effects that rise to the level of Level B harassment for high-frequency cetaceans based on the developed thresholds. Ranges are provided for a representative source depth and cluster size (the number of rounds fired, or buoys dropped, within a very short duration) for each bin. For events with multiple explosions, sound from successive explosions can be expected to accumulate and increase the range to the onset of an impact based on SEL thresholds. Ranges to non-auditory injury and mortality are shown in Tables 30 and 31, respectively.

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

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

Range to effects for explosives: High-frequency cetaceans [1] Bin	Source depth (m)	Cluster size	Range to PTS (m)	Range to TTS (m)	Range to behavioral (m)
E1	0.1	1	361 (350–370)	1,108 (1,000–1,275)	1,515 (1,025–2,025)
		18	1,002 (925–1,025)	2,404 (1,275–4,025)	3,053 (1,275–5,025)
E2	0.1	1	439 (420–450)	1,280 (1,025–1,775)	1,729 (1,025–2,525)

TABLE 25—SEL-BASED RANGES TO ONSET PTS, ONSET TTS, AND BEHAVIORAL REACTION (IN METERS) FOR HIGH-FREQUENCY CETACEANS—Continued

Range to effects for explosives: High-frequency cetaceans [1]					
Bin	Source depth (m)	Cluster size	Range to PTS (m)	Range to TTS (m)	Range to behavioral (m)
		5	826 (775–875)	1,953 (1,275–3,025)	2,560 (1,275–4,275)
E3	10	1	1,647 (160–3,525)	2,942 (160–10,275)	3,232 (160–12,275)
		12	3,140 (160–9,525)	3,804 (160–17,525)	3,944 (160–21,775)
	18.25	1	684 (550–1,000)	2,583 (1,025–5,025)	4,217 (1,525–7,525)
		12	1,774 (1,025–3,775)	5,643 (1,775–10,025)	7,220 (2,025–13,275)
E4	10	2	1,390 (950–3,025)	5,250 (2,275–8,275)	7,004 (2,775–11,275)
	30	2	1,437 (925–2,775)	4,481 (1,525–7,775)	5,872 (2,775–10,525)
	70	2	1,304 (925–2,275)	3,845 (2,525–7,775)	5,272 (3,525–9,525)
	90	2	1,534 (900–2,525)	5,115 (2,525–7,525)	6,840 (3,275–10,275)
E5	0.1	1	940 (850–1,025)	2,159 (1,275–3,275)	2,762 (1,275–4,275)
		20	1,930 (1,275–2,775)	4,281 (1,775–6,525)	5,176 (2,025–7,775)
E7	10	1	2,536 (1,275–3,775)	6,817 (2,775–11,025)	8,963 (3,525–14,275)
	30	1	1,916 (1,025–4,275)	5,784 (2,775–10,525)	7,346 (2,775–12,025)
E8	45.75	1	1,938 (1,275–4,025)	4,919 (1,775–11,275)	5,965 (2,025–15,525)
E10	0.1	1	1,829 (1,025–2,775)	4,166 (1,775–6,025)	5,023 (2,025–7,525)
E11	91.4	1	3,245 (2,025–6,775)	6,459 (2,525–15,275)	7,632 (2,775–19,025)
	200	1	3,745 (3,025–5,025)	7,116 (4,275–11,275)	8,727 (5,025–15,025)

[1] Average distance (meters) to PTS, TTS, and behavioral thresholds are depicted above the minimum and maximum distances (due to varying propagation environments), which are in parentheses.
Notes: PTS = permanent threshold shift, SEL = sound exposure level, TTS = temporary threshold shift.

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

TABLE 26—SEL-BASED RANGES TO ONSET PTS, ONSET TTS, AND BEHAVIORAL REACTION (IN METERS) FOR LOW-FREQUENCY CETACEANS

Range to effects for explosives: Low-frequency cetaceans [1]					
Bin	Source depth (meters)	Cluster size	Range to PTS (meters)	Range to TTS (meters)	Range to behavioral (meters)
E1	0.1	1	52 (50–55)	221 (120–250)	354 (160–420)
		18	177 (110–200)	656 (230–875)	836 (280–1,025)
E2	0.1	1	66 (55–70)	276 (140–320)	432 (180–525)
		5	128 (90–140)	512 (200–650)	735 (250–975)
E3	10	1	330 (160–550)	1,583 (160–4,025)	2,085 (160–7,525)
		12	1,177 (160–2,775)	2,546 (160–11,775)	2,954 (160–17,025)
	18.25	1	198 (180–220)	1,019 (490–2,275)	1,715 (625–4,025)
		12	646 (390–1,025)	3,723 (800–9,025)	6,399 (1,025–46,525)
E4	10	2	462 (400–600)	3,743 (2,025–7,025)	6,292 (2,525–13,275)
	30	2	527 (330–950)	3,253 (1,775–4,775)	5,540 (2,275–8,275)
	70	2	490 (380–775)	3,026 (1,525–4,775)	5,274 (2,275–7,775)
	90	2	401 (360–500)	3,041 (1,275–4,525)	5,399 (1,775–9,275)
E5	0.1	1	174 (100–260)	633 (220–850)	865 (270–1,275)
		20	550 (200–700)	1,352 (420–2,275)	2,036 (700–4,275)
E7	10	1	1,375 (875–2,525)	7,724 (3,025–15,025)	11,787 (4,525–25,275)
	30	1	1,334 (675–2,025)	7,258 (2,775–11,025)	11,644 (4,525–24,275)
E8	45.75	1	1,227 (575–2,525)	3,921 (1,025–17,275)	7,961 (1,275–48,525)
E10	0.1	1	546 (200–700)	1,522 (440–5,275)	3,234 (850–30,525)
E11	91.4	1	2,537 (950–5,525)	11,249 (1,775–50,775)	37,926 (6,025–94,775)
	200	1	2,541 (1,525–4,775)	7,407 (2,275–43,275)	42,916 (6,275–51,275)

[1] Average distance (meters) is shown with the minimum and maximum distances due to varying propagation environments in parentheses. Values depict the range produced by SEL hearing threshold criteria levels.
Notes: PTS = permanent threshold shift, SEL = sound exposure level, TTS = temporary threshold shift.

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

TABLE 27—SEL-BASED RANGES TO ONSET PTS, ONSET TTS, AND BEHAVIORAL REACTION (IN METERS) FOR MID-FREQUENCY CETACEANS

Range to effects for explosives: Mid-frequency cetaceans [1]

Bin	Source depth (meters)	Cluster size	Range to PTS (meters)	Range to TTS (meters)	Range to behavioral (meters)
E1	0.1	1	25 (25–25)	118 (110–120)	203 (190–210)
		18	96 (90–100)	430 (410–440)	676 (600–700)
E2	0.1	1	30 (30–30)	146 (140–150)	246 (230–250)
		5	64 (60–65)	298 (290–300)	493 (470–500)
E3	10	1	61 (50–100)	512 (160–750)	928 (160–2,025)
		12	300 (160–625)	1,604 (160–3,525)	2,085 (160–5,525)
	18.25	1	40 (35–40)	199 (180–280)	368 (310–800)
		12	127 (120–130)	709 (575–1,000)	1,122 (875–2,525)
E4	10	2	73 (70–75)	445 (400–575)	765 (600–1,275)
	30	2	71 (65–90)	554 (320–1,025)	850 (525–1,775)
	70	2	63 (60–85)	382 (320–675)	815 (525–1,275)
	90	2	59 (55–85)	411 (310–900)	870 (525–1,275)
E5	0.1	1	79 (75–80)	360 (350–370)	575 (525–600)
		20	295 (280–300)	979 (800–1,275)	1,442 (925–1,775)
E7	10	1	121 (110–130)	742 (575–1,275)	1,272 (875–2,275)
	30	1	111 (100–130)	826 (500–1,775)	1,327 (925–2,275)
E8	45.75	1	133 (120–170)	817 (575–1,525)	1,298 (925–2,525)
E10	0.1	1	273 (260–280)	956 (775–1,025)	1,370 (900–1,775)
E11	91.4	1	242 (220–310)	1,547 (1,025–3,025)	2,387 (1,275–4,025)
	200	1	209 (200–300)	1,424 (1,025–2,025)	2,354 (1,525–3,775)

[1] Average distance (meters) is shown with the minimum and maximum distances due to varying propagation environments in parentheses.
Note: PTS = permanent threshold shift, SEL = sound exposure level, TTS = temporary threshold shift.

Table 28 shows the minimum, average, and maximum ranges to onset of auditory and likely behavioral effects that rise to the level of Level B harassment for otariid pinnipeds based on the developed thresholds.

TABLE 28—SEL-BASED RANGES TO ONSET PTS, ONSET TTS, AND BEHAVIORAL REACTION (IN METERS) FOR OTARIIDS

Range to effects for explosives: Otariids [1]

Bin	Source depth (meters)	Cluster size	Range to PTS (meters)	Range to TTS (meters)	Range to behavioral (meters)
E1	0.1	1	7 (7–8)	34 (30–35)	58 (55–60)
		18	25 (25–25)	124 (120–130)	208 (200–210)
E2	0.1	1	9 (9–10)	43 (40–45)	72 (70–75)
		5	19 (19–20)	88 (85–90)	145 (140–150)
E3	10	1	21 (18–25)	135 (120–210)	250 (160–370)
		12	82 (75–100)	551 (160–875)	954 (160–2,025)
	18.25	1	15 (15–15)	91 (85–95)	155 (150–160)
		12	53 (50–55)	293 (260–430)	528 (420–825)
E4	10	2	30 (30–30)	175 (170–180)	312 (300–350)
	30	2	25 (25–25)	176 (160–250)	400 (290–750)
	70	2	26 (25–35)	148 (140–200)	291 (250–400)
	90	2	26 (25–35)	139 (130–190)	271 (250–360)
E5	0.1	1	25 (24–25)	111 (110–120)	188 (180–190)
		20	93 (90–95)	421 (390–440)	629 (550–725)
E7	10	1	60 (60–60)	318 (300–360)	575 (500–775)
	30	1	53 (50–65)	376 (290–700)	742 (500–1,025)
E8	45.75	1	55 (55–55)	387 (310–750)	763 (525–1,275)
E10	0.1	1	87 (85–90)	397 (370–410)	599 (525–675)
E11	91.4	1	100 (100–100)	775 (550–1,275)	1,531 (900–3,025)
	200	1	94 (90–100)	554 (525–700)	1,146 (900–1,525)

[1] Average distance (meters) is shown with the minimum and maximum distances due to varying propagation environments in parentheses.
Notes: PTS = permanent threshold shift, SEL = sound exposure level, TTS = temporary threshold shift.

Table 29 shows the minimum, average, and maximum ranges to onset of auditory and likely behavioral effects that rise to the level of Level B harassment for phocid pinnipeds based on the developed thresholds.

TABLE 29—SEL-BASED RANGES TO ONSET PTS, ONSET TTS, AND BEHAVIORAL REACTION (IN METERS) FOR PHOCIDS

Range to effects for explosives: Phocids [1]					
Bin	Source depth (meters)	Cluster size	Range to PTS (meters)	Range to TTS (meters)	Range to behavioral (meters)
E1	0.1	1	47 (45–50)	219 (210–230)	366 (350–370)
		18	171 (160–180)	764 (725–800)	1,088 (1,025–1,275)
E2	0.1	1	59 (55–60)	273 (260–280)	454 (440–460)
		5	118 (110–120)	547 (525–550)	881 (825–925)
E3	10	1	185 (160–260)	1,144 (160–2,775)	1,655 (160–4,525)
		12	760 (160–1,525)	2,262 (160–8,025)	2,708 (160–12,025)
	18.25	1	112 (110–120)	628 (500–950)	1,138 (875–2,525)
		12	389 (330–625)	2,248 (1,275–4,275)	4,630 (1,275–8,525)
E4	10	2	226 (220–240)	1,622 (950–3,275)	3,087 (1,775–5,775)
	30	2	276 (200–600)	1,451 (1,025–2,275)	2,611 (1,775–4,275)
	70	2	201 (180–280)	1,331 (1,025–1,775)	2,403 (1,525–3,525)
	90	2	188 (170–270)	1,389 (975–2,025)	2,617 (1,775–3,775)
E5	0.1	1	151 (140–160)	685 (650–700)	1,002 (950–1,025)
		20	563 (550–575)	1,838 (1,275–2,275)	2,588 (1,525–3,525)
E7	10	1	405 (370–490)	3,185 (1,775–6,025)	5,314 (2,275–11,025)
	30	1	517 (370–875)	2,740 (1,775–4,275)	4,685 (3,025–7,275)
E8	45.75	1	523 (390–1,025)	2,502 (1,525–6,025)	3,879 (2,025–10,275)
E10	0.1	1	522 (500–525)	1,800 (1,275–2,275)	2,470 (1,525–3,275)
E11	91.4	1	1,063 (675–2,275)	5,043 (2,775–10,525)	7,371 (3,275–18,025)
	200	1	734 (675–850)	5,266 (3,525–9,025)	7,344 (5,025–12,775)

[1] Average distance (meters) is shown with the minimum and maximum distances due to varying propagation environments in parentheses.
Notes: PTS = permanent threshold shift, SEL = sound exposure level, TTS = temporary threshold shift.

Table 30 shows the minimum, average, and maximum ranges due to varying propagation conditions to non-auditory injury as a function of animal mass and explosive bin (*i.e.,* net explosive weight). Ranges to gastrointestinal tract injury typically exceed ranges to slight lung injury; therefore, the maximum range to effect is not mass-dependent. Animals within these water volumes would be expected to receive minor injuries at the outer ranges, increasing to more substantial injuries, and finally mortality as an animal approaches the detonation point.

TABLE 30—RANGES [1] TO NON-AUDITORY INJURY (IN METERS) FOR ALL MARINE MAMMAL HEARING GROUPS

Bin	Range to non-auditory injury (meters) [1]
E1	12 (11–13)
E2	16 (15–16)
E3	25 (25–45)
E4	31 (23–50)
E5	40 (40–40)
E7	104 (80–190)
E8	149 (130–210)
E10	153 (100–400)
E11	419 (350–725)

[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 31 below.

TABLE 31—RANGES [1] TO MORTALITY (IN METERS) FOR ALL MARINE MAMMAL HEARING GROUPS AS A FUNCTION OF ANIMAL MASS

Bin	Range to mortality (meters) for various animal mass intervals (kg) [1]					
	10 kg	250 kg	1,000 kg	5,000 kg	25,000 kg	72,000 kg
E1	3 (2–3)	1 (0–3)	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)
E2	4 (3–5)	2 (1–3)	1 (0–1)	0 (0–0)	0 (0–0)	0 (0–0)
E3	10 (9–20)	5 (3–20)	2 (1–5)	0 (0–3)	0 (0–1)	0 (0–1)
E4	13 (11–19)	7 (4–13)	3 (2–4)	2 (1–3)	1 (1–1)	1 (0–1)
E5	13 (11–15)	7 (4–11)	3 (3–4)	2 (1–3)	1 (1–1)	1 (0–1)
E7	49 (40–80)	27 (15–60)	13 (10–20)	9 (5–12)	4 (4–6)	3 (2–4)
E8	65 (60–75)	34 (22–55)	17 (14–20)	11 (9–13)	6 (5–6)	5 (4–5)
E10	43 (40–50)	25 (16–40)	13 (11–16)	9 (7–11)	5 (4–6)	4 (3–4)
E11	185 (90–230)	90 (30–170)	40 (30–50)	28 (23–30)	15 (13–16)	11 (9–13)

[1] Average distance to mortality (meters) is depicted above the minimum and maximum distances, which are in parentheses for each animal mass interval.
Notes: kg = kilogram.

Marine Mammal Density

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

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

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

To characterize marine species density for large oceanic regions, the Navy reviews, critically assesses, and prioritizes existing density estimates from multiple sources, requiring the development of a systematic method for selecting the most appropriate density estimate for each combination of species/stock, area, and season. The selection and compilation of the best available marine species density data resulted in the Navy Marine Species Density Database (NMSDD), which includes seasonal density values for every marine mammal species and stock present within the NWTT Study Area. This database is described in the technical report titled ''U.S. Navy Marine Species Density Database Phase III for the Northwest Training and Testing Study Area'' (U.S. Department of the Navy, 2019), hereafter referred to as the Density Technical Report. NMFS vetted all cetacean densities by the Navy prior to use in the Navy's acoustic analysis for the current NWTT rulemaking process.

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

1. Spatial density models are preferred and used when available because they provide an estimate with the least amount of uncertainty by deriving estimates for divided segments of the sampling area. These models (see Becker *et al.,* 2016; Forney *et al.,* 2015) predict spatial variability of animal presence as a function of habitat variables (*e.g.,* sea surface temperature, seafloor depth, *etc.*). This model is developed for areas, species, and, when available, specific timeframes (months or seasons) with sufficient survey data; therefore, this model cannot be used for species with low numbers of sightings.

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

3. Design-based density estimations use line-transect survey data from land and aerial surveys designed to cover a specific geographic area (see Carretta *et al.,* 2015). These estimates use the same survey data as stratified design-based estimates, but are not segmented into sub-regions and instead provide one estimate for a large surveyed area. Although relative environmental suitability (RES) models provide estimates for areas of the oceans that have not been surveyed using information on species occurrence and inferred habitat associations and have been used in past density databases, these models were not used in the current quantitative analysis.

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

The Navy's estimate of abundance (based on density estimates used in the NWTT Study Area) utilizes NMFS' SARs, except for species with high site fidelity/smaller home ranges within the NWTT Study Area, relative to their geographic distribution (*e.g.,* harbor seals). For harbor seals in the inland waters, more up-to-date, site specific population estimates were available. For some species, the stock assessment for a given species may exceed the Navy's density prediction because those species' home range extends beyond the Study Area boundaries. For other species, the stock assessment abundance may be much less than the number of animals in the Navy's modeling given that the NWTT Study Area extends beyond the U.S waters covered by the SAR abundance estimate. The primary source of density estimates are geographically specific survey data and either peer-reviewed line-transect estimates or habitat-based density models that have been extensively validated to provide the most accurate estimates possible.

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

Take Request

The 2019 NWTT DSEIS/OEIS considered all training and testing activities proposed to occur in the NWTT 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 by harassment of marine mammals from the Navy's planned activities.

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

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

The quantitative analysis process used for the 2019 NWTT DSEIS/OEIS and the Navy's take request in the rulemaking/LOA application to estimate potential exposures to marine mammals resulting from acoustic and explosive stressors is detailed in the technical report titled *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing* (U.S. Department of the Navy, 2018). The Navy Acoustic Effects Model estimates acoustic and explosive effects without taking mitigation into account; therefore, the model overestimates predicted impacts on marine mammals within mitigation zones. To account for mitigation for marine species in the take estimates, the Navy conducts a quantitative assessment of mitigation. The Navy conservatively quantifies the manner in which procedural mitigation is expected to reduce the risk for model-estimated PTS for exposures to sonars and for model-estimated mortality for exposures to explosives, based on species sightability, observation area, visibility, and the ability to exercise positive control over the sound source. Where the analysis indicates mitigation would effectively reduce risk, the model-estimated PTS are considered reduced to TTS and the model-estimated mortalities are considered reduced to injury. For a complete explanation of the process for assessing the effects of mitigation, see the Navy's rulemaking/LOA application and the technical report titled *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing* (U.S. Department of the Navy, 2018). The extent to which the mitigation areas reduce impacts on the affected species is addressed separately in the *Preliminary Analysis and Negligible Impact Determination* section.

The Navy assessed the effectiveness of its procedural mitigation measures on a per-scenario basis for four factors: (1) Species sightability, (2) a Lookout's ability to observe the range to PTS (for sonar and other transducers) and range to mortality (for explosives), (3) the portion of time when mitigation could potentially be conducted during periods of reduced daytime visibility (to include inclement weather and high sea-state) and the portion of time when mitigation could potentially be conducted at night, and (4) the ability for sound sources to be positively controlled (*e.g.,* powered down).

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

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

Equation 1:

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

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

Testing (U.S. Department of the Navy, 2018).

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

Equation 2:

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

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

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

NMFS coordinated with the Navy in the development of this quantitative method to address the effects of procedural mitigation on acoustic and explosive exposures and takes, and NMFS independently reviewed and concurs with the Navy that it is appropriate to incorporate the quantitative assessment of mitigation into the take estimates based on the best available science. For additional information on the quantitative analysis process and mitigation measures, refer to the technical report titled *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing* (U.S. Department of the Navy, 2018) and Chapter 6 (*Take Estimates for Marine Mammals*) and Chapter 11 (*Mitigation Measures*) of the Navy's rulemaking/LOA application.

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

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

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

Summary of Requested Take From Training and Testing Activities

Based on the methods discussed in the previous sections and the Navy's model and quantitative assessment of mitigation, the Navy provided its take estimate and request for authorization of takes incidental to the use of acoustic and explosive sources for training and testing activities both annually (based on the maximum number of activities that could occur per 12-month period) and over the seven-year period covered by the Navy's rulemaking/LOA application. The following species/stocks present in the NWTT Study Area were modeled by the Navy and estimated to have 0 takes of any type from any activity source: Eastern North Pacific Northern Resident stock of killer whales, Western North Pacific stock of gray whales, and California stock of harbor seals. NMFS has reviewed the Navy's data, methodology, and analysis and determined that it is complete and accurate. NMFS agrees that the estimates for incidental takes by harassment from all sources requested for authorization are the maximum number of instances in which marine mammals are reasonably expected to be taken.

Estimated Harassment Take From Training and Testing Activities

For training and testing activities, Tables 32 and 33 summarize the Navy's take estimate and request and the annual and maximum amount and type of Level A harassment and Level B harassment for the seven-year period that NMFS concurs is reasonably expected to occur by species and stock. Note that take by Level B harassment includes both behavioral disruption and TTS. Tables 6–14–41 (sonar and other transducers) and 6–56–71 (explosives) in Section 6 of the Navy's rulemaking/LOA application provide the comparative amounts of TTS and behavioral disruption for each species and stock annually, noting that if a modeled marine mammal was ''taken'' through exposure to both TTS and behavioral disruption in the model, it was recorded as a TTS.

TABLE 32—ANNUAL AND SEVEN-YEAR TOTAL SPECIES-SPECIFIC TAKE ESTIMATES PROPOSED FOR AUTHORIZATION FROM ACOUSTIC AND EXPLOSIVE SOUND SOURCE EFFECTS FOR ALL TRAINING ACTIVITIES IN THE NWTT STUDY AREA

Species	Stock	Annual		7-Year total	
		Level B	Level A	Level B	Level A
Order Cetacea					
Suborder Mysticeti (baleen whales)					
Family Balaenopteridae (rorquals):					
Blue whale *	Eastern North Pacific	2	0	11	0
Fin whale *	Northeast Pacific	0	0	0	0
	California/Oregon/Washington	54	0	377	0
Sei whale *	Eastern North Pacific	30	0	206	0
Minke whale	Alaska	0	0	0	0
	California/Oregon/Washington	110	0	767	0
Humpback whale *	Central North Pacific	5	0	31	0
	California/Oregon/Washington	4	0	32	0
Family Eschrichtiidae (gray whale):					
Gray whale	Eastern North Pacific	2	0	10	0
Suborder Odontoceti (toothed whales)					
Family Delphinidae (dolphins):					
Bottlenose dolphin	California/Oregon/Washington Offshore.	5	0	33	0
Killer whale	Alaska Resident	0	0	0	0
	Eastern North Pacific Offshore	68	0	478	0
	West Coast Transient	78	0	538	0
	Southern Resident †	3	0	15	0
Northern right whale dolphin	California/Oregon/Washington	7,941	0	55,493	0
Pacific white-sided dolphin	North Pacific	0	0	0	0
	California/Oregon/Washington	5,284	0	36,788	0
Risso's dolphin	California/Oregon/Washington	2,286	0	15,972	0
Short-beaked common dolphin	California/Oregon/Washington	1,165	0	8,124	0
Short-finned pilot whale	California/Oregon/Washington	57	0	398	0
Striped dolphin	California/Oregon/Washington	439	0	3,059	0
Family Kogiidae (Kogia species):					
Kogia species Pygmy	California/Oregon/Washington	381	0	2,664	0
Family Phocoenidae (porpoises):					
Dall's porpoise	Alaska	0	0	0	0
	California/Oregon/Washington	13,299	8	92,793	48
Harbor porpoise	Southeast Alaska	0	0	0	0
	Northern Oregon/Washington Coast	299	0	2,092	0
	Northern California/Southern Oregon.	21	0	145	0
	Washington Inland Waters	12,315	43	79,934	291
Family Physeteridae (sperm whale):					
Sperm whale *	California/Oregon/Washington	512	0	3,574	0
Family Ziphiidae (beaked whales):					
Baird's beaked whale	California/Oregon/Washington	556	0	3,875	0
Cuvier's beaked whale	California/Oregon/Washington	1,462	0	10,209	0

TABLE 32—ANNUAL AND SEVEN-YEAR TOTAL SPECIES-SPECIFIC TAKE ESTIMATES PROPOSED FOR AUTHORIZATION FROM ACOUSTIC AND EXPLOSIVE SOUND SOURCE EFFECTS FOR ALL TRAINING ACTIVITIES IN THE NWTT STUDY AREA—Continued

Species	Stock	Annual		7-Year total	
		Level B	Level A	Level B	Level A
Mesoplodon species	California/Oregon/Washington	652	0	4,549	0
Suborder Pinnipedia					
Family Otariidae (sea lions and fur seals):					
California sea lion	U.S. Stock	3,624	0	25,243	0
Steller sea lion	Eastern U.S.	108	0	743	0
Guadalupe fur seal *	Mexico	608	0	4,247	0
Northern fur seal	Eastern Pacific	2,134	0	14,911	0
	California	43	0	300	0
Family Phocidae (true seals):					
Harbor seal	Southeast Alaska—Clarence Strait	0	0	0	0
	Oregon/Washington Coastal	0	0	0	0
	Washington Northern Inland Waters	669	5	3,938	35
	Hood Canal	2,686	1	18,662	5
	Southern Puget Sound	1,090	1	6,657	6
Northern elephant seal	California	1,909	1	13,324	1

* ESA-listed species (all stocks) within the NWTT Study Area.
† Only designated stocks are ESA-listed.

TABLE 33—ANNUAL AND SEVEN-YEAR TOTAL SPECIES-SPECIFIC TAKE ESTIMATES PROPOSED FOR AUTHORIZATION FROM ACOUSTIC AND EXPLOSIVE SOUND SOURCE EFFECTS FOR ALL TRAINING ACTIVITIES IN THE NWTT STUDY AREA

Species	Stock	Annual		7-Year total	
		Level B	Level A	Level B	Level A
Order Cetacea					
Suborder Mysticeti (baleen whales)					
Family Balaenopteridae (rorquals):					
Blue whale *	Eastern North Pacific	8	0	38	0
Fin whale *	Northeast Pacific	2	0	10	0
	California/Oregon/Washington	81	0	392	0
Sei whale *	Eastern North Pacific	53	0	258	0
Minke whale	Alaska	2	0	9	0
	California/Oregon/Washington	192	0	916	0
Humpback whale *	Central North Pacific	110	0	578	0
	California/Oregon/Washington	89	0	460	0
Family Eschrichtiidae (gray whale):					
Gray whale	Eastern North Pacific	41	0	189	0
Suborder Odontoceti (toothed whales)					
Family Delphinidae (dolphins):					
Bottlenose dolphin	California/Oregon/Washington Offshore.	3	0	14	0
Killer whale	Alaska Resident	34	0	202	0
	Eastern North Pacific Offshore	89	0	412	0
	West Coast Transient	154	0	831	0
	Southern Resident †	48	0	228	0
Northern right whale dolphin	California/Oregon/Washington	13,759	1	66,457	7
Pacific white-sided dolphin	North Pacific	101	0	603	0
	California/Oregon/Washington	15,681	1	76,980	8
Risso's dolphin	California/Oregon/Washington	4,069	0	19,637	0
Short-beaked common dolphin	California/Oregon/Washington	984	0	3,442	0
Short-finned pilot whale	California/Oregon/Washington	31	0	126	0
Striped dolphin	California/Oregon/Washington	344	0	1,294	0
Family Kogiidae (Kogia species):					
Kogia species	California/Oregon/Washington	501	1	2,376	9
Family Phocoenidae (porpoises):					
Dall's porpoise	Alaska	638	0	3,711	0
	California/Oregon/Washington	20,398	90	98,470	523
Harbor porpoise	Southeast Alaska	130	0	794	0
	Northern Oregon/Washington Coast	52,113	103	265,493	525

TABLE 33—ANNUAL AND SEVEN-YEAR TOTAL SPECIES-SPECIFIC TAKE ESTIMATES PROPOSED FOR AUTHORIZATION FROM ACOUSTIC AND EXPLOSIVE SOUND SOURCE EFFECTS FOR ALL TRAINING ACTIVITIES IN THE NWTT STUDY AREA—Continued

Species	Stock	Annual		7-Year total	
		Level B	Level A	Level B	Level A
	Northern California/Southern Oregon.	2,018	86	12,131	432
	Washington Inland Waters	17,228	137	115,770	930
Family Physeteridae (sperm whale):					
Sperm whale *	California/Oregon/Washington	327	0	1,443	0
Family Ziphiidae (beaked whales):					
Baird's beaked whale	California/Oregon/Washington	420	0	1,738	0
Cuvier's beaked whale	California/Oregon/Washington	1,077	0	4,979	0
Mesoplodon species	California/Oregon/Washington	470	0	2,172	0
Suborder Pinnipedia					
Family Otariidae (sea lions and fur seals):					
California sea lion	U.S. Stock	20,474	1	93,906	5
Steller sea lion	Eastern U.S.	2,130	0	10,745	0
Guadalupe fur seal *	Mexico	887	0	4,022	0
Northern fur seal	Eastern Pacific	9,458	0	45,813	0
	California	189	0	920	0
Family Phocidae (true seals):					
Harbor seal	Southeast Alaska—Clarence Strait	2,352	0	13,384	0
	Oregon/Washington Coastal	1,180	2	6,222	11
	Washington Northern Inland Waters	578	0	3,227	0
	Hood Canal	58,784	0	396,883	0
	Southern Puget Sound	5,748	3	39,511	24
Northern elephant seal	California	2,935	3	14,120	18

* ESA-listed species (all stocks) within the NWTT Study Area.
† Only designated stocks are ESA-listed.

Estimated Take From Vessel Strikes by Serious Injury or Mortality

Vessel strikes from commercial, recreational, and military vessels are known to affect large whales and have resulted in serious injury and occasional fatalities to cetaceans (Berman-Kowalewski *et al.,* 2010; Calambokidis, 2012; Douglas *et al.,* 2008; Laggner 2009; Lammers *et al.,* 2003). Records of collisions date back to the early 17th century, and the worldwide number of collisions appears to have increased steadily during recent decades (Laist *et al.,* 2001; Ritter 2012).

Numerous studies of interactions between surface vessels and marine mammals have demonstrated that free-ranging marine mammals often, but not always (*e.g.,* McKenna *et al.,* 2015), engage in avoidance behavior when surface vessels move toward them. It is not clear whether these responses are caused by the physical presence of a surface vessel, the underwater noise generated by the vessel, or an interaction between the two (Amaral and Carlson, 2005; Au and Green, 2000; Bain *et al.,* 2006; Bauer 1986; Bejder *et al.,* 1999; Bejder and Lusseau, 2008; Bejder *et al.,* 2009; Bryant *et al.,* 1984; Corkeron, 1995; Erbe, 2002; Félix, 2001; Goodwin and Cotton, 2004; Lemon *et al.,* 2006; Lusseau, 2003; Lusseau, 2006; Magalhaes *et al.,* 2002; Nowacek *et al.,* 2001; Richter *et al.,* 2003; Scheidat *et al.,* 2004; Simmonds, 2005; Watkins, 1986; Williams *et al.,* 2002; Wursig *et al.,* 1998). Several authors suggest that the noise generated during motion is probably an important factor (Blane and Jaakson, 1994; Evans *et al.,* 1992; Evans *et al.,* 1994). Water disturbance may also be a factor. These studies suggest that the behavioral responses of marine mammals to surface vessels are similar to their behavioral responses to predators. Avoidance behavior is expected to be even stronger in the subset of instances during which the Navy is conducting training or testing activities using active sonar or explosives.

The marine mammals most vulnerable to vessel strikes 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.,* sperm whales). In addition, some baleen whales seem generally unresponsive to vessel sound, making them more susceptible to vessel collisions (Nowacek *et al.,* 2004). These species are primarily large, slow moving whales.

Some researchers have suggested the relative risk of a vessel strike can be assessed as a function of animal density and the magnitude of vessel traffic (*e.g.,* Fonnesbeck *et al.,* 2008; Vanderlaan *et al.,* 2008). Differences among vessel types also influence the probability of a vessel strike. The ability of any ship to detect a marine mammal and avoid a collision depends on a variety of factors, including environmental conditions, ship design, size, speed, and ability and number of personnel observing, as well as the behavior of the animal. Vessel speed, size, and mass are all important factors in determining if injury or death of a marine mammal is likely due to a vessel strike. For large vessels, speed and angle of approach can influence the severity of a strike. For example, Vanderlaan and Taggart (2007) found that between vessel speeds of 8.6 and 15 knots, the probability that a vessel strike is lethal increases from 0.21 to 0.79. Large whales also do not have to be at the water's surface to be struck. Silber *et al.* (2010) found when a whale is below the surface (about one to two times the vessel draft), under certain circumstances (vessel speed and location of the whale relative to the ship's centerline), there is likely to be a pronounced propeller suction effect.

This suction effect may draw the whale into the hull of the ship, increasing the probability of propeller strikes.

There are some key differences between the operation of military and non-military vessels, which make the likelihood of a military vessel striking a whale lower than some other vessels (*e.g.,* commercial merchant vessels). Key differences include:

• Many military ships have their bridges positioned closer to the bow, offering better visibility ahead of the ship (compared to a commercial merchant vessel);

• There are often aircraft associated with the training or testing activity (which can serve as Lookouts), which can more readily detect cetaceans in the vicinity of a vessel or ahead of a vessel's present course before crew on the vessel would be able to detect them;

• Military ships are generally more maneuverable than commercial merchant vessels, and if cetaceans are spotted in the path of the ship, could be capable of changing course more quickly;

• The crew size on military vessels is generally larger than merchant ships, allowing for stationing more trained Lookouts on the bridge. At all times when Navy vessels are underway, trained Lookouts and bridge navigation teams are used to detect objects on the surface of the water ahead of the ship, including cetaceans. Additional Lookouts, beyond those already stationed on the bridge and on navigation teams, are positioned as Lookouts during some training events; and

• When submerged, submarines are generally slow moving (to avoid detection) and therefore marine mammals at depth with a submarine are likely able to avoid collision with the submarine. When a submarine is transiting on the surface, there are Lookouts serving the same function as they do on surface ships.

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 NWTT Study Area or while in transit.

Data from the ports of Vancouver, British Columbia; Seattle, Washington; and Tacoma, Washington indicate there were more than 7,000 commercial vessel transits in 2017 associated with visits to just those ports (The Northwest Seaport Alliance, 2018; Vancouver Fraser Port Authority). This number of vessel transits does not account for other vessel traffic in the Strait of Juan de Fuca or Puget Sound including commercial ferries, tourist vessels, or recreational vessels. Additional commercial traffic in the NWTT Study Area also includes vessels transiting offshore along the Pacific coast, bypassing ports in Canada and Washington; traffic associated with ports to the south along the coast of Washington and in Oregon; and vessel traffic in Southeast Alaska (Nuka Research & Planning Group, 2012). Navy vessel traffic accounts for only a small portion of vessel activities in the NWTT Study Area. The Navy has, in total, the following homeported operational vessels: 2 Aircraft carriers, 6 destroyers, 14 submarines, and 22 smaller security vessels with a combined annual total of 241 Navy vessel transits (see Appendix A (Navy Activities Descriptions) of the 2019 DSEIS/OEIS for descriptions of the number of vessels used during the various types of Navy's proposed activities). Activities involving military vessel movement would be widely dispersed throughout the NWTT Study Area.

Navy vessel strike records have been kept since 1995, and since 1995 there have been two recorded strikes of whales by Navy vessels (or vessels being operated on behalf of the Navy) in the NWTT Study Area. Neither strike was associated with training or testing activities. The first strike occurred in 2012 by a Navy destroyer off the southern coast of Oregon while in transit to San Diego. The whale was suspected to be a minke whale due to the appearance and size (25 ft, dark with white belly), however the Navy could not rule out the possibility that it was a juvenile fin whale. The whale was observed swimming after the strike and no blood or injury was sighted. The second strike occurred in 2016 by a U.S. Coast Guard cutter operating on behalf of the Navy as part of a Maritime Security Operation escort vessel in the Strait of Juan de Fuca. The whale was positively identified as a humpback whale. It was observed for 10 minutes post-collision and appeared normal at the surface. There was no blood observed in the water and the whale subsequently swam away.

In order to account for the potential risk from vessel movement within the NWTT Study Area within the seven-year period in particular, the Navy requested incidental takes based on probabilities derived from a Poisson distribution using ship strike data between 2009–2018 in the NWTT Study Area (the time period from when current mitigation measures to reduce the likelihood of vessel strikes were instituted until the Navy conducted the analysis for the Navy's application), as well as historical at-sea days in the NWTT Study Area from 2009–2018 and estimated potential at-sea days for the period from 2020 to 2027 covered by the requested regulations. This distribution predicted the probabilities of a specific number of strikes (n = 0, 1, 2, *etc.*) over the period from 2020 to 2027. The analysis for the period of 2020 to 2027 is described in detail in Chapter 6.6 (Vessel Strike Analysis) of the Navy's rulemaking/LOA application.

For the same reasons listed above, describing why a Navy vessel strike is comparatively unlikely, it is highly unlikely that a Navy vessel would strike a whale, dolphin, porpoise, or pinniped without detecting it and, accordingly, NMFS is confident that the Navy's reported strikes are accurate and appropriate for use in the analysis. Specifically, Navy ships have multiple Lookouts, including on the forward part of the ship that can visually detect a hit animal, in the unlikely event ship personnel do not feel the strike. Unlike the situation for non-Navy ships engaged in commercial activities, NMFS and the Navy have no evidence that the Navy has struck a whale and not detected it. Navy's strict internal procedures and mitigation requirements include reporting of any vessel strikes of marine mammals, and the Navy's discipline, extensive training (not only for detecting marine mammals, but for detecting and reporting any potential navigational obstruction), and strict chain of command give NMFS a high level of confidence that all strikes actually get reported.

The Navy used those two whale strikes in their calculations to determine the number of strikes likely to result from their activities and evaluated data beginning in 2009. The Navy's Marine Species Awareness Training was first used in 2006 and was fully integrated across the Navy in 2009, which is why the Navy uses 2009 as the date to begin the analysis. The adoption of additional mitigation measures to address ship strike also began in 2009, and will remain in place along with additional mitigation measures during the seven years of this rule. The probability analysis concluded that there was a 26 percent chance that zero whales would be struck by Navy vessels over the seven-year period, and a 35, 24, 11, and 4 percent chance that one, two, three, or four whales, respectively, would be struck over the seven-year period (with a 74 percent chance total that at least one whale would be struck over the seven-year period). Therefore, the Navy estimates, and NMFS agrees, that there is some probability that the Navy could strike, and take by serious injury or mortality, up to three large whales incidental to training and testing activities within the NWTT Study Area over the course of the seven years.

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

Taking into account the available information regarding how many of any given stock could be struck and therefore should be authorized for take, NMFS considered three factors in addition to those considered in the Navy's request: (1) The relative likelihood of hitting one stock versus another based on available strike data from all vessel types as denoted in the SARs, (2) whether the Navy has ever definitively struck an individual from a particular species or stock in the NWTT Study Area, and if so, how many times, and (3) whether there are records that an individual from a particular species or stock has been struck by any vessel in the NWTT Study Area, and if so, how many times (based on ship strike records provided by the NMFS West Coast Region in February 2020). To address number (1) above, NMFS compiled information from NMFS' SARs on detected annual rates of large whale serious injury or mortality (M/SI) from vessel collisions (Table 34). The annual rates of large whale serious injury or mortality from vessel collisions from the SARs help inform the relative susceptibility of large whale species to vessel strike in NWTT Study Area as recorded systematically over the last five years (the period used for the SARs). However, we note that the SARs present strike data from the stock's entire range, which is much larger than the NWTT Study Area, and available ship strike records show that the majority of strikes that occur off the United States West Coast occur in southern California. We summed the annual rates of serious injury or mortality from vessel collisions as reported in the SARs, then divided each species' annual rate by this sum to get the proportion of strikes for each species/stock. To inform the likelihood of striking a particular species of large whale, we multiplied the proportion of striking each species by the probability of striking at least one whale (*i.e.,* 74 percent, as described by the Navy's probability analysis above). We note that these probabilities vary from year to year as the average annual mortality for a given five-year window in the SAR changes; however, over the years and through changing SARs, stocks tend to consistently maintain a relatively higher or relatively lower likelihood of being struck (and we include the annual averages from 2017 SARs in Table 34 to illustrate).

The probabilities calculated as described above are then considered in combination with the information indicating the species that the Navy has definitively hit in the NWTT Study Area since 1995 (since they started tracking consistently) and the species that are known to have been struck by any vessel (through regional stranding data) in the NWTT Study Area. We also note that Rockwood *et al.* (2017) modeled the likely vessel strike of blue whales, fin whales, and humpback whales on the U.S. West Coast (discussed in more detail in the *Serious Injury or Mortality* subsection of the *Preliminary Analysis and Negligible Impact Determination* section), and those numbers help inform the relative likelihood that the Navy will hit those stocks.

For each indicated stock, Table 34 includes the percent likelihood of hitting an individual whale once based on SAR data, total strikes from Navy vessels (from 1995), total strikes from any vessel (from 2000 from regional stranding data), and modeled vessel strikes from Rockwood *et al.* (2017). The last column indicates the annual serious injury or mortality proposed for authorization.

TABLE 34—SUMMARY OF FACTORS CONSIDERED IN DETERMINING THE NUMBER OF INDIVIDUALS IN EACH STOCK POTENTIALLY STRUCK BY A VESSEL

ESA status	Species	Stock	Annual rate of M/SI from vessel collision (observed from 2017 SARs)	Annual rate of M/SI from vessel collision (observed from 2019 Draft SARs)	Percent likelihood of hitting individual from species/stock once (from 2019 Draft SARs)	Total known strikes in OR, WA, northern CA (from 2000 to present) [1]	Total known navy strikes in NWTT study area	Rockwood *et al.* (2017) modeled vessel strikes [5]	MMPA proposed authorized takes (from the 3 total)	Annual proposed authorized take
Listed	Blue whale	Eastern North Pacific	0	0.4	3.7			18	0	0
	Fin whale	Northeast Pacific	0.2	0.4	3.7	[2] 10			2	0.29
		CA/OR/WA	1.8	1.6	14.8	[2] 10		43	2	0.29
	Sei whale	Eastern North Pacific	0	0.2	1.85				0	0
	Humpback whale	CA/OR/WA (Mexico and Central America DPS).	1.1	2.1	19.425	[3] 4	[4] 1	22	2	0.29
	Sperm whale	CA/OR/WA	0.2	0	0	3			1	0.14
Not Listed	Minke whale	Alaska	0	0	0				0	0
		CA/OR/WA	0	0	0	1	1		1	0.14
	Gray whale	Eastern North Pacific	2	0.8	7.4	9			1	0.14
	Humpback whale	Central North Pacific (Hawaii DPS)	2.6	2.5	23.125	[3] 4	[4] 1		2	0.29

[1] Only one ship strike was reported in California in the NWTT Study Area (which is limited to Humbolt and Del Norte Counties). This strike occurred in 2004 in Humbolt County and was not identified to species.

[2] A total of 10 fin whale strikes are reported in the regional stranding database, however no information on stock is provided. As these two stocks of fin whales are known to overlap spatially and temporally in the NWTT Study Area, the 10 reported strikes could come from either stock or a combination of both stocks.

[3] A total of 4 humpback whales strikes are reported in the regional stranding database, however no information on stock is provided. As these two stocks of humpback whales are known to overlap spatially and temporally in the NWTT Study Area, the 4 reported strikes could come from either stock or a combination of both stocks.

[4] One humpback whale was reported as struck by a U.S. Coast Guard cutter operating on behalf of the Navy, however it was not possible for the Navy to determine which stock this whale came from. As these two stocks of humpback whales are known to overlap spatially and temporally in the NWTT Study Area, this whale could have come from either stock.

[5] Rockwood *et al.* modeled likely annual vessel strikes off the West Coast for these three species only.

Accordingly, stocks that have no record of having been struck by any vessel are considered unlikely to be struck by the Navy in the seven-year period of the rule. Stocks that have never been struck by the Navy, have rarely been struck by other vessels, and have a low likelihood of being struck based on the SAR calculation and a low relative abundance (Eastern North Pacific stock of blue whales, Eastern North Pacific stock of sei whales, and Alaska stock of minke whales) are also considered unlikely to be struck by the Navy during the seven-year rule. This rules out all but seven stocks.

The two stocks of humpback whales (CA/OR/WA and Central North Pacific) and two stocks of fin whales (CA/OR/WA and Northeast Pacific) are known to overlap spatially and temporally in the NWTT Study Area, and it is not possible to distinguish the difference between individuals of these stocks based on visual sightings in the field. The Navy has previously struck a humpback whale in the NWTT Study Area and it is the second most common species struck by any vessel in the Study Area based on stranding data. Based on the SAR data, the two stocks of humpback whales also have the highest likelihood of being struck. Though the Navy has not definitively struck a fin whale in the NWTT Study Area (noting that the Navy could not rule out that the minke whale strike could have been a juvenile fin whale), fin whales are the most common species struck by any vessel in the Study Area based on stranding data. Based on the SAR data, the CA/OR/WA stock has the third highest likelihood of being struck. Based on all of these factors, it is considered reasonably likely that humpback whales (from either the CA/OR/WA or Central North Pacific stocks) could be struck twice and fin whales (from either the CA/OR/WA or Northeast Pacific stocks) could be struck twice during the seven-year rule.

Based on the SAR data, the CA/OR/WA stock of sperm whales and CA/OR/WA stock of minke whales have a very low likelihood of being struck. However, 3 sperm whales have been struck by non-Navy vessels in the NWTT Study Area (in 2002, 2007, and 2012) and the Navy has previously struck a minke whale in the NWTT Study Area. Therefore, we consider it reasonable to predict that an individual from each of these stocks could be struck by the Navy once during the seven-year rule. Finally, based on stranding data, gray whales are the second most commonly struck whale in the NWTT Study Area and the SAR data indicates that on average, 0.8 whales from this stock are struck throughout the stock's range each year. Based on these data, we consider it reasonable to predict that an individual from the Eastern North Pacific stock of gray whales could be struck by the Navy once during the seven-year rule.

In conclusion, although it is generally unlikely that any whales will be struck in a year, based on the information and analysis above, NMFS anticipates that no more than three whales have the potential to be taken by serious injury or mortality over the seven-year period of the rule. Of those three whales over the seven years, no more than two may come from any of the following species/stocks: Fin whale (which may come from either the Northeast Pacific or CA/OR/WA stock) and humpback whale (which may come from either the Central North Pacific or CA/OR/WA stock). Additionally, of those three whales over the seven years no more than one may come from any of the following species/stocks: Sperm whale (CA/OR/WA stock), minke whale (CA/OR/WA stock), and gray whale (Eastern North Pacific stock). Accordingly, NMFS has evaluated under the negligible impact standard the M/SI of 0.14 or 0.29 whales annually from each of these species or stocks (*i.e.,* 1 or 2 takes, respectively, divided by seven years to get the annual number), along with the expected incidental takes by harassment. We do not anticipate, nor propose to authorize, ship strike takes to blue whales (Eastern North Pacific stock), minke whales (Alaska stock), or sei whales (Eastern North Pacific stock).

Proposed Mitigation Measures

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

In *Conservation Council for Hawaii* v. *National Marine Fisheries Service,* 97 F. Supp. 3d 1210, 1229 (D. Haw. 2015), the Court stated that NMFS ''appear[s] to think [it] satisf[ies] the statutory 'least practicable adverse impact' requirement with a 'negligible impact' finding.'' More recently, expressing similar concerns in a challenge to a U.S. Navy Surveillance Towed Array Sensor System Low Frequency Active Sonar (SURTASS LFA) incidental take rule (77 FR 50290), the Ninth Circuit Court of Appeals in *Natural Resources Defense Council (NRDC)* v. *Pritzker,* 828 F.3d 1125, 1134 (9th Cir. 2016), stated, ''[c]ompliance with the 'negligible impact' requirement does not mean there [is] compliance with the 'least practicable adverse impact' standard.'' As the Ninth Circuit noted in its opinion, however, the Court was interpreting the statute without the benefit of NMFS' formal interpretation. We state here explicitly that NMFS is in full agreement that the ''negligible impact'' and ''least practicable adverse impact'' requirements are distinct, even though both statutory standards refer to species and stocks. With that in mind, we provide further explanation of our interpretation of least practicable adverse impact, and explain what distinguishes it from the negligible impact standard. This discussion is consistent with previous rules we have published, such as the Navy's Hawaii-Southern California Training and Testing (HSTT) rule (83 FR 66846; December 27, 2018), Atlantic Fleet Training and Testing (AFTT) rule (84 FR 70712; December 23, 2019), and Mariana Islands Training and Testing (MITT) proposed rule (85 FR 5782; January 31, 2020).

Before NMFS can issue incidental take regulations under section 101(a)(5)(A) of the MMPA, it must make a finding that the total taking will have a ''negligible impact'' on the affected ''species or stocks'' of marine mammals. NMFS' and U.S. Fish and Wildlife Service's implementing regulations for section 101(a)(5) both define ''negligible impact'' as an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival (50 CFR 216.103 and 50 CFR 18.27(c)). Recruitment (*i.e.,* reproduction) and survival rates are used to determine population growth rates [3] and, therefore are considered in evaluating population level impacts.

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

While some level of impact on population numbers or growth rates of a species or stock may occur and still satisfy the negligible impact requirement—even without consideration of mitigation—the least practicable adverse impact provision separately requires NMFS to prescribe means of effecting the least practicable adverse impact on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, 50 CFR 216.102(b), which are typically identified as mitigation measures.[4]

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

This interpretation is consistent with Congress' statutory findings for enacting the MMPA, nearly all of which are most applicable at the species or stock (*i.e.,* population) level. *See* MMPA section 2 (finding that it is species and population stocks that are or may be in danger of extinction or depletion; that it is species and population stocks that should not diminish beyond being significant functioning elements of their ecosystems; and that it is species and population stocks that should not be permitted to diminish below their optimum sustainable population level). Annual rates of recruitment (*i.e.,* reproduction) and survival are the key biological metrics used in the evaluation of population-level impacts, and accordingly these same metrics are also used in the evaluation of population level impacts for the least practicable adverse impact standard.

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

Section 101(a)(5)(A)(i)(II) requires NMFS to issue, in conjunction with its authorization, binding—and enforceable—restrictions (in the form of regulations) setting forth how the activity must be conducted, thus ensuring the activity has the ''least practicable adverse impact'' on the affected species or stocks. In situations where mitigation is specifically needed to reach a negligible impact determination, section 101(a)(5)(A)(i)(II) also provides a mechanism for ensuring compliance with the ''negligible impact'' requirement. Finally, the least practicable adverse impact standard also requires consideration of measures for marine mammal habitat, with particular attention to rookeries, mating grounds, and other areas of similar significance, and for subsistence impacts, whereas the negligible impact standard is concerned solely with conclusions about the impact of an activity on annual rates of recruitment and survival.[5] In *NRDC* v. *Pritzker,* the Court stated, ''[t]he statute is properly read to mean that even if population levels are not threatened *significantly,* still the agency must adopt mitigation measures aimed at protecting *marine mammals* to the greatest extent practicable in light of military readiness needs.'' *Pritzker* at 1134 (emphases added). This statement is consistent with our understanding stated above that even when the effects of an action satisfy the negligible impact standard (*i.e.,* in the Court's words, ''population levels are not threatened significantly''), still the agency must prescribe mitigation under the least practicable adverse impact standard. However, as the statute indicates, the focus of both standards is ultimately the impact on the affected ''species or stock,'' and not solely focused on or directed at the impact on individual marine mammals.

We have carefully reviewed and considered the Ninth Circuit's opinion in *NRDC* v. *Pritzker* in its entirety. While the Court's reference to ''marine mammals'' rather than ''marine mammal species or stocks'' in the italicized language above might be construed as 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

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

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

[5] 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).

question of whether the standard applies to individual animals as opposed to the species or stock as a whole. We recognize that while consideration of mitigation can play a role in a negligible impact determination, consideration of mitigation measures extends beyond that analysis. In evaluating what mitigation measures are appropriate, NMFS considers the potential impacts of the Specified Activities, the availability of measures to minimize those potential impacts, and the practicability of implementing those measures, as we describe below.

Implementation of Least Practicable Adverse Impact Standard

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

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

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

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

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

While direct evidence of impacts to species or stocks from a specified activity is rarely available, and additional study is still needed to understand how specific disturbance events affect the fitness of individuals of certain species, there have been improvements in understanding the process by which disturbance effects are translated to the population. With recent scientific advancements (both marine mammal energetic research and the development of energetic frameworks), the relative likelihood or degree of impacts on species or stocks may often be inferred given a detailed understanding of the activity, the environment, and the affected species or stocks—and the best available science has been used here. This same information is used in the development of mitigation measures and helps us understand how mitigation measures contribute to lessening effects (or the risk thereof) to species or stocks. We also acknowledge that there is always the potential that new information, or a new recommendation could become available in the future and necessitate reevaluation of mitigation measures (which may be addressed through adaptive management) to see if further reductions of population impacts are possible and practicable.

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

1. *Reduction of adverse impacts to marine mammal species or stocks and their habitat.*[6] The emphasis given to a measure's ability to reduce the impacts on a species or stock considers the degree, likelihood, and context of the anticipated reduction of impacts to individuals (and how many individuals) as well as the status of the species or stock.

The ultimate impact on any individual from a disturbance event (which informs the likelihood of adverse species- or stock-level effects) is dependent on the circumstances and associated contextual factors, such as duration of exposure to stressors. Though any proposed mitigation needs to be evaluated in the context of the specific activity and the species or stocks affected, measures with the following types of effects have greater value in reducing the likelihood or severity of adverse species- or stock-level impacts: Avoiding or minimizing injury or mortality; limiting interruption of known feeding, breeding, mother/young, or resting behaviors; minimizing the abandonment of important habitat (temporally and spatially); minimizing the number of individuals subjected to these types of disruptions; and limiting degradation of habitat. Mitigating these types of effects is intended to reduce the likelihood that the activity will result in energetic or other types of impacts that

[6] 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.

are more likely to result in reduced reproductive success or survivorship. It is also important to consider the degree of impacts that are expected in the absence of mitigation in order to assess the added value of any potential measures. Finally, because the least practicable adverse impact standard gives NMFS discretion to weigh a variety of factors when determining appropriate mitigation measures and because the focus of the standard is on reducing impacts at the species or stock level, the least practicable adverse impact standard does not compel mitigation for every kind of take, or every individual taken, if that mitigation is unlikely to meaningfully contribute to the reduction of adverse impacts on the species or stock and its habitat, even when practicable for implementation by the applicant.

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

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

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

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

Assessment of Mitigation Measures for NWTT Study Area

NMFS has fully reviewed the specified activities and the mitigation measures included in the Navy's rulemaking/LOA application and the 2019 NWTT DSEIS/OEIS to determine if the mitigation measures would result in the least practicable adverse impact on marine mammals and their habitat. NMFS worked with the Navy in the development of the Navy's initially proposed measures, which are informed by years of implementation and monitoring. A complete discussion of the Navy's evaluation process used to develop, assess, and select mitigation measures, which was informed by input from NMFS, can be found in Chapter 5 (*Mitigation*) and Appendix K (*Geographic Mitigation Assessment*) of the 2019 NWTT DSEIS/OEIS. The process described in Chapter 5 (*Mitigation*) and Appendix K (*Geographic Mitigation Assessment*) of the 2019 NWTT DSEIS/OEIS robustly supported NMFS' independent evaluation of whether the mitigation measures would meet the least practicable adverse impact standard. The Navy would be required to implement the mitigation measures identified in this rule for the full seven years to avoid or reduce potential impacts from acoustic, explosive, and physical disturbance and strike stressors.

As a general matter, where an applicant proposes measures that are likely to reduce impacts to marine mammals, the fact that they are included in the application indicates that the measures are practicable, and it is not necessary for NMFS to conduct a detailed analysis of the measures the applicant proposed (rather, they are simply included). However, it is still necessary for NMFS to consider whether there are additional practicable measures that would meaningfully reduce the probability or severity of impacts that could affect reproductive success or survivorship.

Overall the Navy has agreed to procedural mitigation measures that would reduce the probability and/or severity of impacts expected to result from acute exposure to acoustic sources or explosives, ship strike, and impacts to marine mammal habitat. Specifically, the Navy would use a combination of delayed starts, powerdowns, and shutdowns to avoid mortality or serious injury, minimize the likelihood or severity of PTS or other injury, and reduce instances of TTS or more severe behavioral disruption caused by acoustic sources or explosives. The Navy would also implement multiple time/area restrictions that would reduce take of marine mammals in areas or at times where they are known to engage in important behaviors, such as calving, where the disruption of those behaviors would have a higher probability of resulting in impacts on reproduction or survival of individuals that could lead to population-level impacts.

The Navy assessed the practicability of the proposed measures in the context of personnel safety, practicality of implementation, and their impacts on the Navy's ability to meet their Title 10 requirements and found that the measures are supportable. As described in more detail below, NMFS has independently evaluated the measures the Navy proposed in the manner described earlier in this section (*i.e.,* in consideration of their ability to reduce adverse impacts on marine mammal species and their habitat and their practicability for implementation). We have determined that the measures will significantly and adequately reduce impacts on the affected marine mammal species and stocks and their habitat and, further, be practicable for Navy implementation. Therefore, the mitigation measures assure that the Navy's activities will have the least practicable adverse impact on the species or stocks and their habitat.

The Navy also evaluated numerous measures in the 2019 NWTT DSEIS/OEIS that were not included in the Navy's rulemaking/LOA application, and NMFS independently reviewed and preliminarily concurs with the Navy's analysis that their inclusion was not appropriate under the least practicable adverse impact standard based on our assessment. The Navy considered these additional potential mitigation measures in two groups. First, Chapter 5 (*Mitigation)* of the 2019 NWTT DSEIS/OEIS, in the *Measures Considered but Eliminated* section, includes an analysis of an array of different types of mitigation that have been recommended over the years by non-governmental organizations or the public, through scoping or public comment on environmental compliance documents. Appendix K (*Geographic Mitigation Assessment*) of the 2019 NWTT DSEIS/OEIS includes an in-depth analysis of time/area restrictions that have been recommended over time or previously implemented as a result of litigation (outside of the NWTT Study Area). As described in Chapter 5 (*Mitigation*) of the 2019 NWTT DSEIS/OEIS, commenters sometimes recommend that the Navy reduce its overall amount of training, reduce explosive use, modify its sound sources, completely replace live training with computer simulation, or include time of day restrictions. Many of these mitigation measures could potentially reduce the number of marine mammals taken, via direct reduction of the activities or amount of sound energy put in the water. However, as described in Chapter 5 (*Mitigation*) of the 2019 NWTT DSEIS/OEIS, the Navy needs to train and test in the conditions in which it fights—and these types of modifications fundamentally change the activity in a manner that would not support the purpose and need for the training and testing (*i.e.,* are entirely impracticable) and therefore are not considered further. NMFS finds the Navy's explanation for why adoption of these recommendations would unacceptably undermine the purpose of the testing and training persuasive. After independent review, NMFS finds Navy's judgment on the impacts of potential mitigation measures to personnel safety, practicality of implementation, and the effectiveness of training and testing within the NWTT Study Area persuasive, and for these reasons, NMFS finds that these measures do not meet the least practicable adverse impact standard because they are not practicable.

Second, in Chapter 5 (*Mitigation*) of the 2019 NWTT DSEIS/OEIS, the Navy evaluated additional potential procedural mitigation measures, including increased mitigation zones, ramp-up measures, additional passive acoustic and visual monitoring, and decreased vessel speeds. Some of these measures have the potential to incrementally reduce take to some degree in certain circumstances, though the degree to which this would occur is typically low or uncertain. However, as described in the Navy's analysis, the measures would have significant direct negative effects on mission effectiveness and are considered impracticable (see Chapter 5 *Mitigation* of 2019 NWTT DSEIS/OEIS). NMFS independently reviewed the Navy's evaluation and concurs with this assessment, which supports NMFS' preliminary findings that the impracticability of this additional mitigation would greatly outweigh any potential minor reduction in marine mammal impacts that might result; therefore, these additional mitigation measures are not warranted.

Last, Appendix K (*Geographic Mitigation Assessment*) of the 2019 NWTT DSEIS/OEIS describes a comprehensive method for analyzing potential geographic mitigation that includes consideration of both a biological assessment of how the potential time/area limitation would benefit the species and its habitat (*e.g.,* is a key area of biological importance or would result in avoidance or reduction of impacts) in the context of the stressors of concern in the specific area and an operational assessment of the practicability of implementation (*e.g.,* including an assessment of the specific importance of that area for training, considering proximity to training ranges and emergency landing fields and other issues). For most of the areas that were considered in the 2019 NWTT DSEIS/OEIS but not included in this rule, the Navy found that the mitigation was not warranted because the anticipated reduction of adverse impacts on marine mammal species and their habitat was not sufficient to offset the impracticability of implementation. In some cases potential benefits to marine mammals were non-existent, while in others the consequences on mission effectiveness were too great.

NMFS has reviewed the Navy's analysis in Chapter 5 *Mitigation* and Appendix K *Geographic Mitigation Assessment* of the 2019 NWTT DSEIS/OEIS, which considers the same factors that NMFS considers to satisfy the least practicable adverse impact standard, and concurs with the analysis and conclusions. Therefore, NMFS is not proposing to include any of the measures that the Navy ruled out in the 2019 NWTT DSEIS/OEIS. Below are the mitigation measures that NMFS determined will ensure the least practicable adverse impact on all affected species and their habitat, including the specific considerations for military readiness activities. The following sections describe the mitigation measures that would be implemented in association with the training and testing activities analyzed in this document. The mitigation measures are organized into two categories: Procedural mitigation and mitigation areas.

Procedural Mitigation

Procedural mitigation is mitigation that the Navy would implement whenever and wherever an applicable training or testing activity takes place within the NWTT 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 35) is designed to aid Lookouts and other applicable Navy personnel with their observation, environmental compliance, and reporting responsibilities. The remainder of the procedural mitigation measures (Tables 36 through 49) are organized by stressor type and activity category and include acoustic stressors (*i.e.,* active sonar, weapons firing noise), explosive stressors (*i.e.,* sonobuoys, torpedoes, medium-caliber and large-caliber projectiles, missiles, bombs, mine counter-measure and neutralization activities, mine neutralization involving Navy divers), 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, non-explosive bombs and mine shapes).

TABLE 35—PROCEDURAL MITIGATION FOR ENVIRONMENTAL AWARENESS AND EDUCATION

Procedural mitigation description
Stressor or Activity: • All training and testing activities, as applicable. Mitigation Requirements: • Appropriate personnel (including civilian personnel) involved in mitigation and training or testing activity reporting under the specified activities will complete one or more modules of the U.S. Navy Afloat Environmental Compliance Training Series, as identified in their career path training plan. Modules include:

TABLE 35—PROCEDURAL MITIGATION FOR ENVIRONMENTAL AWARENESS AND EDUCATION—Continued

Procedural mitigation description
—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 36 and 37.

Procedural Mitigation for Active Sonar

Procedural mitigation for active sonar is described in Table 36 below.

TABLE 36—PROCEDURAL MITIGATION FOR ACTIVE SONAR

Procedural mitigation description
Stressor or Activity: • Low-frequency active sonar, mid-frequency active sonar, high-frequency active sonar: —For vessel-based active sonar activities, mitigation applies only to sources that are positively controlled and deployed from manned surface vessels (*e.g.,* sonar sources towed from manned surface platforms). —For aircraft-based active sonar activities, mitigation applies only to sources that are positively controlled and deployed from manned aircraft that do not operate at high altitudes (*e.g.,* rotary-wing aircraft). Mitigation does not apply to active sonar sources deployed from unmanned aerial systems or aircraft operating at high altitudes (*e.g.,* maritime patrol aircraft). Number of Lookouts and Observation Platform: • Hull-mounted sources: —1 Lookout: Platforms with space or manning restrictions while underway (at the forward part of a small boat or ship) and platforms using active sonar while moored or at anchor (including pierside). —2 Lookouts: Platforms without space or manning restrictions while underway (at the forward part of the ship). • Sources that are not hull-mounted: —1 Lookout on the ship or aircraft conducting the activity. Mitigation Requirements: • Mitigation zones: —1,000 yd power down, 500 yd power down, and 200 yd or 100 yd shut down for low-frequency active sonar ≥200 decibels (dB) and hull-mounted mid-frequency active sonar. —200 yd or 100 yd shut down for low-frequency active sonar <200 dB, mid-frequency active sonar sources that are not hull-mounted, and high-frequency active sonar. • Prior to the initial start of the activity (*e.g.,* when maneuvering on station): —Observe the mitigation zone for floating vegetation; if observed, relocate or delay the start until the mitigation zone is clear. —Observe the mitigation zone for marine mammals; if observed, relocate or delay the start of active sonar transmission. • During the activity: —Low-frequency active sonar ≥200 decibels (dB) and hull-mounted mid-frequency active sonar: Observe the mitigation zone for marine mammals; power down active sonar transmission by 6 dB if a marine mammal is observed within 1,000 yd of the sonar source; power down an additional 4 dB (10 dB total) if a marine mammal is observed within 500 yd; cease transmission if a cetacean in the NWTT Offshore Area, NWTT Inland Area, or Western Behm Canal is observed within 200 yd; cease transmission if a pinniped in the NWTT Offshore Area or Western Behm Canal is observed within 200 yd and cease transmission if a pinniped in NWTT Inland Waters is observed within 100 yd (except if hauled out on, or in the water near, man-made structures and vessels). —Low-frequency active sonar <200 dB, mid-frequency active sonar sources that are not hull-mounted, and high-frequency active sonar: Observe the mitigation zone for marine mammals; cease transmission if a cetacean or pinniped in the NWTT Offshore Area or Western Behm Canal is observed within 200 yd of the sonar source; cease transmission if a pinniped in NWTT Inland Waters is observed within 100 yd (except if hauled out on, or in the water near, man-made structures and vessels). • Commencement/recommencement conditions after a marine mammal sighting before or during the activity:

TABLE 36—PROCEDURAL MITIGATION FOR ACTIVE SONAR—Continued

Procedural mitigation description
—The Navy will allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing or powering up active sonar transmission) until one of the following conditions has been met: (1) The animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the sonar source; (3) the mitigation zone has been clear from any additional sightings for 10 minutes for aircraft-deployed sonar sources or 30 minutes for vessel-deployed sonar sources; (4) for mobile activities, the active sonar source has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting; or (5) for activities using hull-mounted sonar, the Lookout concludes that dolphins are deliberately closing in on the ship to ride the ship's bow wave, and are therefore out of the main transmission axis of the sonar (and there are no other marine mammal sightings within the mitigation zone).

Procedural Mitigation for Weapons Firing Noise

Procedural mitigation for weapons firing noise is described in Table 37 below.

TABLE 37—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 one described in Table 40 for Explosive Medium-Caliber and Large-Caliber Projectiles or Table 47 for Small-, Medium-, and Large-Caliber Non-Explosive Practice Munitions. Mitigation Requirements: • Mitigation zone: —30° on either side of the firing line out to 70 yd from the muzzle of the weapon being fired. • Prior to the initial start of the activity: —Observe the mitigation zone for floating vegetation; if observed, relocate or delay the start until the mitigation zone is clear. —Observe the mitigation zone for marine mammals; if observed, relocate or delay the start of weapons firing. • During the activity: —Observe the mitigation zone for marine mammals; if observed, cease weapons firing. • Commencement/recommencement conditions after a marine mammal sighting before or during the activity: —The Navy will allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing weapons firing) until one of the following conditions has been met: (1) The animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the firing ship; (3) the mitigation zone has been clear from any additional sightings for 30 minutes; 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 38 through 44.

Procedural Mitigation for Explosive Sonobuoys

Procedural mitigation for explosive sonobuoys is described in Table 38 below.

TABLE 38—PROCEDURAL MITIGATION FOR EXPLOSIVE SONOBUOYS

Procedural mitigation description
Stressor or Activity: • Explosive sonobuoys. Number of Lookouts and Observation Platform: • 1 Lookout positioned in an aircraft or on a small boat. • If additional platforms are participating in the activity, personnel positioned in those assets (*e.g.,* safety observers, evaluators) will support observing the mitigation zone for marine mammals while performing their regular duties. Mitigation Requirements: • Mitigation zone: —600 yd. around an explosive sonobuoy. • Prior to the initial start of the activity (*e.g.,* during deployment of a sonobuoy field, which typically lasts 20–30 minutes): —Observe the mitigation zone for floating vegetation; if observed, relocate or delay the start until the mitigation zone is clear. —Conduct passive acoustic monitoring for marine mammals; use information from detections to assist visual observations. —Visually observe the mitigation zone for marine mammals; if observed, relocate or delay the start of sonobuoy or source/receiver pair detonations.

TABLE 38—PROCEDURAL MITIGATION FOR EXPLOSIVE SONOBUOYS—Continued

Procedural mitigation description
• During the activity: —Observe the mitigation zone for marine mammals; if observed, cease sonobuoy or source/receiver pair detonations. • Commencement/recommencement conditions after a marine mammal sighting before or during the activity: —The Navy will allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing detonations) until one of the following conditions has been met: (1) The animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the sonobuoy; or (3) the mitigation zone has been clear from any additional sightings for 10 minutes when the activity involves aircraft that have fuel constraints, or 30 minutes when the activity involves aircraft that are not typically fuel constrained. • After completion of the activity (*e.g.,* prior to maneuvering off station): —When practical (*e.g.,* when platforms are not constrained by fuel restrictions or mission-essential follow-on commitments), observe for marine mammals in the vicinity of where detonations occurred; if any injured or dead marine mammals are observed, follow established incident reporting procedures. —If additional platforms are supporting this activity (*e.g.,* providing range clearance), these assets will assist in the visual observation of the area where detonations occurred.

Procedural Mitigation for Explosive Torpedoes

Procedural mitigation for explosive torpedoes is described in Table 39 below.

TABLE 39—PROCEDURAL MITIGATION FOR EXPLOSIVE TORPEDOES

Procedural Mitigation Description
Stressor or Activity: • Explosive torpedoes. Number of Lookouts and Observation Platform: • 1 Lookout positioned in an aircraft. • If additional platforms are participating in the activity, personnel positioned in those assets (*e.g.,* safety observers, evaluators) will support observing the mitigation zone for marine mammals while performing their regular duties. Mitigation Requirements: • Mitigation zone: —2,100 yd around the intended impact location. • Prior to the initial start of the activity (*e.g.,* during deployment of the target): —Observe the mitigation zone for floating vegetation; if observed, relocate or delay the start until the mitigation zone is clear. —Conduct passive acoustic monitoring for marine mammals; use information from detections to assist visual observations. —Visually observe the mitigation zone for marine mammals; if observed, relocate or delay the start of firing. • During the activity: —Observe the mitigation zone for marine mammals; if observed, cease firing. • Commencement/recommencement conditions after a marine mammal sighting before or during the activity: —The Navy will allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing firing) until one of the following conditions has been met: (1) The animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended impact location; or (3) the mitigation zone has been clear from any additional sightings for 10 minutes when the activity involves aircraft that have fuel constraints, or 30 minutes when the activity involves aircraft that are not typically fuel constrained. • After completion of the activity (*e.g.,* prior to maneuvering off station): —When practical (*e.g.,* when platforms are not constrained by fuel restrictions or mission-essential follow-on commitments), observe for marine mammals in the vicinity of where detonations occurred; if any injured or dead marine mammals are observed, follow established incident reporting procedures. —If additional platforms are supporting this activity (*e.g.,* providing range clearance), these assets will assist in the visual observation of the area where detonations occurred.

Procedural Mitigation for Explosive Medium-Caliber and Large-Caliber Projectiles

Procedural mitigation for Explosive Medium-Caliber and Large-Caliber Projectiles is described in Table 40 below.

TABLE 40—PROCEDURAL MITIGATION FOR EXPLOSIVE MEDIUM-CALIBER AND LARGE-CALIBER PROJECTILES

Procedural mitigation description
Stressor or Activity: • Gunnery activities using explosive medium-caliber and large-caliber projectiles: —Mitigation applies to activities using a surface target. Number of Lookouts and Observation Platform: • 1 Lookout on the vessel 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 37 for Weapons Firing Noise. • If additional platforms are participating in the activity, personnel positioned in those assets (*e.g.,* safety observers, evaluators) will support observing the mitigation zone for marine mammals while performing their regular duties. Mitigation Requirements: • Mitigation zones: —600 yd around the intended impact location for explosive medium-caliber projectiles. —1,000 yd around the intended impact location for explosive large-caliber projectiles. • Prior to the initial start of the activity (*e.g.,* when maneuvering on station): —Observe the mitigation zone for floating vegetation; if observed, relocate or delay the start until the mitigation zone is clear. —Observe the mitigation zone for marine mammals; if observed, relocate or delay the start of firing. • During the activity: —Observe the mitigation zone for marine mammals; if observed, cease firing. • Commencement/recommencement conditions after a marine mammal sighting before or during the activity: —The Navy will allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing firing) until one of the following conditions has been met: (1) The animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended impact location; (3) the mitigation zone has been clear from any additional sightings for 30 minutes for vessel-based firing; or (4) for activities using mobile targets, the intended impact location has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting. • After completion of the activity (*e.g.,* prior to maneuvering off station): —When practical (*e.g.,* when platforms are not constrained by fuel restrictions or mission-essential follow-on commitments), observe for marine mammals in the vicinity of where detonations occurred; if any injured or dead marine mammals are observed, follow established incident reporting procedures. —If additional platforms are supporting this activity (*e.g.,* providing range clearance), these assets will assist in the visual observation of the area where detonations occurred.

Procedural Mitigation for Explosive Missiles

Procedural mitigation for explosive missiles is described in Table 41 below.

TABLE 41—PROCEDURAL MITIGATION FOR EXPLOSIVE MISSILES

Procedural mitigation description
Stressor or Activity: • Aircraft-deployed explosive missiles: —Mitigation applies to activities using a surface target. Number of Lookouts and Observation Platform: • 1 Lookout positioned in an aircraft. • If additional platforms are participating in the activity, personnel positioned in those assets (*e.g.,* safety observers, evaluators) will support observing the mitigation zone for marine mammals while performing their regular duties. Mitigation Requirements: • Mitigation zone: —2,000 yd around the intended impact location. • Prior to the initial start of the activity (*e.g.,* during a fly-over of the mitigation zone): —Observe the mitigation zone for floating vegetation; if observed, relocate or delay the start until the mitigation zone is clear. —Observe the mitigation zone for marine mammals; if observed, relocate or delay the start of firing. • During the activity: —Observe the mitigation zone for marine mammals; if observed, cease firing. • Commencement/recommencement conditions after a marine mammal sighting before or during the activity: —The Navy will allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing firing) until one of the following conditions has been met: (1) The animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended impact location; or (3) the mitigation zone has been clear from any additional sightings for 10 minutes when the activity involves aircraft that have fuel constraints, or 30 minutes when the activity involves aircraft that are not typically fuel constrained. • After completion of the activity (*e.g.,* prior to maneuvering off station): —When practical (*e.g.,* when platforms are not constrained by fuel restrictions or mission-essential follow-on commitments), observe for marine mammals in the vicinity of where detonations occurred; if any injured or dead marine mammals are observed, follow established incident reporting procedures.

TABLE 41—PROCEDURAL MITIGATION FOR EXPLOSIVE MISSILES—Continued

Procedural mitigation description
—If additional platforms are supporting this activity (*e.g.,* providing range clearance), these assets will assist in the visual observation of the area where detonations occurred.

Procedural Mitigation for Explosive Bombs

Procedural mitigation for explosive bombs is described in Table 42 below.

TABLE 42—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. • If additional platforms are participating in the activity, personnel positioned in those assets (*e.g.,* safety observers, evaluators) will support observing the mitigation zone for marine mammals while performing their regular duties. Mitigation Requirements: • Mitigation zone: —2,500 yd around the intended target. • Prior to the initial start of the activity (*e.g.,* when arriving on station): —Observe the mitigation zone for floating vegetation; if observed, relocate or delay the start until the mitigation zone is clear. —Observe the mitigation zone for marine mammals; if observed, relocate or delay the start of bomb deployment. • During the activity (*e.g.,* during target approach): —Observe the mitigation zone for marine mammals; if observed, cease bomb deployment. • Commencement/recommencement conditions after a marine mammal sighting before or during the activity: —The Navy will allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing bomb deployment) until one of the following conditions has been met: (1) The animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended target; (3) the mitigation zone has been clear from any additional sightings for 10 minutes; or (4) for activities using mobile targets, the intended target has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting. • After completion of the activity (*e.g.,* prior to maneuvering off station): —When practical (*e.g.,* when platforms are not constrained by fuel restrictions or mission-essential follow-on commitments), observe for marine mammals in the vicinity of where detonations occurred; if any injured or dead marine mammals are observed, follow established incident reporting procedures. —If additional platforms are supporting this activity (*e.g.,* providing range clearance), these assets will assist in the visual observation of the area where detonations occurred.

Procedural Mitigation for Explosive Mine Countermeasure and Neutralization Activities

Procedural mitigation for explosive mine countermeasure and neutralization activities is described in Table 43 below.

TABLE 43—PROCEDURAL MITIGATION FOR EXPLOSIVE MINE COUNTERMEASURE AND NEUTRALIZATION ACTIVITIES

Procedural mitigation description
Stressor or Activity: • Explosive mine countermeasure and neutralization activities. Number of Lookouts and Observation Platform: • 1 Lookout positioned on a vessel or in an aircraft when implementing the smaller mitigation zone. • 2 Lookouts (one positioned in an aircraft and one on a small boat) when implementing the larger mitigation zone. • If additional platforms are participating in the activity, personnel positioned in those assets (*e.g.,* safety observers, evaluators) will support observing the mitigation zone for marine mammals while performing their regular duties. Mitigation Requirements: • Mitigation zones: —600 yd around the detonation site for activities using ≤5 lb net explosive weight. —2,100 yd around the detonation site for activities using >5–60 lb net explosive weight. • Prior to the initial start of the activity (*e.g.,* when maneuvering on station; typically, 10 minutes when the activity involves aircraft that have fuel constraints, or 30 minutes when the activity involves aircraft that are not typically fuel constrained): —Observe the mitigation zone for floating vegetation; if observed, relocate or delay the start until the mitigation zone is clear. —Observe the mitigation zone for marine mammals; if observed, relocate or delay the start of detonations. • During the activity:

TABLE 43—PROCEDURAL MITIGATION FOR EXPLOSIVE MINE COUNTERMEASURE AND NEUTRALIZATION ACTIVITIES—Continued

Procedural mitigation description
—Observe for marine mammals; if observed, cease detonations. • Commencement/recommencement conditions after a marine mammal sighting before or during the activity: —The Navy will allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing detonations) until one of the following conditions has been met: (1) The animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to detonation site; or (3) the mitigation zone has been clear from any additional sightings for 10 minutes when the activity involves aircraft that have fuel constraints, or 30 minutes when the activity involves aircraft that are not typically fuel constrained. • After completion of the activity (typically 10 minutes when the activity involves aircraft that have fuel constraints, or 30 minutes when the activity involves aircraft that are not typically fuel constrained): —Observe for marine mammals in the vicinity of where detonations occurred; if any injured or dead marine mammals are observed, follow established incident reporting procedures. —If additional platforms are supporting this activity (*e.g.,* providing range clearance), these assets will assist in the visual observation of the area where detonations occurred.

Procedural Mitigation for Explosive Mine Neutralization Activities lnvolving Navy Divers

Procedural mitigation for explosive mine neutralization activities involving Navy divers is described in Table 44 below.

TABLE 44—PROCEDURAL MITIGATION FOR EXPLOSIVE MINE NEUTRALIZATION ACTIVITIES INVOLVING NAVY DIVERS

Procedural mitigation description
Stressor or Activity: • Explosive mine neutralization activities involving Navy divers. Number of Lookouts and Observation Platform: • 2 Lookouts on two small boats with one Lookout each, one of which will be a Navy biologist. • All divers placing the charges on mines will support the Lookouts while performing their regular duties and will report applicable sightings to the lead Lookout, the supporting small boat, or the Range Safety Officer. • If additional platforms are participating in the activity, personnel positioned in those assets (*e.g.,* safety observers, evaluators) will support observing the mitigation zone for marine mammals while performing their regular duties. Mitigation Requirements: • Mitigation zone: —500 yd around the detonation site during activities using >0.5–2.5 lb net explosive weight. • Prior to the initial start of the activity (starting 30 minutes before the first planned detonation): —Observe the mitigation zone for floating vegetation; if observed, relocate or delay the start until the mitigation zone is clear. —Observe the mitigation zone for marine mammals; if observed, relocate or delay the start of detonations. —The Navy will ensure the area is clear of marine mammals for 30 minutes prior to commencing a detonation. —A Navy biologist will serve as the lead Lookout and will make the final determination that the mitigation zone is clear of any biological resource sightings prior to the commencement of a detonation. The Navy biologist will maintain radio communication with the unit conducting the event and the other Lookout. • During the activity: —Observe the mitigation zone for marine mammals; if observed, cease detonations. —To the maximum extent practicable depending on mission requirements, safety, and environmental conditions, boats will position themselves near the midpoint 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, 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. —The Navy will use only positively controlled charges (*i.e.,* no time-delay fuses). —The Navy will use the smallest practicable charge size for each activity. —Activities will be conducted in Beaufort sea state number 2 conditions or better and will not be conducted in low visibility conditions. • Commencement/recommencement conditions after a marine mammal sighting before or during the activity: —The Navy will allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing detonations) until one of the following conditions has been met: (1) The animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the detonation site; or (3) the mitigation zone has been clear from any additional sightings for 30 minutes. • After each detonation and the completion of an activity (for 30 minutes): —Observe for marine mammals in the vicinity of where detonations occurred and immediately downstream of the detonation location; if any injured or dead marine mammals are observed, follow established incident reporting procedures. —If additional platforms are supporting this activity (*e.g.,* providing range clearance), these assets will assist in the visual observation of the area where detonations occurred. • Additional requirements: —At the Hood Canal Explosive Ordnance Disposal Range and Crescent Harbor Explosive Ordnance Disposal Range, naval units will obtain permission from the appropriate designated Command authority prior to conducting explosive mine neutralization activities involving the use of Navy divers.

TABLE 44—PROCEDURAL MITIGATION FOR EXPLOSIVE MINE NEUTRALIZATION ACTIVITIES INVOLVING NAVY DIVERS—Continued

Procedural mitigation description
—At the Hood Canal Explosive Ordnance Disposal Range, during February, March, and April (the juvenile migration period for Hood Canal Summer Run Chum), the Navy will not use explosives in bin E3 (>0.5–2.5 lb net explosive weight), and will instead use explosives in bin E0 (<0.1 lb net explosive weight). —At the Hood Canal Explosive Ordnance Disposal Range, during August, September, and October (the adult migration period for Hood Canal summer-run chum and Puget Sound Chinook), the Navy will avoid the use of explosives in bin E3 (>0.5–2.5 lb net explosive weight), and will instead use explosive bin E0 (<0.1 lb net explosive weight) to the maximum extent practicable unless necessitated by mission requirements. —At the Crescent Harbor Explosive Ordnance Disposal Range, the Navy will conduct explosive activities at least 1,000 m from the closest point of land to avoid or reduce impacts on fish (*e.g.,* bull trout) in nearshore habitat areas.

Procedural Mitigation for Physical Disturbance and Strike Stressors

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

Procedural Mitigation for Vessel Movement

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

TABLE 45—PROCEDURAL MITIGATION FOR VESSEL MOVEMENT

Procedural mitigation description
Stressor or Activity: • Vessel movement: —The mitigation will not be applied if: (1) The vessel's safety is threatened, (2) the vessel is restricted in its ability to maneuver (*e.g.,* during launching and recovery of aircraft or landing craft, during towing activities, when mooring, during Transit Protection Program exercises or other events involving escort vessels), (3) the vessel is operated autonomously, or (4) when impractical based on mission requirements (*e.g.,* during test body retrieval by range craft). Number of Lookouts and Observation Platform: • 1 Lookout on the vessel that is underway. Mitigation Requirements: • Mitigation zones: —500 yd (for surface ships other than small boats) around whales. —200 yd (for surface ships other than small boats) around all marine mammals other than whales (except bow-riding dolphins and pinnipeds hauled out on man-made navigational structures, port structures, and vessels). —100 yd (for small boats, such as range craft) around marine mammals (except bow-riding dolphins and pinnipeds hauled out on man-made navigational structures, port structures, and vessels). • During the activity: —When underway, observe the mitigation zone for marine mammals; if observed, maneuver to maintain distance. • Additional requirements: —Prior to Small Boat Attack exercises at Naval Station Everett, Naval Base Kitsap Bangor, or Naval Base Kitsap Bremerton, Navy event planners will coordinate with Navy biologists during the event planning process. Navy biologists will work with NMFS to determine the likelihood of marine mammal presence in the planned training location. Navy biologists will notify event planners of the likelihood of species presence as they plan specific details of the event (*e.g.,* timing, location, duration). The Navy will provide additional environmental awareness training to event participants. The training will alert participating ship and aircraft crews to the possible presence of marine mammals in the training location. Lookouts will use the information to assist their visual observation of applicable mitigation zones and to aid in the implementation of procedural mitigation. —If a marine mammal vessel strike occurs, the Navy will follow the established incident reporting procedures.

Procedural Mitigation for Towed In-Water Devices

TABLE 46—PROCEDURAL MITIGATION FOR TOWED IN-WATER DEVICES

Procedural mitigation description
Stressor or Activity: • Towed in-water devices: —Mitigation applies to devices towed from a manned surface platform or manned aircraft, or when a manned support craft is already participating in an activity involving in-water devices being towed by unmanned platforms. —The mitigation will not be applied if the safety of the towing platform or in-water device is threatened. Number of Lookouts and Observation Platform: • 1 Lookout positioned on the towing platform or support craft. Mitigation Requirements: • Mitigation zones: —250 yd (for in-water devices towed by aircraft or surface ships other than small boats) around marine mammals (except bow-riding dolphins and pinnipeds hauled out on man-made navigational structures, port structures, and vessels).

TABLE 46—PROCEDURAL MITIGATION FOR TOWED IN-WATER DEVICES—Continued

Procedural mitigation description
—100 yd (for in-water devices towed by small boats, such as range craft) around marine mammals (except bow-riding dolphins and pinnipeds hauled out on man-made navigational structures, port structures, and vessels). • During the activity (*i.e.,* when towing an in-water device): —Observe the mitigation zone for marine mammals; if observed, maneuver to maintain distance.

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

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

Procedural mitigation description
Stressor or Activity: • Gunnery activities using small-, medium-, and large-caliber non-explosive practice munitions: —Mitigation applies to activities using a surface target. Number of Lookouts and Observation Platform: • 1 Lookout positioned on the platform conducting the activity. • Depending on the activity, the Lookout could be the same as the one described in Table 37 for Weapons Firing Noise. Mitigation Requirements: • Mitigation zone: —200 yd around the intended impact location. • Prior to the initial start of the activity (*e.g.,* when maneuvering on station): —Observe the mitigation zone for floating vegetation; if observed, relocate or delay the start until the mitigation zone is clear. —Observe the mitigation zone for marine mammals; if observed, relocate or delay the start of firing. • During the activity: —Observe the mitigation zone for marine mammals; if observed, cease firing. • Commencement/recommencement conditions after a marine mammal sighting before or during the activity: —The Navy will allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing firing) until one of the following conditions has been met: (1) The animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended impact location; (3) the mitigation zone has been clear from any additional sightings for 10 minutes for aircraft-based firing or 30 minutes 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

TABLE 48—PROCEDURAL MITIGATION FOR NON-EXPLOSIVE MISSILES

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

Procedural Mitigation for Non-Explosive Bombs and Mine Shapes

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

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

Mitigation Areas

In addition to procedural mitigation, the Navy would implement mitigation measures within mitigation areas to avoid or minimize potential impacts on marine mammals. A full technical analysis (for which the methods were summarized above) of the mitigation areas that the Navy considered for marine mammals is provided in Appendix K (*Geographic Mitigation Assessment*) of the 2019 NWTT DSEIS/OEIS. The Navy took into account public comments received on the 2019 NWTT DSEIS/OEIS, the best available science, and the practicability of implementing additional mitigation measures and has enhanced its mitigation areas and mitigation measures beyond those that were included in the 2015–2020 regulations to further reduce impacts to marine mammals.

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

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

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

Mitigation area description
Stressor or Activity: • Sonar. • Explosives. • Physical disturbance and strikes. Mitigation Requirements: • Marine Species Coastal Mitigation Area (year-round): —Within 50 nmi from shore in the Marine Species Coastal Mitigation Area, the Navy will not conduct: (1) Explosive training activities, (2) explosive testing activities (with the exception of explosive Mine Countermeasure and Neutralization Testing activities), and (3) non-explosive missile training activities. Should national security present a requirement to conduct these activities in the mitigation area, naval units will obtain permission from the appropriate designated Command authority prior to commencement of the activity. The Navy will provide NMFS with advance notification and include information about the event in its annual activity reports to NMFS. —Within 20 nmi from shore in the Marine Species Coastal Mitigation Area, the Navy will not conduct non-explosive large-caliber gunnery training activities and non-explosive bombing training activities. Should national security present a requirement to conduct these activities in the mitigation area, naval units will obtain permission from the appropriate designated Command authority prior to commencement of the activity. The Navy will provide NMFS with advance notification and include information about the event in its annual activity reports to NMFS.

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

Mitigation area description
—Within 12 nmi from shore in the Marine Species Coastal Mitigation Area, the Navy will not conduct: (1) Non-explosive small- and medium-caliber gunnery training activities, (2) non-explosive torpedo training activities, and (3) Anti-Submarine Warfare Tracking Exercise—Helicopter, Maritime Patrol Aircraft, Ship, or Submarine training activities. Should national security present a requirement to conduct these activities in the mitigation area, naval units will obtain permission from the appropriate designated Command authority prior to commencement of the activity. The Navy will provide NMFS with advance notification and include information about the event in its annual activity reports to NMFS.
• Olympic Coast National Marine Sanctuary Mitigation Area (year-round):
—Within the Olympic Coast National Marine Sanctuary Mitigation Area, the Navy will not conduct more than 32 hours of MF1 mid-frequency active sonar during training annually and will not conduct non-explosive bombing training activities. Should national security present a requirement to conduct more than 32 hours of MF1 mid-frequency active sonar during training annually or conduct non-explosive bombing training activities in the mitigation area, naval units will obtain permission from the appropriate designated Command authority prior to commencement of the activity. The Navy will provide NMFS with advance notification and include information about the event in its annual activity reports to NMFS.
—Within the Olympic Coast National Marine Sanctuary Mitigation Area, the Navy will not conduct more than 33 hours of MF1 mid-frequency active sonar during testing annually (except within the portion of the mitigation area that overlaps the Quinault Range Site) and will not conduct explosive Mine Countermeasure and Neutralization Testing activities. Should national security present a requirement for the Navy to conduct more than 33 hours of MF1 mid-frequency active sonar during testing annually (except within the portion of the mitigation area that overlaps the Quinault Range Site) or conduct explosive Mine Countermeasure and Neutralization Testing activities in the mitigation area, naval units will obtain permission from the appropriate designated Command authority prior to commencement of the activity. The Navy will provide NMFS with advance notification and include information about the event in its annual activity reports to NMFS.
• Stonewall and Heceta Bank Humpback Whale Mitigation Area (May 1–November 30):
—Within the Stonewall and Heceta Bank Humpback Whale Mitigation Area, the Navy will not use MF1 mid-frequency active sonar or explosives during training and testing from May 1 to November 30. Should national security present a requirement to use MF1 mid-frequency active sonar or explosives during training and testing from May 1 to November 30, naval units will obtain permission from the appropriate designated Command authority prior to commencement of the activity. The Navy will provide NMFS with advance notification and include information about the event in its annual activity reports to NMFS.
• Point St. George Humpback Whale Mitigation Area (July 1–November 30):
—Within the Point St. George Humpback Whale Mitigation Area, the Navy will not use MF1 mid-frequency active sonar or explosives during training and testing from July 1 to November 30. Should national security present a requirement to use MF1 mid-frequency active sonar or explosives during training and testing from July 1 to November 30, naval units will obtain permission from the appropriate designated Command authority prior to commencement of the activity. The Navy will provide NMFS with advance notification and include information about the event in its annual activity reports to NMFS.
• Puget Sound and Strait of Juan de Fuca Mitigation Area (year-round):
—Within the Puget Sound and Strait of Juan de Fuca Mitigation Area, the Navy will require units to obtain approval from the appropriate designated Command authority prior to: (1) The use of hull-mounted mid-frequency active sonar during training while underway, and (2) conducting ship and submarine active sonar pierside maintenance or testing.
—Within the Puget Sound and Strait of Juan de Fuca Mitigation Area for Civilian Port Defense—Homeland Security Anti-Terrorism/Force Protection Exercises, Navy event planners will coordinate with Navy biologists during the event planning process. Navy biologists will work with NMFS to determine the likelihood of gray whale and Southern Resident Killer Whale presence in the planned training location. Navy biologists will notify event planners of the likelihood of species presence as they plan specific details of the event (*e.g.,* timing, location, duration). The Navy will ensure environmental awareness of event participants. Environmental awareness will help alert participating ship and aircraft crews to the possible presence of marine mammals in the training location, such as gray whales and Southern Resident Killer Whales.
• Northern Puget Sound Gray Whale Mitigation Area (March 1–May 31):
—Within the Northern Puget Sound Gray Whale Mitigation Area, the Navy will not conduct Civilian Port Defense—Homeland Security Anti-Terrorism/Force Protection Exercises from March 1 to May 31. Should national security present a requirement to conduct Civilian Port Defense—Homeland Security Anti-Terrorism/Force Protection Exercises from March 1 to May 31, naval units will obtain permission from the appropriate designated Command authority prior to commencement of the activity. The Navy will provide NMFS with advance notification and include information about the event in its annual activity reports to NMFS.

BILLING CODE 3510–22–P

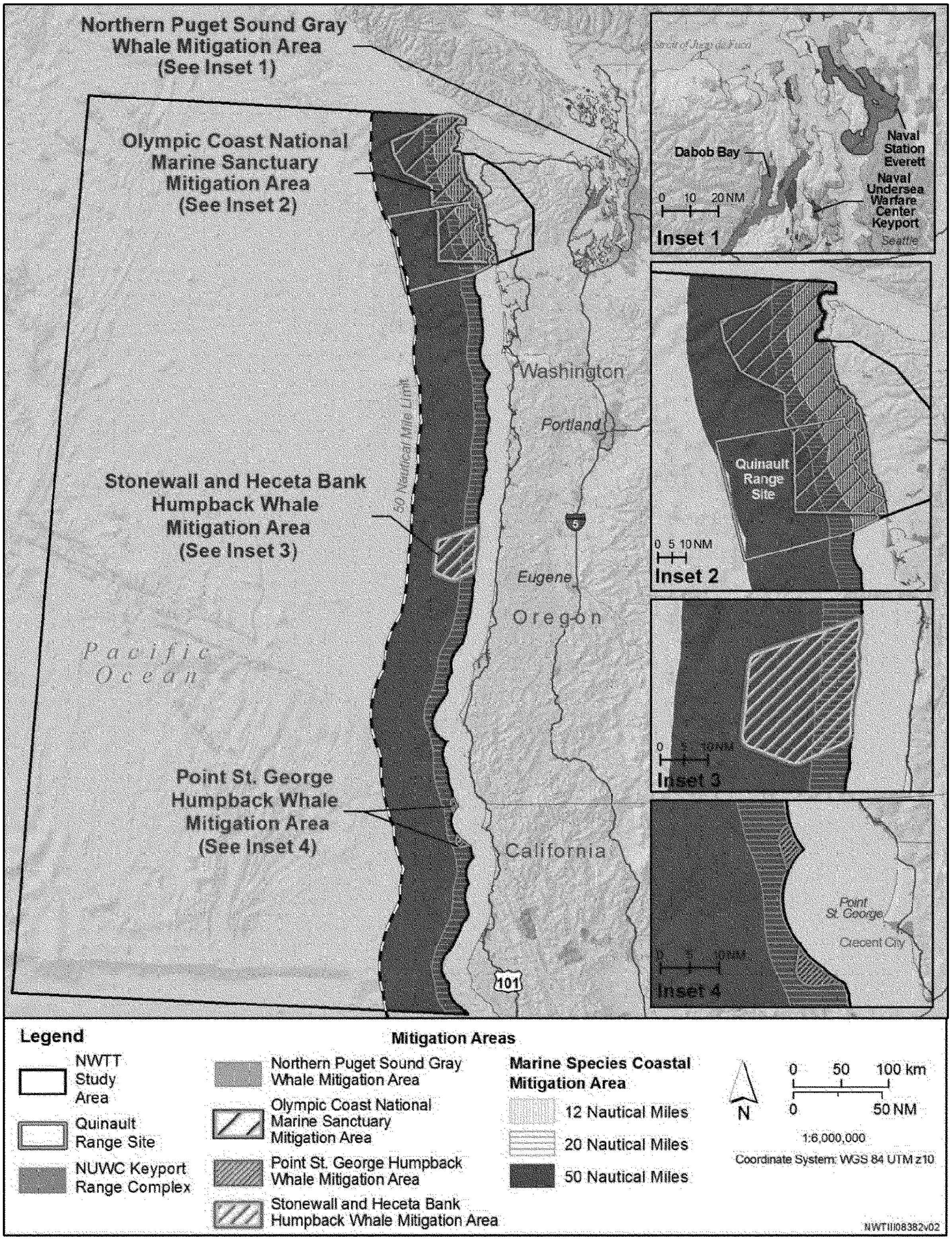

Figure 2 -- Geographic Mitigation Areas for Marine Mammals in the NWTT Study Area. (a color version of this map is presented as Figure 11-1 in the Navy's Application at *https://www.fisheries.noaa.gov/action/incidental-take-authorization-us-navy-northwest-training-and-testing-nwtt-2020*).

BILLING CODE 3510–22–C

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 but several of which are new since implementation of the current 2015 to 2020 regulations—and considered a broad range of other measures (*i.e.,* the measures considered but eliminated in the 2019 NWTT DSEIS/OEIS, which reflect many of the comments that have arisen via NMFS or public input in past years) in the context of ensuring that NMFS prescribes the means of effecting the least practicable adverse impact on the affected marine mammal species and their habitat. Our evaluation of potential measures included consideration of the following factors in relation to one another: The manner in which, and the degree to which, the successful implementation of the mitigation measures is expected to reduce the likelihood and/or magnitude of adverse impacts to marine mammal species and their habitat; the proven or likely efficacy of the measures; and the practicability of the measures for applicant implementation, including consideration of personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity.

Based on our evaluation of the Navy's proposed measures, as well as other measures considered by the Navy and NMFS, NMFS has preliminarily determined that these proposed mitigation measures are appropriate means of effecting the least practicable adverse impact on marine mammal species and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and considering specifically personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity. Additionally, an adaptive management component helps further ensure that mitigation is regularly assessed and provides a mechanism to improve the mitigation, based on the factors above, through modification as appropriate.

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

Proposed Monitoring

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

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

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

As agreed upon between the Navy and NMFS, the monitoring measures presented here, as well as the mitigation measures described above, focus on the protection and management of potentially affected marine mammals. A well-designed monitoring program can provide important feedback for validating assumptions made in analyses and allow for adaptive management of marine resources. Monitoring is required under the MMPA, and details of the monitoring program for the specified activities have been developed through coordination between NMFS and the Navy through the regulatory process for previous Navy at-sea training and testing activities.

Integrated Comprehensive Monitoring Program

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

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

likely exposure of marine mammals and ESA-listed species to any of the potential stressors associated with the action (*e.g.,* sound, explosive detonation, or expended materials), through better understanding of one or more of the following: (1) The nature of the action and its surrounding environment (*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 ESA-listed marine species with the action (in whole or part), and (4) the likely biological or behavioral context of exposure to the stressor for the marine mammal and ESA-listed marine species (*e.g.,* age class of exposed animals or known pupping, calving, or feeding areas);

- An increase in the 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 the 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 impacts on annual rates of recruitment or survival);
- An increase in the understanding of the effectiveness of mitigation and monitoring measures;
- A better understanding and record of the manner in which the Navy complies with the incidental take regulations and LOAs and the ESA Incidental Take Statement;
- An increase in the probability of detecting marine mammals (through improved technology or methods), both specifically within the mitigation zone (thus allowing for more effective implementation of the mitigation) and in general, to better achieve the above goals; and
- Ensuring that adverse impact of activities remains at the least practicable level.

Strategic Planning Process for Marine Species Monitoring

The Navy also developed the Strategic Planning Process for Marine Species Monitoring, which serves to guide the investment of resources to most efficiently address ICMP objectives and intermediate scientific objectives developed through this process. The Strategic Planning Process 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; 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. More information on the Strategic Planning Process for Marine Species Monitoring including results, reports, and publications, is also available online (*http://www.navymarinespeciesmonitoring.us/*).

Past and Current Monitoring in the NWTT Study Area

The monitoring program has undergone significant changes since the first rule was issued for the NWTT Study Area in 2010, which highlights the monitoring program's evolution through the process of adaptive management. The monitoring program developed for the first cycle of environmental compliance documents (*e.g.,* U.S. Department of the Navy, 2008a, 2008b) utilized effort-based compliance metrics that were somewhat limiting. Through adaptive management discussions, the Navy designed and conducted monitoring studies according to scientific objectives and eliminated specific effort requirements.

Progress has also been made on the conceptual framework categories from the Scientific Advisory Group for Navy Marine Species Monitoring (U.S. Department of the Navy, 2011), ranging from occurrence of animals, to their exposure, response, and population consequences. The Navy continues to manage the Atlantic and Pacific program as a whole, with monitoring in each range complex taking a slightly different but complementary approach. The Navy has continued to use the approach of layering multiple simultaneous components in many of the range complexes to leverage an increase in return of the progress toward answering scientific monitoring questions. This includes in the NWTT Study Area, for example, (a) satellite tagging of blue whales, fin whales, humpback whales, and Southern Resident killer whales; (b) analysis of existing passive acoustic monitoring datasets; and (c) line-transect aerial surveys for marine mammals in Puget Sound, Washington.

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

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

NMFS and the Navy also consider data collected during procedural mitigations as monitoring. Data are collected by shipboard personnel on hours spent training, hours of observation, hours of sonar, and marine mammals observed within the mitigation zones when mitigations are implemented. These data are provided to NMFS in both classified and unclassified annual exercise reports, which would continue under this proposed rule.

NMFS has received multiple years' worth of annual exercise and monitoring reports addressing active sonar use and explosive detonations within the NWTT 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 NWTT 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 *https://www.navymarinespeciesmonitoring.us/reporting/.*

The Navy's marine species monitoring program typically supports several monitoring projects in the NWTT Study Area at any given time. Additional details on the scientific objectives for each project can be found at *https://www.navymarinespeciesmonitoring.us/regions/pacific/current-projects/.* Projects can be either major multi-year efforts, or one to two-year special studies. The emphasis on monitoring in the Pacific Northwest is directed towards collecting and analyzing tagging data related to the occurrence of blue whales, fin whales, humpback whales, and Southern Resident killer whales. In 2017, researchers deployed 28 tags on blue whales and one tag on a fin whale off southern and central California (Mate *et al.,* 2017). Detailed analyses for the 2017 tagging effort are ongoing and will be available later in a final report and posted at *https://www.navymarinespeciesmonitoring.us/.* Humpback whales have been tagged with satellite tags, and biopsy samples have been collected (Mate *et al.,* 2017). Location information on Southern Resident killer whales was provided via satellite tag data and acoustic detections (Hanson *et al.,* 2018). Also, distribution of Chinook salmon (a key prey species of Southern Resident killer whales) in coastal waters from Alaska to Northern California was studied (Shelton *et al.,* in review). Future monitoring efforts in the NWTT Study Area are anticipated to continue along the same objectives: Determining the species and populations of marine mammals present and potentially exposed to Navy training and testing activities in the NWTT Study Area, through tagging, passive acoustic monitoring, refined modeling, photo identification, biopsies, and visual monitoring.

Adaptive Management

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

The reporting requirements associated with this rule are designed to provide NMFS with monitoring data from the previous year to allow NMFS to consider whether any changes to existing mitigation and monitoring requirements are appropriate. The use of adaptive management allows NMFS to consider new information from different sources to determine (with input from the Navy regarding practicability) on an annual or biennial basis if mitigation or monitoring measures should be modified (including additions or deletions). Mitigation measures could be modified if new data suggests that such modifications would have a reasonable likelihood of more effectively accomplishing the goals of the mitigation and monitoring and if the measures are practicable. If the modifications to the mitigation, monitoring, or reporting measures are substantial, NMFS would publish a notice of the planned LOAs in the **Federal Register** and solicit public comment.

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

Proposed Reporting

In order to issue incidental take authorization for an activity, section 101(a)(5)(A) of the MMPA states that NMFS must set forth requirements pertaining to the monitoring and reporting of such taking. Effective reporting is critical both to compliance as well as ensuring that the most value is obtained from the required monitoring. Reports from individual monitoring events, results of analyses, publications, and periodic progress reports for specific monitoring projects will be posted to the Navy's Marine Species Monitoring web portal: *http://www.navymarinespeciesmonitoring.us.*

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

Notification of Injured, Live Stranded or Dead Marine Mammals

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

Annual NWTT Monitoring Report

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

As an alternative, the Navy may submit a Pacific-Range Complex annual

Monitoring Plan report to fulfill this requirement. Such a report describes progress of knowledge made with respect to monitoring study questions across multiple Navy ranges associated with the ICMP. Similar study questions would be treated together so that progress on each topic is summarized across multiple Navy ranges. The report need not include analyses and content that does not provide direct assessment of cumulative progress on the monitoring study question. This would continue to allow the Navy to provide a cohesive monitoring report covering multiple ranges (as per ICMP goals), rather than entirely separate reports for the NWTT, GOA, MITT, and HSTT Study Areas.

Annual NWTT Training Exercise Report and Testing Activity Reports

Each year, the Navy would submit one preliminary report (Quick Look Report) to NMFS detailing the status of applicable sound sources within 21 days after the anniversary of the date of issuance of the LOA. Each year, the Navy would also submit a detailed report (NWTT Annual Training Exercise Report and Testing Activity Report) to NMFS within three months after the one-year anniversary of the date of issuance of the LOA. NMFS will submit comments or questions on the report, if any, within one month of receipt. The report will be considered final after the Navy has addressed NMFS' comments, or one month after submittal of the draft if NMFS does not provide comments on the draft report. The annual report would contain a summary of all sound sources used (total hours or quantity (per the LOA) of each bin of sonar or other non-impulsive source; total annual number of each type of explosive exercises; and total annual expended/detonated rounds (missiles, bombs, sonobuoys, *etc.*) for each explosive bin). The annual report will also contain cumulative sonar and explosive use quantity from previous years' reports through the current year. Additionally, if there were any changes to the sound source allowance in the reporting year, or cumulatively, the report would include a discussion of why the change was made and include analysis to support how the change did or did not affect the analysis in the NWTT EIS/OEIS and MMPA final rule. The annual report would also include the details regarding specific requirements associated with specific mitigation areas. The analysis in the detailed report would be based on the accumulation of data from the current year's report and data collected from previous annual reports. The final annual/close-out report at the conclusion of the authorization period (year seven) would also serve as the comprehensive close-out report and include both the final year annual use compared to annual authorization as well as a cumulative seven-year annual use compared to seven-year authorization. Information included in the annual reports may be used to inform future adaptive management of activities within the NWTT Study Area.

The Annual NWTT Training Exercise Report and Testing Activity Navy report (classified or unclassified versions) could be consolidated with other exercise reports from other range complexes in the Pacific Ocean for a single Pacific Exercise Report, if desired.

Other Reporting and Coordination

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

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

Preliminary Analysis and Negligible Impact Determination

General Negligible Impact Analysis

Introduction

NMFS has defined negligible impact as an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival (50 CFR 216.103). A negligible impact finding is based on the lack of likely adverse effects on annual rates of recruitment or survival (*i.e.,* population-level effects). An estimate of the number of takes alone is not enough information on which to base an impact determination. For Level A harassment or Level B harassment (as presented in Tables 32 and 33), in addition to considering estimates of the number of marine mammals that might be taken NMFS considers other factors, such as the likely nature of any responses (*e.g.,* intensity, duration) and the context of any responses (*e.g.,* critical reproductive time or location, migration), as well as effects on habitat and the likely effectiveness of the mitigation. We also assess the number, intensity, and context of estimated takes by evaluating this information relative to population status. Consistent with the 1989 preamble for NMFS' implementing regulations (54 FR 40338; September 29, 1989), the impacts from other past and ongoing anthropogenic activities are incorporated into this analysis via their impacts on the environmental baseline (*e.g.,* as reflected in the regulatory status of the species, population size and growth rate where known, other ongoing sources of human-caused mortality, and ambient noise levels).

In the *Estimated Take of Marine Mammals* section, we identified the subset of potential effects that would be expected to rise to the level of takes both annually and over the seven-year period covered by this proposed rule, and then identified the maximum number of takes we believe could occur (mortality) or are reasonably expected to occur (harassment) based on the methods described. The impact that any given take will have is dependent on many case-specific factors that need to be considered in the negligible impact analysis (*e.g.,* the context of behavioral exposures such as duration or intensity of a disturbance, the health of impacted animals, the status of a species that incurs fitness-level impacts to individuals, *etc.*). For this proposed rule we evaluated the likely impacts of the enumerated maximum number of harassment takes that are proposed for authorization and reasonably expected to occur, in the context of the specific circumstances surrounding these predicted takes. We also include a specific assessment of serious injury or mortality (hereafter referred to as M/SI) takes that could occur, as well as consideration of the traits and statuses of the affected species and stocks. Last, we collectively evaluated this information, as well as other more taxa-specific information and mitigation measure effectiveness, in group-specific assessments that support our negligible impact conclusions for each stock or species. Because all of the Navy's specified activities would occur within the ranges of the marine mammal stocks identified in the rule, all negligible impact analyses and determinations are at the stock level (*i.e.,* additional species-level determinations are not needed).

Harassment

The Specified Activities reflect representative levels of training and testing activities. The *Description of the Specified Activity* section describes annual activities. There may be some flexibility in the exact number of hours, items, or detonations that may vary from year to year, but take totals would not exceed the maximum annual totals and seven-year totals indicated in Tables 32 and 33. We base our analysis and negligible impact determination on the maximum number of takes that would be reasonably expected to occur annually and are proposed to be authorized, although, as stated before, the number of takes are only a part of the analysis, which includes extensive qualitative consideration of other contextual factors that influence the degree of impact of the takes on the affected individuals. To avoid repetition, we provide some general analysis immediately below that applies to all the species listed in Tables 32 and 33, 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 stocks), or groups of species (and the associated stocks) where relevant similarities exist, to provide more specific information related to the anticipated effects on individuals of a specific stock or where there is information about the status or structure of any species that would lead to a differing assessment of the effects on the species or stock. Organizing our analysis by grouping species or stocks that share common traits or that will respond similarly to effects of the Navy's activities and then providing species- or stock-specific information allows us to avoid duplication while assuring that we have analyzed the effects of the specified activities on each affected species or stock.

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

Generally speaking, the Navy and NMFS anticipate more severe effects from takes resulting from exposure to higher received levels (though this is in no way a strictly linear relationship for behavioral effects throughout species, individuals, or circumstances) and less severe effects from takes resulting from exposure to lower received levels. However, there is also growing evidence of the importance of distance in predicting marine mammal behavioral response to sound—*i.e.,* sounds of a similar level emanating from a more distant source have been shown to be less likely to evoke a response of equal magnitude (DeRuiter 2012). The estimated number of Level A harassment and Level B harassment takes does not equate to the number of individual animals the Navy expects to harass (which is lower), but rather to the instances of take (*i.e.,* exposures above the Level A harassment and Level B harassment threshold) that are anticipated to occur over the seven-year period. These instances may represent either brief exposures (seconds or minutes) or, in some cases, longer durations of exposure within a day. Some individuals may experience multiple instances of take (meaning over multiple days) over the course of the year, which means that the number of individuals taken is smaller than the total estimated takes. Generally speaking, the higher the number of takes as compared to the population abundance, the more repeated takes of individuals are likely, and the higher the actual percentage of individuals in the population that are likely taken at least once in a year. We look at this comparative metric to give us a relative sense of where a larger portion of a species is being taken by Navy activities, where there is a higher likelihood that the same individuals are being taken across multiple days, and where that number of days might be higher or more likely sequential. Where the number of instances of take is less than 100 percent of the abundance and there is no information to specifically suggest that a small subset of animals is being repeatedly taken over a high number of sequential days, the overall magnitude is generally considered low, as it could on one extreme mean that every take represents a separate individual in the population being taken on one day (a very minimal impact) or, more likely, that some smaller number of individuals are taken on one day annually and some are taken on a few not likely sequential days annually, and of course some are not taken at all.

In the ocean, the use of sonar and other active acoustic sources is often transient and is unlikely to repeatedly expose the same individual animals within a short period, for example within one specific exercise. However, for some individuals of some species repeated exposures across different activities could occur over the year, especially where events occur in generally the same area with more resident species. In short, for some species we expect that the total anticipated takes represent exposures of a smaller number of individuals of which some would be exposed multiple times, but based on the nature of the Navy activities and the movement patterns of marine mammals, it is unlikely that individuals from most stocks would be taken over more than a few sequential days. This means that even where repeated takes of individuals are likely to occur, they are more likely to result from non-sequential exposures from different activities, and, even if sequential, individual animals are not predicted to be taken for more than several days in a row, at most. As described elsewhere, the nature of the majority of the exposures would be expected to be of a less severe nature and based on the numbers it is likely that any individual exposed multiple times is still only taken on a small percentage of the days of the year. The greater likelihood is that not every individual is taken, or perhaps a smaller subset is taken with a slightly higher average and larger variability of highs and lows, but still with no reason to think that any individuals would be taken a significant portion of the days of the year, much less that many of the days of disturbance would be sequential.

Physiological Stress Response

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

Behavioral Response

The estimates calculated using the behavioral response function do not differentiate between the different types of behavioral responses that rise to the level of Level B harassments. As described in the Navy's application, the Navy identified (with NMFS' input) the types of behaviors that would be considered a take (moderate behavioral responses as characterized in Southall *et al.* (2007) (*e.g.,* altered migration paths or dive profiles, interrupted nursing, breeding or feeding, or avoidance) that also would be expected to continue for the duration of an exposure). The Navy then compiled the available data indicating at what received levels and distances those responses have occurred, and used the indicated literature to build biphasic behavioral response curves that are used to predict how many instances of Level B behavioral harassment occur in a day. Take estimates alone do not provide information regarding the potential fitness or other biological consequences of the reactions on the affected individuals. We therefore consider the available activity-specific, environmental, and species-specific information to determine the likely nature of the modeled behavioral responses and the potential fitness consequences for affected individuals.

Use of sonar and other transducers would typically be transient and temporary. The majority of acoustic effects to individual animals from sonar and other active sound sources during training and testing activities would be primarily from ASW events. Unlike other Navy training and testing Study Areas, no major training exercises (MTEs) are proposed in the NWTT Study Area. In the range of potential behavioral effects that might expect to be part of a response that qualifies as an instance of Level B behavioral harassment (which by nature of the way it is modeled/counted, occurs within one day), the less severe end might include exposure to comparatively lower levels of a sound, at a detectably greater distance from the animal, for a few or several minutes. A less severe exposure of this nature could result in a behavioral response such as avoiding an area that an animal would otherwise have chosen to move through or feed in for some amount of time or breaking off one or a few feeding bouts. More severe effects could occur when the animal gets close enough to the source to receive a comparatively higher level of sound, is exposed continuously to one source for a longer time, or is exposed intermittently to different sources throughout a day. Such effects might result in an animal having a more severe flight response and leaving a larger area for a day or more or potentially losing feeding opportunities for a day. However, such severe behavioral effects are expected to occur infrequently.

To help assess this, for sonar (LFAS/MFAS/HFAS) used in the NWTT Study Area, the Navy provided information estimating the percentage of animals that may be taken by Level B harassment under each behavioral response function that would occur within 6-dB increments (percentages discussed below in the *Group and Species-Specific Analyses* section). As mentioned above, all else being equal, an animal's exposure to a higher received level is more likely to result in a behavioral response that is more likely to lead to adverse effects, which could more likely accumulate to impacts on reproductive success or survivorship of the animal, but other contextual factors (such as distance) are also important. The majority of Level B harassment takes are expected to be in the form of milder responses (*i.e.,* lower-level exposures that still rise to the level of take, but would likely be less severe in the range of responses that qualify as take) of a generally shorter duration. We anticipate more severe effects from takes when animals are exposed to higher received levels of sound or at closer proximity to the source. Because species belonging to taxa that share common characteristics are likely to respond and be affected in similar ways, these discussions are presented within each species group below in the *Group and Species-Specific Analyses* section. As noted previously in this proposed rule, behavioral response is likely highly variable between species, individuals within a species, and context of the exposure. Specifically, given a range of behavioral responses that may be classified as Level B harassment, to the degree that higher received levels of sound are expected to result in more severe behavioral responses, only a smaller percentage of the anticipated Level B harassment from Navy activities might necessarily be expected to potentially result in more severe responses (see the *Group and Species-Specific Analyses* section below for more detailed information). To fully understand the likely impacts of the predicted/proposed authorized take on an individual (*i.e.,* what is the likelihood or degree of fitness impacts), one must look closely at the available contextual information, such as the duration of likely exposures and the likely severity of the exposures (*e.g.,* whether they will occur for a longer duration over sequential days or the comparative sound level that will be received). Ellison *et al.* (2012) and Moore and Barlow (2013), among others emphasize the importance of context (*e.g.,* behavioral state of the animals, distance from the sound source, *etc.*) in evaluating behavioral responses of marine mammals to acoustic sources.

Diel Cycle

Many animals perform vital functions, such as feeding, resting, traveling, and socializing on a diel cycle (24-hour cycle). Behavioral reactions to noise exposure, when taking place in a biologically important context, such as disruption of critical life functions, displacement, or avoidance of important habitat, are more likely to be significant if they last more than one diel cycle or recur on subsequent days (Southall *et al.,* 2007). Henderson *et al.* (2016) found that ongoing smaller scale events had little to no impact on foraging dives for Blainville's beaked whale, while multi-day training events may decrease foraging behavior for Blainville's beaked whale (Manzano-Roth *et al.,* 2016). Consequently, a behavioral response lasting less than one day and not recurring on subsequent days is not considered severe unless it could directly affect reproduction or survival (Southall *et al.,* 2007). Note that there is a difference between multiple-day substantive behavioral reactions and multiple-day anthropogenic activities. For example, just because an at-sea exercise lasts for multiple days does not necessarily mean that individual animals are either exposed to those exercises for multiple days or, further, exposed in a manner resulting in a sustained multiple day substantive behavioral response. Large multi-day Navy exercises such as ASW activities, typically include vessels that are continuously moving at speeds typically 10–15 kn, or higher, and likely cover large areas that are relatively far from shore (typically more than 3 nmi from shore) and in waters greater than 600 ft deep. Additionally marine mammals are moving as well, which would make it unlikely that the same animal could remain in the immediate vicinity of the ship for the entire duration of the exercise. Further, the Navy does not necessarily operate active sonar the entire time during an exercise. While it is certainly possible that these sorts of exercises could overlap with individual marine mammals multiple days in a row at levels above those anticipated to result in a take, because of the factors mentioned above, it is considered unlikely for the majority of takes. However, it is also worth noting that the Navy conducts many different types of noise-producing activities over the course of the year and it is likely that some marine mammals will be exposed to more than one activity 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 (*Navy Activity Descriptions*) of the 2019 NWTT DSEIS/OEIS. Sonar used during ASW would impart the greatest amount of acoustic energy of any category of sonar and other transducers analyzed in the Navy's rulemaking/LOA application and include hull-mounted, towed, line array, sonobuoy, helicopter dipping, and torpedo sonars. Most ASW sonars are MFAS (1–10 kHz); however, some sources may use higher or lower frequencies. ASW training activities using hull mounted sonar proposed for the NWTT Study Area generally last for only a few hours (see Table 3). Some ASW testing activities range from several hours, to days, to up to 3 weeks for Pierside-Sonar Testing and Submarine Sonar Testing/Maintenance (see Table 4). For these multi-day exercises there will typically be extended intervals of non-activity in between active sonar periods. Because of the need to train in a large variety of situations, the Navy does not typically conduct successive ASW exercises in the same locations. Given the average length of ASW exercises (times of sonar use) and typical vessel speed, combined with the fact that the majority of the cetaceans would not likely remain in proximity to the sound source, it is unlikely that an animal would be exposed to LFAS/MFAS/HFAS at levels or durations likely to result in a substantive response that would then be carried on for more than one day or on successive days.

Most planned explosive events are scheduled to occur over a short duration (1–8 hours); however Mine Countermeasure and Neutralization Testing would last 1–10 days (see Tables 3 and 4). The explosive component of these activities only lasts for minutes. Although explosive exercises may sometimes be conducted in the same general areas repeatedly, because of their short duration and the fact that they are in the open ocean and animals can easily move away, it is similarly unlikely that animals would be exposed for long, continuous amounts of time, or demonstrate sustained behavioral responses. All of these factors make it unlikely that individuals would be exposed to the exercise for extended periods or on consecutive days.

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

As described previously, Navy modeling uses the best available science to predict the instances of exposure above certain acoustic thresholds, which are equated, as appropriate, to harassment takes (and further corrected to account for mitigation and avoidance). As further noted, for active acoustics it is more challenging to parse out the number of individuals taken by Level B harassment and the number of times those individuals are taken from this larger number of instances. One method that NMFS uses to help better understand the overall scope of the impacts is to compare these total instances of take against the abundance of that species (or stock if applicable). For example, if there are 100 harassment takes in a population of 100, one can assume either that every individual was exposed above acoustic thresholds in no more than one day, or that some smaller number were exposed in one day but a few of those individuals were exposed multiple days within a year and a few were not exposed at all. Where the instances of take exceed 100 percent of the population, multiple takes of some individuals are predicted and expected to occur within a year. Generally speaking, the higher the number of takes as compared to the population abundance, the more multiple takes of individuals are likely, and the higher the actual percentage of individuals in the population that are likely taken at least once in a year. We look at this comparative metric to give us a relative sense of where larger portions of the species are being taken by Navy activities and where there is a higher likelihood that the same individuals are being taken across multiple days and where that number of days might be higher. It also provides a relative picture of the scale of impacts to each species.

In the ocean, unlike a modeling simulation with static animals, the use of sonar and other active acoustic sources is often transient, and is unlikely to repeatedly expose the same individual animals within a short period, for example within one specific exercise. However, some repeated exposures across different activities could occur over the year with more resident species. In short, we expect that the total anticipated takes represent exposures of a smaller number of individuals of which some could be exposed multiple times, but based on the nature of the Navy's activities and the movement patterns of marine mammals, it is unlikely that any particular subset would be taken over more than several sequential days (with a few possible exceptions discussed in the species-specific conclusions).

When calculating the proportion of a population affected by takes (*e.g.,* the number of takes divided by population abundance), which can also be helpful in estimating the number of days over which some individuals may be taken, it is important to choose an appropriate population estimate against which to make the comparison. The SARs, where available, provide the official population estimate for a given species or stock in U.S. waters in a given year (and are typically based solely on the most recent survey data). When the stock is known to range well outside of U.S. Exclusive Economic Zone (EEZ) boundaries, population estimates based on surveys conducted only within the U.S. EEZ are known to be underestimates. The information used to estimate take includes the best available survey abundance data to model density layers. Accordingly, in calculating the percentage of takes versus abundance for each species in order to assist in understanding both the percentage of the species affected, as well as how many days across a year individuals could be taken, we use the data most appropriate for the situation. For all species and stocks except for a few stocks of harbor seals for which SAR data are unavailable and Navy abundance surveys of the inland areas of the NWTT Study Area are used, the most recent NMFS SARs are used to calculate the proportion of a population affected by takes.

The estimates found in NMFS' 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. In some cases, NMFS' abundance estimates show substantial year-to-year variability. However, for highly migratory species (*e.g.,* large whales) or those whose geographic distribution extends well beyond the boundaries of the NWTT Study Area (*e.g.,* populations with distribution along the entire eastern Pacific Ocean rather than just the NWTT Study Area), comparisons to the SAR are appropriate. Many of the stocks present in the NWTT Study Area have ranges significantly larger than the NWTT Study Area and that abundance is captured by the SAR. A good descriptive example is migrating large whales, which traverse the NWTT Study Area for several days to weeks on their migrations. Therefore, at any one time there may be a stable number of animals, but over the course of the entire year the entire population may pass through the NWTT Study Area. Therefore, comparing the estimated takes to an abundance, in this case the SAR abundance, which represents the total population, may be more appropriate than modeled abundances for only the NWTT Study Area.

Temporary Threshold Shift

NMFS and the Navy have estimated that all species of marine mammals may sustain some level of TTS from active sonar. As mentioned previously, in general, TTS can last from a few minutes to days, be of varying degree, and occur across various frequency bandwidths, all of which determine the severity of the impacts on the affected individual, which can range from minor to more severe. Tables 52–57 indicate the number of takes by TTS that may be incurred by different species from exposure to active sonar and explosives. The TTS sustained by an animal is primarily classified by three characteristics:

1. Frequency—Available data (of mid-frequency hearing specialists exposed to mid- or high-frequency sounds; Southall *et al.,* 2007) suggest that most TTS occurs in the frequency range of the source up to one octave higher than the source (with the maximum TTS at ½ octave above). The Navy's MF sources, which are the highest power and most numerous sources and the ones that cause the most take, utilize the 1–10 kHz frequency band, which suggests that if TTS were to be induced by any of these MF sources it would be in a frequency band somewhere between approximately 2 and 20 kHz, which is in the range of communication calls for many odontocetes, but below the range of the echolocation signals used for foraging. There are fewer hours of HF source use and the sounds would attenuate more quickly, plus they have lower source levels, but if an animal were to incur TTS from these sources, it would cover a higher frequency range (sources are between 10 and 100 kHz, which means that TTS could range up to 200 kHz), which could overlap with the range in which some odontocetes communicate or echolocate. However, HF systems are typically used less frequently and for shorter time periods than surface ship and aircraft MF systems, so TTS from these sources is unlikely. There are fewer LF sources and the majority are used in the more readily mitigated testing environment, and TTS from LF sources would most likely occur below 2 kHz, which is in the range where many mysticetes communicate and also where other non-communication auditory cues are located (waves, snapping shrimp, fish prey). Also of note, the majority of sonar sources from which TTS may be incurred occupy a narrow frequency band, which means that the TTS incurred would also be across a narrower band (*i.e.,* not affecting the majority of an animal's hearing range). This frequency provides information about the cues to which a marine mammal may be temporarily less sensitive, but not the degree or duration of sensitivity loss. TTS from explosives would be broadband.

2. Degree of the shift (*i.e.,* by how many dB the sensitivity of the hearing is reduced)—Generally, both the degree of TTS and the duration of TTS will be greater if the marine mammal is exposed to a higher level of energy (which would occur when the peak dB level is higher or the duration is longer). The threshold for the onset of TTS was discussed previously in this rule. An animal would have to approach closer to the source or remain in the vicinity of the sound source appreciably longer to increase the received SEL, which would be difficult considering the Lookouts and the nominal speed of an active sonar vessel (10–15 kn) and the relative motion between the sonar vessel and the animal. In the TTS studies discussed in the *Potential Effects of Specified Activities on Marine Mammals and their Habitat* 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. Since any hull-mounted sonar, such as the SQS–53, engaged in anti-submarine warfare training would be moving at between 10 and 15 knots and nominally pinging every 50 seconds, the vessel will have traveled a minimum distance of approximately 257 m during the time between those pings. A scenario could occur where an animal does not leave the vicinity of a ship or travels a course parallel to the ship, however, the close distances required make TTS exposure unlikely. For a Navy vessel moving at a nominal 10 knots, it is unlikely a marine mammal could maintain speed parallel to the ship and receive adequate energy over successive pings to suffer TTS.

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

3. Duration of TTS (recovery time)—In the TTS laboratory studies (as discussed in the *Potential Effects of Specified Activities on Marine Mammals and their Habitat* 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 NWTT Study Area, it is unlikely that marine mammals would ever sustain a TTS from MFAS that alters their sensitivity by more than 20 dB for more than a few hours—and any incident of TTS would likely be far less severe due to the short duration of the majority of the events and the speed of a typical vessel, especially given the fact that the higher power sources resulting in TTS are predominantly intermittent, which have been shown to result in shorter durations of TTS. Also, for the same reasons discussed in the *Preliminary Analysis and Negligible Impact Determination—Diel Cycle* section, and because of the short distance within which animals would need to approach the sound source, it is unlikely that animals would be exposed to the levels necessary to induce TTS in subsequent time periods such that their recovery is impeded. Additionally, though the frequency range of TTS that marine mammals might sustain would overlap with some of the frequency ranges of their vocalization types, the frequency range of TTS from MFAS would not usually span the entire frequency range of one vocalization type, much less span all types of vocalizations or other critical auditory cues.

Tables 52–57 indicate the number of incidental takes by TTS for each species that are likely to result from the Navy's activities. As a general point, the majority of these TTS takes are the result of exposure to hull-mounted MFAS (MF narrower band sources), with fewer from explosives (broad-band lower frequency sources), and even fewer from LFAS or HFAS sources (narrower band). As described above, we expect the majority of these takes to be in the form of mild (single-digit), short-term (minutes to hours), narrower band (only affecting a portion of the animal's hearing range) TTS. This means that for one to several times per year, for several minutes to maybe a few hours at most each, a taken individual will have slightly diminished hearing sensitivity (slightly more than natural variation, but nowhere near total deafness). More often than not, such an exposure would occur within a narrower mid- to higher frequency band that may overlap part (but not all) of a communication, echolocation, or predator range, but sometimes across a lower or broader bandwidth. The significance of TTS is also related to the auditory cues that are germane within the time period that the animal incurs the TTS. For example, if an odontocete has TTS at echolocation frequencies, but incurs it at night when it is resting and not feeding, it is not impactful. In short, the expected results of any one of these small number of mild TTS occurrences could be that (1) it does not overlap signals that are pertinent to that animal in the given time period, (2) it overlaps parts of signals that are important to the animal, but not in a manner that impairs interpretation, or (3) it reduces detectability of an important signal to a small degree for a short amount of time—in which case the animal may be aware and be able to compensate (but there may be slight energetic cost), or the animal may have some reduced opportunities (*e.g.,* to detect prey) or reduced capabilities to react with maximum effectiveness (*e.g.,* to detect a predator or navigate optimally). However, given the small number of times that any individual might incur TTS, the low degree of TTS and the short anticipated duration, and the low likelihood that one of these instances would occur in a time period in which the specific TTS overlapped the entirety of a critical signal, it is unlikely that TTS of the nature expected to result from the Navy activities would result in behavioral changes or other impacts that would impact any individual's (of any hearing sensitivity) reproduction or survival.

Auditory Masking or Communication Impairment

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

Standard hull-mounted MFAS typically pings every 50 seconds. Some hull-mounted anti-submarine sonars can also be used in an object detection mode known as ''Kingfisher'' mode (*e.g.,* used on vessels when transiting to and from port) where pulse length is shorter but pings are much closer together in both time and space since the vessel goes slower when operating in this mode. For the majority of other sources, the pulse length is significantly shorter than hull-mounted active sonar, on the order of several microseconds to tens of milliseconds. Some of the vocalizations that many marine mammals make are less than one second long, so, for example with hull-mounted sonar, there would be a 1 in 50 chance (only if the source was in close enough proximity for the sound to exceed the signal that is being detected) that a single vocalization might be masked by a ping. However, when vocalizations (or series of vocalizations) are longer than one second, masking would not occur. Additionally, when the pulses are only several microseconds long, the majority of most animals' vocalizations would not be masked.

Most ASW sonars and countermeasures use MF frequencies and a few use LF and HF frequencies. Most of these sonar signals are limited in the temporal, frequency, and spatial domains. The duration of most individual sounds is short, lasting up to a few seconds each. A few systems operate with higher duty cycles or nearly continuously, but they typically use lower power, which means that an animal would have to be closer, or in the vicinity for a longer time, to be masked to the same degree as by a higher level source. Nevertheless, masking could occasionally occur at closer ranges to these high-duty cycle and continuous active sonar systems, but as described previously, it would be expected to be of a short duration when the source and animal are in close proximity. While data are lacking on behavioral responses of marine mammals to continuously active sonars, mysticete species are known to be able to habituate to novel and continuous sounds (Nowacek *et al.,* 2004), suggesting that they are likely to have similar responses to high-duty cycle sonars. Furthermore, most of these systems are hull-mounted on surface ships with the ships moving at least 10 kn, and it is unlikely that the ship and the marine mammal would continue to move in the same direction and the marine mammal subjected to the same exposure due to that movement. Most

ASW activities are geographically dispersed and last for only a few hours, often with intermittent sonar use even within this period. Most ASW sonars also have a narrow frequency band (typically less than one-third octave). These factors reduce the likelihood of sources causing significant masking. HF signals (above 10 kHz) attenuate more rapidly in the water due to absorption than do lower frequency signals, thus producing only a very small zone of potential masking. If masking or communication impairment were to occur briefly, it would more likely be in the frequency range of MFAS (the more powerful source), which overlaps with some odontocete vocalizations (but few mysticete vocalizations); however, it would likely not mask the entirety of any particular vocalization, communication series, or other critical auditory cue, because the signal length, frequency, and duty cycle of the MFAS/HFAS signal does not perfectly resemble the characteristics of any single marine mammal species' vocalizations.

Other sources used in Navy training and testing that are not explicitly addressed above, many of either higher frequencies (meaning that the sounds generated attenuate even closer to the source) or lower amounts of operation, are similarly not expected to result in masking. For the reasons described here, any limited masking that could potentially occur would be minor and short-term.

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

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

Tables 52 through 57 indicate the number of individuals of each species for which Level A harassment in the form of PTS resulting from exposure to active sonar and/or explosives is estimated to occur. The number of individuals to potentially incur PTS annually (from sonar and explosives) for each species/stock ranges from 0 to 180 (the 180 is for the Inland Washington stock of harbor porpoise), but is more typically 0 or 1. No species/stocks have the potential to incur tissue damage from sonar or explosives.

Data suggest that many marine mammals would deliberately avoid exposing themselves to the received levels of active sonar necessary to induce injury by moving away from or at least modifying their path to avoid a close approach. Additionally, in the unlikely event that an animal approaches the sonar-emitting vessel at a close distance, NMFS has determined that the mitigation measures (*i.e.,* shutdown/powerdown zones for active sonar) would typically ensure that animals would not be exposed to injurious levels of sound. As discussed previously, the Navy utilizes both aerial (when available) and passive acoustic monitoring (during ASW exercises, passive acoustic detections are used as a cue for Lookouts' visual observations when passive acoustic assets are already participating in an activity) in addition to Lookouts on vessels to detect marine mammals for mitigation implementation. As discussed previously, the Navy utilized a post-modeling quantitative assessment to adjust the take estimates based on avoidance and the likely success of some portion of the mitigation measures. As is typical in predicting biological responses, it is challenging to predict exactly how avoidance and mitigation will affect the take of marine mammals, and therefore the Navy erred on the side of caution in choosing a method that would more likely still overestimate the take by PTS to some degree. Nonetheless, these modified Level A harassment take numbers represent the maximum number of instances in which marine mammals would be reasonably expected to incur PTS, and we have analyzed them accordingly.

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

The Navy implements mitigation measures (described in the *Proposed Mitigation Measures* section) during explosive activities, including delaying detonations when a marine mammal is observed in the mitigation zone. Nearly all explosive events would occur during daylight hours to improve the sightability of marine mammals and thereby improve mitigation effectiveness. Observing for marine mammals during the explosive activities would include visual and passive acoustic detection methods (when they are available and part of the activity) before the activity begins, in order to cover the mitigation zones that can range from 600 yds (656 m) to 2,500 yds (2,286 m) depending on the source (*e.g.,* explosive sonobuoy, explosive torpedo, explosive bombs; see Tables 38–44). For all of these reasons, the proposed mitigation measures associated with explosives are expected to be effective in preventing tissue damage to any potentially affected species, and no species are anticipated to incur tissue damage during the period of the proposed rule.

Serious Injury and Mortality

NMFS is authorizing a very small number of serious injuries or mortalities that could occur in the event of a ship strike. We note here that the takes from potential ship strikes enumerated below could result in non-serious injury, but their worst potential outcome (mortality) is analyzed for the purposes of the negligible impact determination.

In addition, we discuss here the connection, and differences, between the legal mechanisms for authorizing incidental take under section 101(a)(5) for activities such as the Navy's testing and training in the NWTT 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, 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. In *Conservation Council for Hawaii* v. *National Marine Fisheries Service,* 97 F. Supp. 3d 1210 (D. Haw. 2015), which concerned a challenge to NMFS' regulations and LOAs to the Navy for activities assessed in the 2013–2018 HSTT MMPA rulemaking, the Court ruled that NMFS' failure to consider PBR when evaluating lethal takes in the negligible impact analysis under section 101(a)(5)(A) violated the requirement to use the best available science.

PBR is defined in section 3 of the MMPA as ''the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population'' (OSP) and, although not controlling, can be one measure considered among other factors when evaluating the effects of M/SI on a marine mammal species or stock during the section 101(a)(5)(A) process. OSP is defined in section 3 of the MMPA 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.'' Through section 2, an overarching goal of the statute 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 the minimum population estimate (N_{min}) incorporates the level of precision and degree of variability associated with abundance information, while also providing reasonable assurance that the stock size is equal to or greater than the estimate (Barlow *et al.,* 1995), typically by using the 20th percentile of a log-normal distribution of the population estimate. 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).

Congress called for PBR to be applied within the management framework for commercial fishing incidental take under section 118 of the MMPA. As a result, PBR cannot be applied appropriately outside of the section 118 regulatory framework without consideration of how it applies within the section 118 framework, as well as how the other statutory management frameworks in the MMPA differ from the framework in section 118. PBR was not designed and is not used as an absolute threshold limiting commercial fisheries. Rather, it serves 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 in the commercial fishing context under section 118, 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. In other words, under section 118 of the MMPA, PBR does not serve as a strict cap on the operation of commercial fisheries that may incidentally take marine mammals.

Similarly, to the extent PBR may be relevant when considering the impacts of incidental take from activities other than commercial fisheries, using it as the sole reason to deny (or issue) incidental take authorization for those activities would be inconsistent with Congress's intent under section 101(a)(5), NMFS' long-standing regulatory definition of ''negligible impact,'' and the use of PBR under section 118. The standard for authorizing incidental take for activities other than commercial fisheries under section 101(a)(5) continues to be, among other things that are not related to PBR, whether the total taking will have a negligible impact on the species or stock. Nowhere does section 101(a)(5)(A) reference use of PBR to make the negligible impact finding or authorize incidental take through multi-year regulations, nor does its companion provision at 101(a)(5)(D) for authorizing non-lethal incidental take under the same negligible-impact standard. NMFS' MMPA implementing regulations state that take has a negligible impact when it does not ''adversely affect the species or stock through effects on annual rates of recruitment or survival''—likewise without reference to PBR. 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), implicitly acknowledging that the negligible impact standard under section 101(a)(5) is separate from the PBR metric 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 ESA) to add compliance with the new section 118 but retained the standard of the negligible impact finding under section 101(a)(5)(A) (and section 101(a)(5)(D)), showing that Congress understood that the determination of negligible impact and application of PBR may share certain features but are, in fact, different.

Since the introduction of PBR in 1994, NMFS had used the concept almost entirely within the context of implementing sections 117 and 118 and other commercial fisheries management-related provisions of the MMPA. Prior to the Court's ruling in *Conservation Council for Hawaii* v. *National Marine Fisheries Service* and consideration of PBR in a series of section 101(a)(5) rulemakings, there were a few examples where PBR had informed agency deliberations under other MMPA sections and programs, such as playing a role in the issuance of a few scientific research permits and subsistence takings. But as the Court found when reviewing examples of past PBR consideration in *Georgia Aquarium* v. *Pritzker,* 135 F. Supp. 3d 1280 (N.D. Ga. 2015), where NMFS had considered PBR outside the commercial fisheries context, ''it has treated PBR as only one 'quantitative tool' and [has not used it] as the sole basis for its impact analyses.'' Further, the agency's thoughts regarding the appropriate role of PBR in relation to MMPA programs outside the commercial fishing context have evolved since the agency's early application of PBR to section 101(a)(5) decisions. Specifically, NMFS' denial of a request for incidental take authorization for the U.S. Coast Guard in 1996 seemingly was based on the potential for lethal take in relation to PBR and did not appear to consider other factors that might also have informed the potential for ship strike in relation to negligible impact (61 FR 54157; October 17, 1996).

The MMPA requires that PBR be estimated in SARs 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'' as defined in section 3), but nothing in the statute requires the application of PBR outside the management of commercial fisheries interactions with marine mammals. Nonetheless, NMFS recognizes that as a quantitative metric, PBR may be useful as a consideration when evaluating the impacts of other human-caused activities on marine mammal stocks. Outside the commercial fishing context, and in consideration of all known human-caused mortality, PBR can help inform the potential effects of M/SI requested to be authorized under 101(a)(5)(A). As noted by NMFS and the U.S. Fish and Wildlife Service in our implementation regulations for the 1986 amendments to the MMPA (54 FR 40341, September 29, 1989), the Services consider many factors, when available, in making a negligible impact determination, including, but not limited to, the status of the species or stock relative to OSP (if known); whether the recruitment rate for the species or stock is increasing, decreasing, stable, or unknown; the size and distribution of the population; and existing impacts and environmental conditions. In this multi-factor analysis, PBR can be a useful indicator for when, and to what extent, the agency should take an especially close look at the circumstances associated with the potential mortality, along with any other factors that could influence annual rates of recruitment or survival.

When considering PBR during evaluation of effects of M/SI under section 101(a)(5)(A), we first calculate a metric for each species or stock that incorporates information regarding ongoing anthropogenic M/SI from all sources into the PBR value (*i.e.,* PBR minus the total annual anthropogenic mortality/serious injury estimate in the SAR), which is called ''residual PBR.'' (Wood *et al.,* 2012). We first focus our analysis on residual PBR because it incorporates anthropogenic mortality occurring from other sources. If the ongoing human-caused mortality from other sources does not exceed PBR, then residual PBR is a positive number, and we consider how the anticipated or potential incidental M/SI from the activities being evaluated compares to residual PBR using the framework in the following paragraph. If the ongoing anthropogenic mortality from other sources already exceeds PBR, then residual PBR is a negative number and we consider the M/SI from the activities being evaluated as described further below.

When ongoing total anthropogenic mortality from the applicant's specified activities does not exceed PBR and residual PBR is a positive number, as a simplifying analytical tool we first consider whether the specified activities could cause incidental M/SI that is less than 10 percent of residual PBR (the ''insignificance threshold,'' see below). If so, we consider M/SI from the specified activities to represent an insignificant incremental increase in ongoing anthropogenic M/SI for the marine mammal stock in question that alone (*i.e.,* in the absence of any other take) will not adversely affect annual rates of recruitment and survival. As such, this amount of M/SI would not be expected to affect rates of recruitment or survival in a manner resulting in more than a negligible impact on the affected stock unless there are other factors that could affect reproduction or survival, such as Level A and/or Level B harassment, or other considerations such as information that illustrates uncertainty involved in the calculation of PBR for some stocks. In a few prior incidental take rulemakings, this threshold was identified as the ''significance threshold,'' but it is more accurately labeled an insignificance threshold, and so we use that terminology here. Assuming that any additional incidental take by Level A or Level B harassment from the activities in question would not combine with the effects of the authorized M/SI to 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. However, M/SI above the 10 percent insignificance threshold does not indicate that the M/SI associated with the specified activities is approaching a level that would necessarily exceed negligible impact. Rather, the 10 percent insignificance threshold is meant only to identify instances where additional analysis of the anticipated M/SI is not required because the negligible impact standard clearly will not be exceeded on that basis alone.

Where the anticipated M/SI is near, at, or above residual PBR, consideration of other factors (positive or negative), including those outlined above, as well as mitigation is especially important to assessing whether the M/SI will have a negligible impact on the species or stock. PBR is a conservative metric and not sufficiently precise to serve as an absolute predictor of population effects upon which mortality caps would appropriately be based. For example, in some cases stock abundance (which is one of three key inputs into the PBR calculation) is underestimated because marine mammal survey data within the U.S. EEZ are used to calculate the abundance even when the stock range extends well beyond the U.S. EEZ. An underestimate of abundance could result in an underestimate of PBR. Alternatively, we sometimes may not have complete M/SI data beyond the U.S. EEZ to compare to PBR, which could result in an overestimate of residual PBR. The accuracy and certainty around the data that feed any PBR calculation, such as the abundance estimates, must be carefully considered to evaluate whether the calculated PBR accurately reflects the circumstances of the particular stock. M/SI that exceeds PBR may still potentially be found to be negligible in light of other factors that offset concern, especially when robust mitigation and adaptive management provisions are included.

In *Conservation Council for Hawaii* v. *National Marine Fisheries Service,* which involved the challenge to NMFS' issuance of LOAs to the Navy in 2013 for activities in the HSTT Study Area, the Court reached a different conclusion, stating, ''Because any mortality level that exceeds PBR will not allow the stock to reach or maintain its OSP, such a mortality level could not be said to have only a 'negligible impact' on the stock.'' As described above, the Court's statement fundamentally misunderstands the two terms and incorrectly indicates that these concepts (PBR and ''negligible impact'') are directly connected, when in fact nowhere in the MMPA is it indicated that these two terms are equivalent.

Specifically, PBR was designed as a tool for evaluating mortality and is defined as the number of animals that can be removed while ''allowing that stock to reach or maintain its [OSP].'' OSP is defined as a population that falls within a range from the population level that is the largest supportable within the ecosystem to the population level that results in maximum net productivity, and thus is an aspirational management goal of the overall statute with no specific timeframe by which it should be met. PBR is designed to ensure minimal deviation from this overarching goal, with the formula for PBR typically ensuring that growth towards OSP is not reduced by more than 10 percent (or equilibrates to OSP 95 percent of the time). As PBR is applied by NMFS, it provides that growth toward OSP is not reduced by more than 10 percent, which certainly allows a stock to ''reach or maintain its [OSP]'' in a conservative and precautionary manner—and we can therefore clearly conclude that if PBR were not exceeded, there would not be adverse effects on the affected species or stocks. Nonetheless, it is equally clear that in some cases the time to reach this aspirational OSP level could be slowed by more than 10 percent (*i.e.,* total human-caused mortality in excess of PBR could be allowed) without adversely affecting a species or stock through effects on its rates of recruitment or survival. Thus even in situations where the inputs to calculate PBR are thought to accurately represent factors such as the species' or stock's abundance or productivity rate, it is still possible for incidental take to have a negligible impact on the species or stock even where M/SI exceeds residual PBR or PBR.

As noted above, in some cases the ongoing human-caused mortality from activities other than those being evaluated already exceeds PBR and, therefore, residual PBR is negative. In these cases (such as is specifically discussed for the CA/OR/WA stock of humpback whales below), any additional mortality, no matter how small, and no matter how small relative to the mortality caused by other human activities, would result in greater exceedance of PBR. PBR is helpful in informing the analysis of the effects of mortality on a species or stock because it is important from a biological perspective to be able to consider how the total mortality in a given year may affect the population. However, section 101(a)(5)(A) of the MMPA indicates that NMFS shall authorize the requested incidental take from a specified activity if we find that ''the total of such taking [*i.e.,* from the specified activity] will have a negligible impact on such species or stock.'' In other words, the task under the statute is to evaluate the applicant's anticipated take in relation to their take's impact on the species or stock, not other entities' impacts on the species or stock. Neither the MMPA nor NMFS' implementing regulations call for consideration of other unrelated activities and their impacts on the species or stock. In fact, in response to public comments on the implementing regulations NMFS explained that such effects are not considered in making negligible impact findings under section 101(a)(5), although the extent to which a species or stock is being impacted by other anthropogenic activities is not ignored. Such effects are reflected in the baseline of existing impacts as reflected in the species' or stock's abundance, distribution, reproductive rate, and other biological indicators.

NMFS guidance for commercial fisheries provides insight when evaluating the effects of an applicant's incidental take as compared to the incidental take caused by other entities. Parallel to section 101(a)(5)(A), section 101(a)(5)(E) of the MMPA provides that NMFS shall allow the incidental take of ESA-listed endangered or threatened marine mammals by commercial fisheries if, among other things, the incidental M/SI from the commercial fisheries will have a negligible impact on the species or stock. As discussed earlier, the authorization of incidental take resulting from commercial fisheries and authorization for activities other than commercial fisheries are under two separate regulatory frameworks. However, when it amended the statute in 1994 to provide a separate incidental take authorization process for commercial fisheries, Congress kept the requirement of a negligible impact determination for this one category of species, thereby applying the standard to both programs. Therefore, while the structure and other standards of the two programs differ such that evaluation of negligible impact under one program may not be fully applicable to the other program (*e.g.,* the regulatory definition of ''negligible impact'' at 50 CFR 216.103 applies only to activities other than commercial fishing), guidance on determining negligible impact for commercial fishing take authorizations can be informative when considering incidental take outside the commercial fishing context. In 1999, NMFS published criteria for making a negligible impact determination pursuant to section 101(a)(5)(E) of the MMPA in a notice of proposed permits for certain fisheries (64 FR 28800; May 27, 1999). Criterion 2 stated if total human-related serious injuries and mortalities are greater than PBR, and fisheries-related mortality is less than 0.1 PBR, individual fisheries may be permitted if management measures are being taken to address non-fisheries-related serious injuries and mortalities. When fisheries-related serious injury and mortality is less than 10 percent of the total, the appropriate management action is to address components that account for the major portion of the total. This criterion addresses when total human-caused mortality is exceeding PBR, but the activity being assessed is responsible for only a small portion of the mortality. The analytical framework we use here appropriately incorporates elements of the one developed for use under section 101(a)(5)(E) and because the negligible impact determination under section 101(a)(5)(A) focuses on the activity being evaluated, it is appropriate to utilize the parallel concept from the framework for section 101(a)(5)(E).

Accordingly, we are using a similar criterion in our negligible impact analysis under section 101(a)(5)(A) to evaluate the relative role of an applicant's incidental take when other sources of take are causing PBR to be exceeded, but the take of the specified activity is comparatively small. Where this occurs, we may find that the impacts of the taking from the specified activity may (those impacts alone, before we have considered the combined effects from any harassment take) be negligible even when total human-caused mortality from all activities exceeds PBR if (in the context of a particular species or stock): The authorized mortality or serious injury would be less than or equal to 10 percent of PBR and management measures are being taken to address serious injuries and mortalities from the other activities (*i.e.,* other than the specified activities covered by the incidental take authorization under consideration). We must also determine, though, that impacts on the species or stock from other types of take (*i.e.,* harassment) caused by the applicant do not combine with the impacts from mortality or serious injury to result in adverse effects on the species or stock through effects on annual rates of recruitment or survival.

As discussed above, however, while PBR is useful in informing the evaluation of the effects of M/SI in section 101(a)(5)(A) determinations, it is just one consideration to be assessed in combination with other factors and is not determinative, including because, as explained above, the accuracy and certainty of the data used to calculate PBR for the species or stock must be considered. And we reiterate the considerations discussed above for why it is not appropriate to consider PBR an absolute cap in the application of this guidance. Accordingly, we use PBR as a trigger for concern while also considering other relevant factors to provide a reasonable and appropriate means of evaluating the effects of potential mortality on rates of recruitment and survival, while acknowledging that it is possible to exceed PBR (or exceed 10 percent of PBR in the case where other human-caused mortality is exceeding PBR but the specified activity being evaluated is an incremental contributor, as described in the last paragraph) by some small amount and still make a negligible impact determination under section 101(a)(5)(A).

Our evaluation of the M/SI for each of the species and stocks for which mortality or serious injury could occur follows. No M/SI are anticipated from the Navy's sonar activities or use of explosives. We first consider maximum potential incidental M/SI from the Navy's ship strike analysis for the affected mysticetes and sperm whales (see Table 51) in consideration of NMFS' threshold for identifying insignificant M/SI take. 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 may affect the species' or stocks' annual rates of recruitment or survival. We also consider the interaction of those mortalities with incidental taking of that species or stock by harassment pursuant to the specified activity.

Based on the methods discussed previously, NMFS believes that mortal takes of three large whales may occur over the course of the seven-year rule. Of the three total M/SI takes, the rule would authorize no more than two from any of the following species/stocks over the seven-year period: Fin whale (which may come from either the Northeast Pacific or CA/OR/WA stock) and humpback whale (which may come from either the Central North Pacific or CA/OR/WA stock). Of the three total M/SI takes, the rule also would authorize no more than one mortality from any of the following species/stocks over the seven-year period: Sperm whale (CA/OR/WA stock), minke whale (CA/OR/WA stock), and gray whale (Eastern North Pacific stock). We do not anticipate, nor authorize, ship strike takes to blue whale (Eastern North Pacific stock), minke whale (Alaska stock), or sei whale (Eastern North Pacific stock). This means an annual average of 0.14 whales from each species or stock where one mortality may occur and an annual average of 0.29 whales from each species or stock where two mortalities may occur, as described in Table 51, is proposed for authorization (*i.e.,* 1 or 2 takes over 7 years divided by 7 to get the annual number).

TABLE 51—SUMMARY INFORMATION RELATED TO MORTALITIES REQUESTED FOR SHIP STRIKE, 2020–2027

Species (stock)	Stock abundance (Nbest) *	Annual proposed NWTT authorized 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 *	Annual Navy HSTT authorized take (2018–2023) [5]	PBR *	Residual PBR-PBR minus annual M/SI and HSTT authorized take [3]	Stock trend * [4]	Recent UME (Y/N); number and year (since 2007)
Fin whale (Northeast Pacific).	3,168	0.29	0.4	N; 0	Y; 0.4	0	5.1	4.7	↑	N
Fin whale (CA/OR/WA)	9,029	0.29	≥43.5	Y; ≥0.5	Y; 43	0.4	81	37.1	↑	N
Humpback whale (Central North Pacific).	10,103	0.29	25	Y; 9.5	[6] Y; 3.9	0.4	83	57.6	↑	N
Humpback whale (CA/OR/WA).	2,900	0.29	≥42.1	Y; ≥17.3	Y; 22	0.2	33.4	−8.9	Stable (↑ (historically)	N
Sperm whale (CA/OR/WA).	1,997	0.14	0.4	Y; 0.4	N; 0	0	2.5	2.1	Unknown	N
Minke whale (CA/OR/WA).	636	0.14	≥1.3	Y; ≥1.3	N; 0	0	3.5	2.2	Unknown	N
Gray whale (Eastern North Pacific).	26,960	0.14	139	Y; 9.6	Y; 0.8	0.4	801	661.6	↑	Y, 264, 2019

* Presented in the 2019 draft SARs or most recent SAR.
[1] This column represents the annual take by serious injury or mortality by vessel collision and was calculated by the number of mortalities proposed for authorization divided by seven 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 NMFS Science Center research activities or Navy strikes authorized for training and testing activities. No NMFS Science Center or Navy M/SI takes for these stocks are recorded in the SARs and no NMFS Science Center M/SI incidental takes have been authorized.
[3] This value represents the calculated PBR minus the average annual estimate of ongoing anthropogenic mortalities (*i.e.,* total annual human-caused M/SI column and the annual authorized take from the HSTT column). This value represents the total PBR for the stock in the stock's entire range.
[4] See relevant SARs for more information regarding stock status and trends.
[5] This column represents annual M/SI take authorized through NMFS' current 5-year HSTT regulations/LOAs (83 FR 66846). Note that NMFS has proposed to replace the current HSTT regulations with 7-year regulations (84 FR 48388) which propose to authorize the same number of M/SI for the same species/stocks, but over a 7-year period rather than a 5-year period (resulting in slightly lower annual authorized take for each species/stock).
[6] This value represents average annual observed M/SI from ship strikes in Alaska (2.5) and Hawaii (1.4). For the purposes of analysis of potential ship strike (see the *Estimated Takes* section) we incorporated only Alaska ship strikes as only these ship strikes have the potential to overlap with the NWTT Study Area.

Stocks With M/SI Below the Insignificance Threshold

As noted above, for a species or stock with incidental M/SI less than 10 percent of residual PBR, we consider M/SI from the specified activities to represent an insignificant incremental increase in ongoing anthropogenic M/SI that alone (*i.e.,* in the absence of any other take and barring any other unusual circumstances) will clearly not adversely affect annual rates of recruitment and survival. In this case, as shown in Table 51, the following species or stocks have potential M/SI from ship strike proposed for authorization below their insignificance threshold: Fin whale (both the Northeast Pacific and CA/OR/WA stocks), humpback whale (Central North Pacific stock), sperm whale (CA/OR/WA stock), minke whale (CA/OR/WA stock), and gray whale (Eastern North Pacific stock). While the M/SI proposed for authorization of gray whales (Eastern North Pacific stock) is below the insignificance threshold, because of the recent UME, we further address how the authorized M/SI and the UME inform the negligible impact determination immediately below. For the other five stocks with M/SI proposed for authorization below the insignificance threshold, there are no other known factors, information, or unusual circumstances that indicate anticipated M/SI below the insignificance threshold could have adverse effects on annual rates of recruitment or survival and they are not discussed further. For the remaining one stock (CA/OR/WA stock of humpback whales) with potential M/SI above the insignificance threshold, how that M/SI compares to residual PBR, as well as additional factors, are discussed below as well.

Gray Whales (Eastern North Pacific Stock)

For this stock, PBR is currently set at 801. The total annual M/SI from other sources of anthropogenic mortality is estimated to be 139. In addition, 0.4 annual mortalities have been authorized for this same stock in the current incidental take regulations for Navy testing and training activities in the HSTT Study Area. This yields a residual PBR of 661.6. The additional 0.29 annual mortalities that are proposed for authorization in this rule are well below the insignificance threshold (10 percent of residual PBR, in this case 66.16). Nonetheless, since January 2019, gray whale strandings along the west coast of North America have been significantly higher than the previous 18-year average. Preliminary findings from necropsies have shown evidence of poor to thin body condition. The seasonal pattern of elevated strandings in the spring and summer months is similar to that of the previous gray whale UME in 1999–2000. Current total monthly strandings are slightly higher than 1999 and lower than 2000. If strandings continue to follow a similar pattern, we would anticipate a decrease in strandings in late summer and fall. However, combined with other annual human-caused mortalities, and viewed through the PBR lens (for human-caused mortalities), total human-caused mortality (inclusive of the potential for additional UME deaths) would still fall well below residual PBR and the insignificance threshold. Because of the abundance, population trend (increasing, despite the UME in 1999–2000), and residual PBR (661.6) of this stock, this UME is not expected to have impacts on the population rate that, in combination with the effects of mortality proposed to be authorized, would affect annual rates of recruitment or survival.

Stocks With M/SI Above the Insignificance Threshold

Humpback Whale (CA/OR/WA Stock)

For this stock, PBR is currently set at 16.7 for U.S. waters and 33.4 for the stock's entire range. The total annual M/SI is estimated at greater than or equal to 42.1. Combined with 0.2 annual mortalities that have been authorized for this same stock in the current incidental take regulations for Navy testing and training activities in the HSTT Study Area, this yields a residual PBR of −8.9. NMFS proposes to authorize up to 2 M/SI takes over the seven-year duration of this rule, which would be 0.29 M/SI takes annually for the purposes of comparing to PBR and considering other possible effects on annual rates of recruitment and survival. This means that with the additional 0.29 M/SI annual takes proposed in this rule, residual PBR would be exceeded by 9.19.

In the commercial fisheries setting for ESA-listed marine mammals (which is similar to the non-fisheries incidental take setting, in that a negligible impact determination is required that is based on the assessment of take caused by the activity being analyzed) NMFS may find the impact of the authorized take from a specified activity to be negligible even if total human-caused mortality exceeds PBR, if the authorized mortality is less than 10 percent of PBR and management measures are being taken to address serious injuries and mortalities from the other activities causing mortality (*i.e.,* other than the specified activities covered by the incidental take authorization under consideration). When those considerations are applied in the section 101(a)(5)(A) context here, the proposed authorized lethal take (0.29 annually) of humpback whales from the CA/OR/WA stock is significantly less than 10 percent of PBR (in fact less than 1 percent of 33.4) and there are management measures in place to address M/SI from activities other than those the Navy is conducting (as discussed below).

Based on identical simulations as those conducted to identify Recovery Factors for PBR in Wade *et al.* (1998), but where values less than 0.1 were investigated (P. Wade, pers. comm.), we predict that where the mortality from a specified activity does not exceed Nmin * ½ Rmax * 0.013, the contemplated mortality for the specific activity will not delay the time to recovery by more than 1 percent. For this stock of humpback whales, Nmin * ½ Rmax * 0.013 = 1.45 and the annual mortality proposed for authorization is 0.29 (*i.e.,* less than 1.45), which means that the mortality proposed to be authorized in this rule for NWTT activities would not delay the time to recovery by more than 1 percent.

NMFS must also ensure that impacts by the applicant on the species or stock from other types of take (*i.e.,* harassment) do not combine with the impacts from M/SI to adversely affect the species or stock via impacts on annual rates of recruitment or survival, which is discussed further below in the species- and stock-specific section.

In November 2019, NMFS published 2019 draft SARs in which PBR is reported as 33.4 with the predicted average annual mortality greater than or equal to 42.1 (including 22 estimated from vessel collisions and greater than 17.3 observed fisheries interactions). While the observed M/SI from vessel strikes remains low at 2.2 per year, the 2018 final and 2019 draft SARs rely on a new method to estimate annual deaths by ship strike utilizing an encounter theory model that combined species distribution models of whale density, vessel traffic characteristics, and whale movement patterns obtained from satellite-tagged animals in the region to estimate encounters that would result in mortality (Rockwood *et al.,* 2017). The model predicts 22 annual mortalities of humpback whales from this stock from vessel strikes. The authors (Rockwood *et al.,* 2017) do not suggest that ship strikes suddenly increased to 22. In fact, the model is not specific to a year, but rather offers a generalized prediction of ship strikes off the U.S. West Coast. Therefore, if the Rockwood *et al.* (2017) model is an accurate representation of vessel strike, then similar levels of ship strike have been occurring in past years as well. Put another way, if the model is correct, for some number of years total human-caused mortality has been significantly underestimated, and PBR has been similarly exceeded by a notable amount, and yet the CA/OR/WA stock of humpback whales is considered stable (or increasing based on population trends since 1990) nevertheless.

The CA/OR/WA stock of humpback whales experienced a steady increase from the 1990s through approximately 2008, and more recent estimates through 2014 indicate a leveling off of the population size. This stock is comprised of the feeding groups of three DPSs. Two DPSs associated with this stock are listed under the ESA as either endangered (Central America DPS) or threatened (Mexico DPS), while the third (Hawaii DPS) is not listed. Humpback whales from the Hawaii DPS are anticipated to be rare in the Study Area with a probability of the DPS foraging in the waters of the Study Area of 1.6 percent (including summer areas of Oregon/California and Southern British Columbia/Washington from Wade, 2017). Humpback whales from the Mexico DPS and Central America DPS are anticipated to be more prevalent in the Study Area with probabilities of the DPSs foraging in the waters of the Study Area of 31.7 and 100 percent, respectively (including summer areas of Oregon/California and Southern British Columbia/Washington from Wade, 2017).

As discussed earlier, we also take into consideration management measures in place to address M/SI caused by other activities. The California swordfish and thresher shark drift gillnet fishery is one of the primary causes of M/SI take from fisheries interactions for humpback whales on the West Coast. NMFS established the Pacific Offshore Cetacean Take Reduction Team in 1996 and prepared an associated Plan (POCTRP) to reduce the risk of M/SI via fisheries interactions. In 1997, NMFS published final regulations formalizing the requirements of the PCTRP, including the use of pingers following several specific provisions and the employment of Skipper education workshops.

Commercial fisheries such as crab pot, gillnet, and prawn fisheries are also a significant source of mortality and serious injury for humpback whales and other large whales and, unfortunately, have increased mortalities and serious injuries over recent years (Carretta *et al.,* 2019). However, the 2019 draft SAR notes that a recent increase in disentanglement efforts has resulted in an increase in the fraction of cases that are reported as non-serious injuries as a result of successful disentanglement. More importantly, since 2015, NMFS has engaged in a multi-stakeholder process in California (including California State resource managers, fishermen, non-governmental organizations (NGOs), and scientists) to identify and develop solutions and make recommendations to regulators and the fishing industry for reducing whale entanglements (see *http://www.opc.ca.gov/whale-entanglement-working-group/*), referred to as the Whale Entanglement Working Group. The Whale Entanglement Working Group has made significant progress since 2015 and is tackling the problem from multiple angles, including:

- Development of Fact Sheets and Best Practices for specific Fisheries issues (*e.g.,* California Dungeness Crab Fishing BMPs and the 2018–2019 Best Fishing Practices Guide);
- 2018–2019 Risk Assessment and Mitigation Program (RAMP) to support the state of California in working collaboratively with experts (fishermen, researchers, NGOs, *etc.*) to identify and assess elevated levels of entanglement risk and determine the need for management options to reduce risk of entanglement; and
- Support of pilot studies to test new fisheries technologies to reduce take (*e.g.,* Exploring Ropeless Fishing Technologies for the California Dungeness Crab Fishery).

The Working Group meets regularly, posts reports and annual recommendations, and makes all of their products and guidance documents readily accessible for the public. The March 2019 Working Group Report reported on the status of the fishery closure, progress and continued development of the RAMP (though there is a separate RAMP report), discussed the role of the Working Group (development of a new Charter), and indicated next steps.

Importantly, in early 2019, as a result of a litigation settlement agreement, the California Department of Fish and Wildlife (CDFW) closed the Dungeness crab fishery three months early for the year, which is expected to reduce the number of likely entanglements. The agreement also limits the fishery duration over the next couple of years and has different triggers to reduce or close it further. Further, pursuant to the settlement, CDFW is required to apply for a Section 10 Incidental Take Permit under the ESA to address protected species interactions with fishing gear and crab fishing gear (pots), and they have agreed to prepare a Conservation Plan by May 2020. Any request for such a permit must include a Conservation Plan that specifies, among other things, what steps the applicant will take to minimize and mitigate the impacts, and the funding that will be available to implement such steps.

Regarding measures in place to reduce mortality from other sources, the Channel Islands NMS staff coordinates, collects, and monitors whale sightings in and around a Whale Advisory Zone and the Channel Islands NMS region, which is within the area of highest vessel strike mortality (90th percentile) for humpback whales on the U.S. West Coast (Rockwood *et al.,* 2017). The seasonally established Whale Advisory Zone spans from Point Arguello to Dana Point, including the Traffic Separation Schemes in the Santa Barbara Channel and San Pedro Channel. Vessels transiting the area from June through November are recommended to exercise caution and voluntarily reduce speed to 10 kn or less for blue, humpback, and fin whales. Channel Island NMS observers collect information from aerial surveys conducted by NOAA, the U.S. Coast Guard, California Department of Fish and Game, and Navy chartered aircraft. Information on seasonal presence, movement, and general distribution patterns of large whales is shared with mariners, NMFS' Office of Protected Resources, the U.S. Coast Guard, the California Department of Fish and Game, the Santa Barbara Museum of Natural History, the Marine Exchange of Southern California, and whale scientists. Real time and historical whale observation data collected from multiple sources can be viewed on the Point Blue Whale Database.

More recently, similar efforts to reduce entanglement risk and severity have also been initiated in Oregon and Washington. Both Oregon and Washington are developing applications for ESA Incidental Take Permits for their commercial crab fisheries. They advocate similar best practices for their fishermen as California, and they are taking regulatory steps related to gear marking and pot limits.

In this case, 0.29 M/SI annually means the potential for two mortalities in one or two of the seven years and zero mortalities in five or six of those seven years. Therefore, the Navy would not be contributing to the total human-caused mortality at all in at least five of the seven, or 71.4 percent, of the years covered by this rule. That means that even if a humpback whale from the CA/OR/WA stock were to be struck, in at least five of the seven years there could be no effect on annual rates of recruitment or survival from Navy-caused M/SI. Additionally, the loss of a male would have far less, if any, of an effect on population rates than the loss of a reproductive female (as males are known to mate with multiple females), and absent any information suggesting that one sex is more likely to be struck than another, we can reasonably assume that there is a 50 percent chance that the strikes proposed to be authorized by this rule would be males, thereby further decreasing the likelihood of impacts on the population rate. In situations like this where potential M/SI is fractional, consideration must be given to the lessened impacts anticipated due to the absence of any M/SI in five or six of the years and due to the fact that strikes could be males. Lastly, we reiterate that PBR is a conservative metric and also not sufficiently precise to serve as an absolute predictor of population effects upon which mortality caps would appropriately be based. Wade *et al.* (1998), authors of the paper from which the current PBR equation is derived, note that ''Estimating incidental mortality in one year to be greater than the PBR calculated from a single abundance survey does not prove the mortality will lead to depletion; it identifies a population worthy of careful future monitoring and possibly indicates that mortality-mitigation efforts should be initiated.''

The information included here illustrates that this humpback whale stock is stable, the potential (and proposed authorized) mortality is well below 10 percent (0.87 percent) of PBR, and management actions are in place to minimize both fisheries interactions and ship strike from other vessel activity in one of the highest-risk areas for strikes. More specifically, although the total human-mortality exceeds PBR, the authorized mortality proposed for the Navy's specified activities would incrementally contribute less than 1 percent of that and, further, given the fact that it would occur in only one or two of the seven years with a 50 percent chance of the take involving males (far less impactful to the population), the potential impacts on population rates are even less. Based on all of the considerations described above, including consideration of the fact that the M/SI of 0.29 proposed for authorization would not delay the time to recovery by more than 1 percent, we do not expect the potential lethal take from Navy activities, alone, to adversely affect the CA/OR/WA stock of humpback whales through effects on annual rates of recruitment or survival. Nonetheless, the fact that total human-caused mortality exceeds PBR necessitates close attention to the remainder of the impacts (*i.e.,* harassment) on the CA/OR/WA stock of humpback whales from the Navy's activities to ensure that the total authorized takes would have a negligible impact on the species and stock. Therefore, this information will be considered in combination with our assessment of the impacts of authorized harassment takes in the *Group and Species-Specific Analyses* section that follows.

Group and Species-Specific Analyses

The maximum amount and type of incidental take of marine mammals reasonably likely to occur and therefore proposed to be authorized from exposures to sonar and other active acoustic sources and explosions during the seven-year training and testing period are shown in Tables 32 and 33 along with the discussion in the *Estimated Take of Marine Mammals* section on Vessel Strike. 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.

In the discussions below, the estimated Level B harassment takes represent instances of take, not the number of individuals taken (the much lower and less frequent Level A harassment takes are far more likely to be associated with separate individuals), and in some cases individuals may be taken more than one time. Below, we compare the total take numbers (including PTS, TTS, and behavioral disruption) for species or stocks to their associated abundance estimates to evaluate the magnitude of impacts across the species and to individuals. Specifically, when an abundance percentage comparison is below 100, it means that that percentage or less of the individuals will be affected (*i.e.,* some individuals will not be taken at all), that the average for those taken is one day per year, and that we would not expect any individuals to be taken more than a few times in a year. When it is more than 100 percent, it means there will definitely be some number of repeated takes of individuals. For example, if the percentage is 300, the average would be each individual is taken on three days in a year if all were taken, but it is more likely that some number of individuals will be taken more than three times and some number of individuals fewer or not at all. While it is not possible to know the maximum number of days across which individuals of a stock might be taken, in acknowledgement of the fact that it is more than the average, for the purposes of this analysis, we assume a number approaching twice the average. For example, if the percentage of take compared to the abundance is 800, we estimate that some individuals might be taken as many as 16 times. Those comparisons are included in the sections below.

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

Use of sonar and other transducers would typically be transient and temporary. The majority of acoustic effects to marine mammals from sonar and other active sound sources during testing and training activities would be primarily from ASW events. It is important to note that unlike other Navy Training and Testing Study Areas, there are no MTEs proposed for the NWTT Study Area. On the less severe end, exposure to comparatively lower levels of sound at a detectably greater distance from the animal, for a few or several minutes, could result in a behavioral response such as avoiding an area that an animal would otherwise have moved through or fed in, or breaking off one or a few feeding bouts. More severe behavioral effects could occur when an animal gets close enough to the source to receive a comparatively higher level of sound, is exposed continuously to one source for a longer time, or is exposed intermittently to different sources throughout a day. Such effects might result in an animal having a more severe flight response and leaving a larger area for a day or more, or potentially losing feeding opportunities for a day. However, such severe behavioral effects are expected to occur infrequently.

Occasional, milder behavioral reactions are unlikely to cause long-term consequences for individual animals or populations, and even if some smaller subset of the takes are in the form of a longer (several hours or a day) and more severe response, if they are not expected to be repeated over sequential days, impacts to individual fitness are not anticipated. Nearly all studies and experts agree that infrequent exposures of a single day or less are unlikely to impact an individual's overall energy budget (Farmer *et al.,* 2018; Harris *et al.,* 2017; King *et al.,* 2015; NAS 2017; New *et al.,* 2014; Southall *et al.,* 2007; Villegas-Amtmann *et al.,* 2015). When impacts to individuals increase in magnitude or severity such that either repeated and sequential higher severity impacts occur (the probability of this goes up for an individual the higher total number of takes it has) or the total number of moderate to more severe impacts increases substantially, especially if occurring across sequential days, then it becomes more likely that the aggregate effects could potentially interfere with feeding enough to reduce energy budgets in a manner that could impact reproductive success via longer cow-calf intervals, terminated pregnancies, or calf mortality. It is important to note that these impacts only accrue to females, which only comprise a portion of the population (typically approximately 50 percent). Based on energetic models, it takes energetic impacts of a significantly greater magnitude to cause the death of an adult marine mammal, and females will always terminate a pregnancy or stop lactating before allowing their health to deteriorate. Also, as noted previously, the death of an adult female has significantly more impact on population growth rates than reductions in reproductive success, while the death of an adult male has very little effect on population growth rates. However, as explained earlier, such severe impacts from the Navy's activities would be very infrequent and not likely to occur at all for most species and stocks. Even for those species or stocks where it is possible for a small number of females to experience reproductive effects, we explain below why there still would be no effect on rates of recruitment or survival.

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

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

Mysticetes

This section builds on the broader discussion above and brings together the discussion of the different types and amounts of take that different species and stocks could potentially or would likely incur, the applicable mitigation, and the status of the species and stocks to support the preliminary negligible impact determinations for each species or stock. We have described (earlier in this section) the unlikelihood of any masking having effects that would impact the reproduction or survival of any of the individual marine mammals affected by the Navy's activities. We have also described above in the *Potential Effects of Specified Activities on Marine Mammals and their Habitat* section the unlikelihood of any habitat impacts having effects that would impact the reproduction or survival of any of the individual marine mammals affected by the Navy's activities. For mysticetes, there is no predicted PTS from sonar or explosives and no predicted tissue damage from explosives for any species. Much of the discussion below focuses on the behavioral effects and the mitigation measures that reduce the probability or severity of effects. Because there are species-specific and stock-specific considerations as well as M/SI take proposed for several stocks, at the end of the section we break out our findings on a species-specific and, for one species, stock-specific basis.

In Table 52 below for mysticetes, we indicate for each species and stock the total annual numbers of take by mortality, Level A and Level B harassment, and a number indicating the instances of total take as a percentage of abundance.

Table 52 -- Annual estimated takes by Level B harassment, Level A harassment, and mortality for mysticetes and number indicating the instances of total take as a percentage of species abundance.

		Instances of indicated types of incidental take (not all takes represent separate individuals, especially for disturbance)					Total takes	Abundance (NMFS SARs)*	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			
Suborder Mysticeti (baleen whales)									
Family Balaenopteridae (roquals)									
Blue whale	Eastern North Pacific	6	4	0	0	0	10	1,496	<1
Fin whale	Northeast Pacific	1	1	0	0	0.29	2.29	3,168	<1
	CA/OR/WA	91	44	0	0	0.29	135.29	9,029	2
Humpback whale	Central North Pacific	47	68	0	0	0.29	115.29	10,103	1
	CA/OR/WA	40	53	0	0	0.29	93.29	2,900	3
Minke whale	Alaska	1	1	0	0	0	2	389 [1]	<1
	CA/OR/WA	111	191	0	0	0.14	302.14	636	48
Sei whale	Eastern North Pacific	33	50	0	0	0	83	519	16
Family Eschrichtiidae									
Gray whale	Eastern North Pacific	28	15	0	0	0.14	43.14	26,960	<1

*Presented in the 2019 draft SARs or most recent SAR.
1 The 2018 final SAR (most recent SAR) for the Alaska stock of minke whales reports the stock abundance as unknown because only a portion of the stock's range has been surveyed. To be conservative, for this stock we report the smallest estimated abundance produced during recent surveys.

The majority of takes by harassment of mysticetes in the NWTT Study Area are caused by anti-submarine warfare (ASW) activities in the Offshore portion of the Study Area. Anti-submarine activities include sources from the MFAS bin (which includes hull-mounted sonar) because they are high level, narrowband sources in the 1–10 kHz range, which intersect what is estimated to be the most sensitive area of hearing for mysticetes. They also are used in a large portion of exercises (see Tables 3 and 4). Most of the takes (90 percent) from the MF1 bin in the NWTT Study Area would result from received levels between 160 and 178 dB SPL, while another 9 percent would result from exposure between 178 and 184 dB SPL. For the remaining active sonar bin types, the percentages are as follows: LF4 = 97 percent between 124 and 142 dB SPL, MF4 = 95 percent between 136 and 148 dB SPL, MF5 = 97 percent between 112 and 142 dB SPL, and HF4 = 91 percent between 100 and 154 dB SPL. For mysticetes, explosive training activities do not result in any take. Explosive testing activities result in a small number of behavioral Level B harassment takes (0–6 per stock) and TTS takes (0–2 per stock). Based on this information, the majority of the Level B behavioral harassment is expected to be of low to sometimes moderate severity and of a relatively shorter duration. No PTS or tissue damage from training and testing activities is anticipated or proposed for authorization for any species or stock.

Research and observations show that if mysticetes are exposed to sonar or other active acoustic sources they may react in a number of ways depending on the characteristics of the sound source, their experience with the sound source, and whether they are migrating or on seasonal feeding or breeding grounds. Behavioral reactions may include alerting, breaking off feeding dives and surfacing, diving or swimming away, or no response at all (DOD, 2017; Nowacek, 2007; Richardson, 1995; Southall *et al.*, 2007). Overall, mysticetes have been observed to be more reactive to acoustic disturbance when a noise source is located directly on their migration route. Mysticetes disturbed while migrating could pause their migration or route around the disturbance, while males en route to breeding grounds have been shown to be less responsive to disturbances. Although some may pause temporarily, they will resume migration shortly after the exposure ends. Animals disturbed while engaged in other activities such as feeding or reproductive behaviors may be more likely to ignore or tolerate the disturbance and continue their natural behavior patterns. Alternately, adult females with calves may be more responsive to stressors. As noted in the *Potential Effects of Specified Activities on Marine Mammals and Their Habitat* section, there are multiple examples from behavioral response studies of odontocetes ceasing their feeding dives when exposed to sonar pulses at certain levels, but alternately, blue whales were less likely to show a visible response to sonar exposures at certain levels when feeding than when traveling. However, Goldbogen *et al.* (2013) indicated some horizontal displacement of deep foraging blue whales in response to simulated MFAS. Southall *et al.* (2019b) observed that after exposure to simulated and operational mid-frequency active sonar, more than 50 percent of blue whales in deep-diving states responded to the sonar, while no behavioral response was observed in shallow-feeding blue whales. Southall *et al.* (2019b) noted that the behavioral responses they observed were generally brief, of low to moderate severity, and highly dependent on exposure context (behavioral state, source-to-whale horizontal range, and prey availability). Most Level B behavioral harassment of mysticetes is likely to be short-term and of low to sometimes moderate severity, with no anticipated effect on reproduction or survival.

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 as they move through an area, although the Navy's activities do not typically use the same training locations day-after-day during multi-day activities, except periodically in instrumented ranges. Therefore, displaced animals could return quickly after even a large activity is completed. In the ocean, the use of Navy sonar and other active acoustic sources is transient and is unlikely to expose the same population of animals repeatedly over a short period of time, especially given the broader-scale movements of mysticetes.

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

As noted previously, when an animal incurs a threshold shift, it occurs in the frequency from that of the source up to one octave above. This means that the vast majority of threshold shifts caused by Navy sonar sources will typically occur in the range of 2–20 kHz (from the 1–10 kHz MF bin, though in a specific narrow band within this range as the sources are narrowband), and if resulting from hull-mounted sonar, will be in the range of 3.5–7 kHz. The majority of mysticete vocalizations occur in frequencies below 1 kHz, which means that TTS incurred by mysticetes will not interfere with conspecific communication. Additionally, many of the other critical sounds that serve as cues for navigation and prey (*e.g.,* waves, fish, invertebrates) occur below a few kHz, which means that detection of these signals will not be inhibited by most threshold shift either. When we look in ocean areas where the Navy has been intensively training and testing with sonar and other active acoustic sources for decades, there is no data suggesting any long-term consequences to reproduction or survival rates of mysticetes from exposure to sonar and other active acoustic sources.

All the mysticete species discussed in this section would benefit from the procedural mitigation measures described earlier in the *Proposed Mitigation Measures* section. Additionally, the Navy would limit activities and employ other measures in mitigation areas that would avoid or reduce impacts to mysticetes. Where these mitigation areas are designed to mitigate impacts to particular species or stocks (gray whales and humpback whales), they are discussed in detail below. Below we compile and summarize the information that supports our preliminary determination that the Navy's activities would not adversely affect any species or stock through effects on annual rates of recruitment or survival for any of the affected mysticete stocks.

Blue Whale (Eastern North Pacific Stock)

Blue whales are listed as endangered under the ESA throughout their range, but there is no ESA designated critical habitat or biologically important areas identified for this species in the NWTT Study Area. The SAR identifies this stock as ''stable''. We further note that this stock was originally listed under the ESA as a result of the impacts from commercial whaling, which is no longer affecting the species. Blue whales are anticipated to be present in summer and winter months and only in the Offshore Area of the Study Area. No mortality from either explosives or vessel strike and no Level A harassment is anticipated or proposed for authorization.

Regarding the magnitude of Level B harassment takes (TTS and behavioral disruption), the number of estimated total instances of take compared to the abundance is less than 1 percent. Given the range of blue whales, this information indicates that only a very small portion of individuals in the stock are likely impacted and repeated exposures of individuals are not anticipated. Regarding the severity of those individual takes by behavioral Level B harassment, we have explained that the duration of any exposure is expected to be between minutes and hours (*i.e.,* relatively short) and the received sound levels largely below 172 dB with a small portion up to 184 dB (*i.e.,* of a moderate or lower level, less likely to evoke a severe response). Regarding the severity of TTS takes, we have explained that they are expected to be low-level, of short duration, and mostly not in a frequency band that would be expected to interfere with blue whale communication or other important low-frequency cues and that the associated lost opportunities and capabilities are not at a level that would impact reproduction or survival.

Altogether, this population is stable, only a very small portion of the stock is anticipated to be impacted, and any individual blue whale is likely to be disturbed at a low-moderate level. No mortality and no Level A harassment is anticipated or proposed for authorization. The low magnitude and severity of harassment effects is not expected to result in impacts on the reproduction or survival of any individuals, let alone have impacts on annual rates of recruitment or survival. For these reasons, we have preliminarily determined, in consideration of all of the effects of the Navy's activities combined, that the proposed authorized take would have a negligible impact on the Eastern North Pacific stock of blue whales.

Fin Whale (Northeast Pacific Stock and California/Oregon/Washington Stock)

Fin whales are listed as endangered under the ESA throughout their range, but no ESA designated critical habitat or biologically important areas are identified for this species in the NWTT Study Area. The SAR identifies these stocks as ''increasing.'' NMFS is proposing to authorize two mortalities of fin whales over the seven years covered by this rule, but because it is not possible to determine from which stock these potential takes would occur, that is 0.29 mortality annually for each stock. The addition of this 0.29 annual mortality still leaves the total annual human-caused mortality well under residual PBR (37.1 for the CA/OR/WA stock and 4.7 for the Northeast Pacific stock) and below the insignificance threshold for both stocks. No mortality from explosives and no Level A harassment is anticipated or proposed for authorization.

Regarding the magnitude of Level B harassment takes (TTS and behavioral disruption), the number of estimated total instances of take compared to the abundance is less than 1 percent for the Northeast Pacific stock and 1.5 percent for the CA/OR/WA stock. This information indicates that only a very small portion of individuals in each stock are likely impacted and repeated exposures of individuals are not anticipated. Regarding the severity of those individual Level B harassment takes by behavioral disruption, we have explained that the duration of any exposure is expected to be between minutes and hours (*i.e.,* relatively short) and the received sound levels largely below 172 dB with a small portion up to 184 dB (*i.e.,* of a moderate or lower level, less likely to evoke a severe response). Regarding the severity of TTS takes, they are expected to be low-level, of short duration, and mostly not in a frequency band that would be expected to interfere with fin whale communication or other important low-frequency cues—and the associated lost opportunities and capabilities are not at a level that would impact reproduction or survival.

Altogether, these populations are increasing, only a small portion of each stock is anticipated to be impacted, and any individual fin whale is likely to be disturbed at a low-moderate level. No Level A harassment is anticipated or proposed to be authorized. This low magnitude and severity of harassment effects is not expected to result in impacts on individual reproduction or survival for any individuals, nor are these harassment takes combined with the proposed authorized mortality expected to adversely affect these stocks through impacts on annual rates of recruitment or survival. For these reasons, we have preliminarily determined, in consideration of all of the effects of the Navy's activities combined, that the proposed authorized take would have a negligible impact on both the Northeast Pacific and CA/OR/WA stocks of fin whales.

Humpback Whale (Central North Pacific Stock)

The Central North Pacific stock of humpback whales consists of winter/spring humpback whale populations of the Hawaiian Islands which migrate primarily to foraging habitat in northern British Columbia/Southeast Alaska, the Gulf of Alaska, and the Bering Sea/Aleutian Islands (Muto *et al.* 2019). Three Feeding Area biologically important areas for humpback whales overlap with the NWTT Study Area: Northern Washington Feeding Area for humpback whales (May–November); Stonewall and Heceta Bank Feeding Area for humpback whales (May–November); and Point St. George Feeding Area for humpback whales (July–November) (Calambokidis *et al.,* 2015). The Marine Species Coastal, Olympic Coast National Marine Sanctuary, Stonewall and Hecta Bank Humpback Whale, and Point St. George Humpback Whale Mitigation Areas overlap with these important foraging areas. The mitigation measures implemented in each of these areas including no MF1 MFAS use seasonally or limited MFAS use year round, no explosive training, *etc.* (see details for each area in the *Proposed Mitigation* section), would reduce the severity of impacts to humpback whales by reducing interference in feeding that could result in lost feeding opportunities or necessitate additional energy expenditure to find other good opportunities.

The SAR identifies this stock as ''increasing'' and the associated Hawaii DPS is not listed under the ESA. No mortality from explosives and no Level A harassment is anticipated or proposed for authorization. NMFS proposes to authorize two mortalities of humpback whales over the seven years covered by this rule, but because it is not possible to determine from which stock these potential takes would occur, that is 0.29 mortality annually for both this stock and the CA/OR/WA stock (discussed separately below). The addition of this 0.29 annual mortality still leaves the total annual human-caused mortality well under both the insignificance threshold and residual PBR (57.6).

Regarding the magnitude of Level B harassment takes (TTS and behavioral disruption), the number of estimated instances of take compared to the abundance is 1 percent. This information and the complicated far-ranging nature of the stock structure indicates that only a very small portion of the stock is likely impacted and repeated exposures of individuals are not anticipated. Regarding the severity of those individual Level B harassment takes by behavioral disruption, we have explained that the duration of any exposure is expected to be between minutes and hours (*i.e.,* relatively short) and the received sound levels largely below 172 dB with a small portion up to 184 dB (*i.e.,* of a moderate or lower level, less likely to evoke a severe response). Regarding the severity of TTS takes, they are expected to be low-level, of short duration, and mostly not in a frequency band that would be expected to interfere with humpback whale communication or other important low-frequency cues, and that the associated lost opportunities and capabilities are not at a level that would impact reproduction or survival.

Altogether, this population is increasing and the associated DPS is not listed as endangered or threatened under the ESA. Only a very small portion of the stock is anticipated to be impacted and any individual humpback whale is likely to be disturbed at a low-moderate level. No Level A harassment is anticipated or proposed to be authorized. This low magnitude and severity of harassment effects is not expected to result in impacts on individual reproduction or survival, nor are these harassment takes combined with the proposed authorized mortality expected to adversely affect this stock through effects on annual rates of recruitment or survival. For these reasons, we have preliminarily determined, in consideration of all of the effects of the Navy's activities combined, that the proposed authorized take would have a negligible impact on the Central North Pacific stock of humpback whales.

Humpback Whale (California/Oregon/Washington Stock)

The CA/OR/WA stock of humpback whales includes individuals from three ESA DPSs: Central America (endangered), Mexico (threatened), and Hawaii (not listed). There is no ESA-designated critical habitat for humpback whales, however NMFS recently proposed to designate critical habitat for humpback whales (84 FR 54354; October 9, 2019). Three Feeding Area biologically important areas for humpback whales overlap with the NWTT Study Area: Northern Washington Feeding Area for humpback whales (May–November); Stonewall and Heceta Bank Feeding Area for humpback whales (May–November); and Point St. George Feeding Area for humpback whales (July–November) (Calambokidis *et al.,* 2015). The Marine Species Coastal, Olympic Coast National Marine Sanctuary, Stonewall and Hecta Bank Humpback Whale, and Point St. George Humpback Whale Mitigation Areas overlap with these important foraging areas. The mitigation measures implemented in each of these areas including no MF1 MFAS use seasonally or limited MFAS use year round, no explosive training, *etc.* (see details for each area in the *Proposed Mitigation* section), would reduce the severity of impacts to humpback whales by reducing interference in feeding that could result in lost feeding opportunities or necessitate additional energy expenditure to find other good opportunities.

The SAR identifies this stock as stable (having shown a long-term increase from 1990 and then leveling off between 2008 and 2014). NMFS proposes to authorize two mortalities over the seven years covered by this rule, or 0.29 mortality annually. With the addition of this 0.29 annual mortality, the total annual human-caused mortality exceeds residual PBR by 9.19. However, as described in more detail in the *Serious Injury or Mortality* section, when total human-caused mortality exceeds PBR, we consider whether the incremental addition of a small amount of mortality proposed for authorization from the specified activity may still result in a negligible impact, in part by identifying whether it is less than 10 percent of PBR. In this case, the mortality proposed for authorization is well below 10 percent of PBR (less than one percent, in fact) and management measures are in place to reduce mortality from other sources. More importantly, as described above in the *Serious Injury or Mortality* section, the mortality of 0.29 proposed for authorization would not delay the time to recovery by more than 1 percent. Given these considerations, the incremental addition of two mortalities over the course of the seven-year Navy rule is not expected to, alone, lead to adverse impacts on the stock through effects on annual rates of recruitment or survival. No mortality from explosives and no Level A harassment is anticipated or proposed for authorization.

Regarding the magnitude of Level B harassment takes (TTS and behavioral disruption), the number of estimated total instances of take compared to the abundance is 3 percent. Given the range of humpback whales, this information indicates that only a very small portion of individuals in the stock are likely impacted and repeated exposures of individuals are not anticipated. Regarding the severity of those individual Level B harassment takes by behavioral disruption, we have explained that the duration of any exposure is expected to be between minutes and hours (*i.e.,* relatively short) and the received sound levels largely below 172 dB with a small portion up to 184 dB (*i.e.,* of a moderate or lower level, less likely to evoke a severe response). Regarding the severity of TTS takes, they are expected to be low-level, of short duration, and mostly not in a frequency band that would be expected to interfere with humpback whale communication or other important low-frequency cues and the associated lost opportunities and capabilities are not at a level that would impact reproduction or survival.

Altogether, this population is stable (even though two of the three associated DPSs are listed as endangered or threatened under the ESA), only a small portion of the stock is anticipated to be impacted, and any individual humpback whale is likely to be disturbed at a low-moderate level. No Level A harassment is anticipated or proposed to be authorized. This low magnitude and severity of harassment effects is not expected to result in impacts on the reproduction or survival of any individuals and, therefore, when combined with the proposed authorized mortality (which our earlier analysis indicated will not, alone, have more than a negligible impact on this stock of humpback whales), the total take is not expected to adversely affect this stock through impacts on annual rates of recruitment or survival. For these reasons, we have preliminarily determined, in consideration of all of the effects of the Navy's activities combined, that the proposed authorized take would have a negligible impact on the CA/OR/WA stock of humpback whales.

Minke Whale (Alaska and California/Oregon/Washington Stocks)

The status of these stocks is unknown and the species is not listed under the ESA. No biologically important areas have been identified for this species in the NWTT Study Area. NMFS proposes to authorize one mortality over the seven years covered by this rule, or 0.14 mortality annually. The addition of this 0.14 annual mortality still leaves the total annual human-caused mortality well under the residual PBR (2.2) and below the insignificance threshold. No mortality from explosives and no Level A harassment is anticipated or proposed for authorization.

Regarding the magnitude of Level B harassment takes (TTS and behavioral disruption), the number of estimated total instances of take compared to the abundance is less than 1 percent for the Alaska stock (based on, to be conservative, the smallest available provisional estimate in the SAR, which is derived from surveys that cover only a portion of the stock's range) and 47.5 percent for the CA/OR/WA stock. Given the range of minke whales, this information indicates that only a portion of individuals in these stocks are likely to be impacted and repeated exposures of individuals are not anticipated. Regarding the severity of those individual Level B harassment takes by behavioral disruption, we have explained that the duration of any exposure is expected to be between minutes and hours (*i.e.,* relatively short) and the received sound levels largely below 172 dB with a small portion up to 184 dB (*i.e.,* of a moderate or lower level, less likely to evoke a severe response). Regarding the severity of TTS takes, they are expected to be low-level, of short duration, and mostly not in a frequency band that would be expected to interfere with minke whale communication or other important low-frequency cues—and the associated lost opportunities and capabilities are not at a level that would impact reproduction or survival.

Altogether, although the status of the stocks is unknown, the species is not listed under the ESA as endangered or threatened, only a portion of these stocks is anticipated to be impacted, and any individual minke whale is likely to be disturbed at a low-moderate level. No Level A harassment is anticipated or proposed to be authorized. This low magnitude and severity of harassment effects is not expected to result in impacts on individual reproduction or survival, nor are these harassment takes combined with the proposed authorized mortality expected to adversely affect these stocks through effects on annual rates of recruitment or survival. For these reasons, we have preliminarily determined, in consideration of all of the effects of the Navy's activities combined, that the proposed authorized take would have a negligible impact on the Alaska and CA/OR/WA stocks of minke whales.

Sei Whale (Eastern North Pacific Stock)

The status of this stock is unknown, however sei whales are listed as endangered under the ESA throughout their range. There is no ESA designated critical habitat or biologically important areas identified for this species in the NWTT Study Area. No mortality from either explosives or vessel strikes and no Level A harassment is anticipated or proposed for authorization.

Regarding the magnitude of Level B harassment takes (TTS and behavioral disruption), the number of estimated total instances of take compared to the abundance is 16 percent. This information and the large range of sei whales suggests that only a small portion of individuals in the stock are likely impacted and repeated exposures of individuals are not anticipated. Regarding the severity of those individual Level B harassment takes by behavioral disruption, we have explained that the duration of any exposure is expected to be between minutes and hours (*i.e.,* relatively short) and the received sound levels largely below 172 dB with a small portion up to 184 dB (*i.e.,* of a moderate or lower level, less likely to evoke a severe response). Regarding the severity of TTS takes, they are expected to be low-level, of short duration, and mostly not in a frequency band that would be expected to interfere with sei whale communication or other important low-frequency cues and the associated lost opportunities and capabilities are not at a level that would impact reproduction or survival.

Altogether, the status of the stock is unknown and the species is listed as endangered, but only a small portion of the stock is anticipated to be impacted and any individual sei whale is likely to be disturbed at a low-moderate level. No mortality and no Level A harassment is anticipated or proposed for authorization. This low magnitude and severity of harassment effects is not expected to result in impacts on individual reproduction or survival, much less annual rates of recruitment or survival. For these reasons, we have preliminarily determined, in consideration of all of the effects of the Navy's activities combined, that the proposed authorized take would have a negligible impact on the Eastern North Pacific stock of sei whales.

Gray Whale (Eastern North Pacific Stock)

The SAR identifies this stock as ''increasing'' and the associated DPS is not listed under the ESA. The NWTT Study Area overlaps with the offshore Northwest Washington and the Northern Puget Sound gray whale Feeding biologically important areas, and a portion of the Northwest coast of Washington approximately from Pacific Beach (WA) and extending north to the Strait of Juan de Fuca overlaps with the gray whale Migrations Corridor biologically important area. The Marine Species Coastal, Olympic Coast National Marine Sanctuary, Stonewall and Hecta Bank Humpback Whale, and Point St. George Humpback Whale, and Northern Puget Sound Gray Whale Mitigation Areas overlap with these important foraging and migration areas. The mitigation measures implemented in each of these areas including no MF1 MFAS use seasonally or limited MFAS use year round, no explosive training, *etc.* (see details for each area in the *Proposed Mitigation* section), would reduce the severity of impacts to gray whales by reducing interference in feeding and migration that could result in lost feeding opportunities or necessitate additional energy expenditure to find other good foraging opportunities or move migration routes.

NMFS proposes to authorize one mortality over the seven years covered by this rule, or 0.14 mortality annually. The addition of this 0.14 annual mortality still leaves the total annual human-caused mortality well under both the insignificance threshold and residual PBR (661.6). No mortality from explosives and no Level A harassment is anticipated or proposed for authorization.

Regarding the magnitude of Level B harassment takes (TTS and behavioral disruption), the number of estimated total instances of take compared to the abundance is less than 1 percent. This information indicates that only a very small portion of individuals in the stock are likely to be impacted and repeated exposures of individuals are not anticipated. Regarding the severity of those individual Level B harassment takes by behavioral disruption, we have explained that the duration of any exposure is expected to be between minutes and hours (*i.e.,* relatively short) and the received sound levels largely below 172 dB with a small portion up to 184 dB (*i.e.,* of a moderate or lower level, less likely to evoke a severe response). Regarding the severity of TTS takes, they are expected to be low-level, of short duration, and mostly not in a frequency band that would be expected to interfere with gray whale communication or other important low-frequency cues and that the associated lost opportunities and capabilities are not at a level that would impact reproduction or survival.

Altogether, while we have considered the impacts of the gray whale UME, this population of gray whales is not endangered or threatened under the ESA and the stock is increasing. No Level A harassment is anticipated or proposed to be authorized. Only a very small portion of the stock is anticipated to be impacted by Level B harassment and any individual gray whale is likely to be disturbed at a low-moderate level. This low magnitude and severity of harassment effects is not expected to result in impacts to reproduction or survival for any individuals, nor are these harassment takes combined with the proposed authorized mortality of one whale over the seven-year period expected to adversely affect this stock through impacts on annual rates of recruitment or survival. For these reasons, we have preliminarily determined, in consideration of all of the effects of the Navy's activities combined, that the proposed authorized take would have a negligible impact on the Eastern North Pacific stock of gray whales.

Odontocetes

This section builds on the broader discussion above and brings together the discussion of the different types and amounts of take that different species and stocks could potentially or would likely incur, the applicable mitigation, and the status of the species and stock to support the negligible impact determinations for each species or stock. We have described (earlier in this section) the unlikelihood of any masking having effects that would impact the reproduction or survival of any of the individual marine mammals affected by the Navy's activities. We have also described above in the Potential Effects of Specified Activities on Marine Mammals and their Habitat section the unlikelihood of any habitat impacts having effects that would impact the reproduction or survival of any of the individual marine mammals affected by the Navy's activities. For odontocetes, there is no anticipated M/SI or tissue damage from sonar or explosives for any species. Here, we include information that applies to all of the odontocete species, which are then further divided and discussed in more detail in the following subsections: Sperm whales, dwarf sperm whales, and pygmy sperm whales; beaked whales; dolphins and small whales; and porpoises. These subsections include more specific information about the groups, as well as conclusions for each species or stock represented.

The majority of takes by harassment of odontocetes in the NWTT Study Area are caused by sources from the MFAS bin (which includes hull-mounted sonar) because they are high level, typically narrowband sources at a frequency (in the 1–10 kHz range) that overlaps a more sensitive portion (though not the most sensitive) of the MF hearing range and they are used in a large portion of exercises (see Tables 3 and 4). For odontocetes other than beaked whales and porpoises (for which these percentages are indicated separately in those sections), most of the takes (96 percent) from the MF1 bin in the NWTT Study Area would result from received levels between 160 and 172 dB SPL. For the remaining active sonar bin types, the percentages are as follows: LF4 = 99 percent between 124 and 154 dB SPL, MF4 = 99 percent between 136 and 166 dB SPL, MF5 = 98 percent between 112 and 148 dB SPL, and HF4 = 95 percent between 100 and 160 dB SPL. Based on this information, the majority of the takes by Level B behavioral harassment are expected to be low to sometimes moderate in nature, but still of a generally shorter duration.

For all odontocetes, takes from explosives (Level B behavioral harassment, TTS, or PTS) comprise a very small fraction (and low number) of those caused by exposure to active sonar. For the following odontocetes, zero takes from explosives are expected to occur: Common bottlenose dolphins, killer whales, short-beaked common dolphins, short-finned pilot whales, the Alaska stock of Dall's porpoises, Southeast Alaska stock of harbor porpoises, sperm whales, Baird's beaked whale, Cuvier's beaked whale, and *Mesoplodon* species. For Level B behavioral disruption from explosives, with the exception of porpoises, one take is anticipated for the remaining species/stocks. For the CA/OR/WA stock of Dall's porpoise and the remaining three harbor porpoise stocks 1–91 Level B behavioral takes from explosives are anticipated. Similarly the instances of TTS and PTS expected to occur from explosives for all remaining species/stocks, with the exception of porpoises, are anticipated to be low (1–3 for TTS and 1 for PTS). Because of the lower TTS and PTS thresholds for HF odontocetes, for the CA/OR/WA stock of Dall's porpoise and the remaining three harbor porpoise stocks, TTS takes range from 61–214 and PTS takes range from 27–86.

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

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

Sperm Whale, Dwarf Sperm Whale, and Pygmy Sperm Whale

This section builds on the broader odontocete discussion above and brings together the discussion of the different types and amounts of take that different species and stocks could potentially or would likely incur, the applicable mitigation, and the status of the species and stocks to support the preliminary negligible impact determinations for each species or stock. For sperm whales, there is no predicted PTS from sonar or explosives and no predicted tissue damage from explosives. For dwarf sperm whales and pygmy sperm whales (described as *Kogia* species below) no mortality or tissue damage from sonar or explosives is anticipated or proposed for authorization and only one PTS take is predicted.

In Table 53 below for sperm whales and *Kogia* species, we indicate the total annual numbers of take by mortality, Level A and Level B harassment, and a number indicating the instances of total take as a percentage of abundance.

Table 53 -- Annual estimated takes by Level B harassment, Level A harassment, and mortality for sperm whales, dwarf sperm whales, and pygmy sperm whales in the NWTT 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 (NMFS SARs)*	Instances of total take as percentage of abundance
		Level B Harassment		Level A Harassment		Mortality			
Species	Stock	Behavioral Disturbance	TTS (may also include disturbance)	PTS	Tissue Damage				
Suborder Odontoceti (toothed whales)									
Family Physeteridae (sperm whale)									
Sperm whale	CA/OR/WA	834	5	0	0	0.14	839	1,997	42
Family Kogiidae (sperm whales)									
Kogia species	CA/OR/WA	364	518	1	0	0	883	4,111	21

*Presented in the 2019 draft SARs or most recent SAR.

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

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

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

Sperm Whale (California/Oregon/Washington Stock)

The SAR identifies the CA/OR/WA stock of sperm whales as ''stable'' and the species is listed as endangered under the ESA. No critical habitat has been designated for sperm whales under the ESA and there are no biologically important areas for sperm whales in the NWTT Study Area. NMFS proposes to authorize one mortality for the CA/OR/WA stock of sperm whales over the seven years covered by this rule, or 0.14 mortality annually. The addition of this 0.14 annual mortality still leaves the total human-caused mortality under residual PBR (2.1) and below the insignificance threshold. No mortality from explosives and no Level A harassment is anticipated or proposed for authorization.

Regarding the magnitude of Level B harassment takes (TTS and behavioral disruption), the number of estimated total instances of take compared to the abundance is 42 percent for sperm whales. Given the range of this stock (which extends the entire length of the West Coast, as well as beyond the U.S. EEZ boundary), this information indicates that only a portion of the individuals in the stock are likely to be impacted and repeated exposures of individuals are not anticipated. Additionally, while interrupted feeding bouts are a known response and concern for odontocetes, we also know that there are often viable alternative habitat options in the relative vicinity. Regarding the severity of those individual Level B harassment takes by behavioral disruption, we have explained that the duration of any exposure is expected to be between minutes and hours (*i.e.,* relatively short) and the received sound levels largely below 172 dB (*i.e.,* of a lower, to occasionally moderate, level and less likely to evoke a severe response). Regarding the severity of TTS takes, they are expected to be low-level, of short duration, and mostly not in a frequency band that would be expected to interfere with sperm whale communication or other important low-frequency cues, and that the associated lost opportunities and capabilities are not at a level that will impact reproduction or survival.

Altogether, this population is stable (even though the species is listed under the ESA), only a portion of the stock is anticipated to be impacted, and any individual sperm whale is likely to be disturbed at a low-moderate level. No Level A harassment is anticipated or proposed to be authorized. This low magnitude and severity of harassment effects is not expected to result in impacts on individual reproduction or survival for any individuals, nor are these harassment takes combined with the proposed authorized mortality expected to adversely affect this stock through impacts on annual rates of recruitment or survival. For these reasons, we have preliminarily determined, in consideration of all of the effects of the Navy's activities combined, that the proposed authorized take would have a negligible impact on the CA/OR/WA stock of sperm whales.

Kogia Species (California/Oregon/Washington Stocks)

The status of the CA/OR/WA stocks of pygmy and dwarf sperm whales (*Kogia* species) is unknown and neither are listed under the ESA. There are no biologically important areas for *Kogia* in the NWTT Study Area. No mortality or Level A harassment from tissue damage are anticipated or proposed for authorization, and one PTS Level A harassment take is expected and proposed for authorization. Due to their pelagic distribution, small size, and cryptic behavior, pygmy sperm whales and dwarf sperm whales (*Kogia* species) are rarely sighted during at-sea surveys and are difficult to distinguish between when visually observed in the field. Many of the relatively few observations of *Kogia* species off the U.S. West Coast were not identified to species. All at-sea sightings of Kogia species have been identified as pygmy sperm whales or *Kogia* species generally. Stranded dwarf sperm and pygmy sperm whales have been found on the U.S. West Coast, however dwarf sperm whale strandings are rare. NMFS SARs suggest that the majority of *Kogia* sighted off the U.S. West Coast were likely pygmy sperm whales. As such, the stock estimate in the NMFS SAR for pygmy sperm whales is the estimate derived for all *Kogia* species in the region (Barlow, 2016), and no separate abundance estimate can be determined for dwarf sperm whales, though some low number likely reside in the U.S. EEZ. Due to the lack of an abundance estimate it is not possible to predict the amount of Level A and Level B harassment take of dwarf sperm whales and therefore take estimates are identified as *Kogia* whales (including both pygmy and dwarf sperm whales). We assume only a small portion of those takes are likely to be dwarf sperm whales as the available information indicates that the density and abundance in the U.S. EEZ is low.

Regarding the magnitude of Level B harassment takes (TTS and behavioral disruption), the number of estimated total instances of take compared to the abundance is 21 percent. Given the range of these stocks (which extends the entire length of the West Coast, as well as beyond the U.S. EEZ boundary), this information indicates that only a portion of the individuals in the stocks are likely to be impacted and repeated exposures of individuals are not anticipated. Additionally, while interrupted feeding bouts are a known response and concern for odontocetes, we also know that there are often viable alternative habitat options in the relative vicinity. Regarding the severity of those individual Level B harassment takes by behavioral disruption, we have explained that the duration of any exposure is expected to be between minutes and hours (*i.e.,* relatively short) and the received sound levels largely below 172 dB (*i.e.,* of a lower, to occasionally moderate, level and less likely to evoke a severe response). Regarding the severity of TTS takes, they are expected to be low-level, of short duration, and mostly not in a frequency band that would be expected to interfere with sperm whale communication or other important low-frequency cues, and that the associated lost opportunities and capabilities are not at a level that will impact reproduction or survival. For these same reasons (low level and frequency band), while a small permanent loss of hearing sensitivity (PTS) may include some degree of energetic costs for compensating or may mean some small loss of opportunities or detection capabilities, at the expected scale the estimated one Level A harassment take by PTS would be unlikely to impact behaviors, opportunities, or detection capabilities to a degree that would interfere with reproductive success or survival of the affected individual. Thus, the one Level A harassment take by PTS for these stocks would be unlikely to affect rates of recruitment and survival for the stock.

Altogether, although the status of the stocks is unknown, these species are not listed under the ESA as endangered or threatened, only a portion of these stocks is anticipated to be impacted, and any individual *Kogia* whale is likely to be disturbed at a low-moderate level. This low magnitude and severity of harassment effects is not expected to result in impacts on the reproduction or survival of any individuals, let alone have impacts on annual rates of recruitment or survival. One individual could be taken by PTS annually of likely low severity. A small permanent loss of hearing sensitivity (PTS) may include some degree of energetic costs for compensating or may mean some small loss of opportunities or detection capabilities, but at the expected scale the estimated one Level A harassment take by PTS would be unlikely to impact behaviors, opportunities, or detection capabilities to a degree that would interfere with reproductive success or survival of that individual, let alone affect annual rates of recruitment or survival. For these reasons, we have preliminarily determined, in consideration of all of the effects of the Navy's activities combined, that the proposed authorized take would have a negligible impact on the CA/OR/WA stocks of *Kogia* whales.

Beaked Whales

This section builds on the broader odontocete discussion above and brings together the discussion of the different types and amounts of take that different beaked whale species and stocks would likely incur, the applicable mitigation for stocks, and the status of the species and stocks to support the preliminary negligible impact determinations for each species or stock. For beaked whales, there is no anticipated Level A harassment by PTS or tissue damage from sonar or explosives, and no mortality is anticipated or proposed for authorization.

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

Table 54 -- Annual estimated takes by Level B harassment, Level A harassment, and mortality for beaked whales in the NWTT 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 (NMFS SARs)*	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			
Suborder Odontoceti (toothed whales)									
Family Ziphiidae (beaked whales)									
Baird's beaked whale	CA/OR/WA	976	0	0	0	0	976	2,697	36
Cuvier's beaked whale	CA/OR/WA	2,535	4	0	0	0	2,539	3,274	78
Mesoplodon species	CA/OR/WA	1,119	3	0	0	0	1,122	3,044	37

*Presented in the 2019 draft SARs or most recent SAR.

This first paragraph provides specific information that is in lieu of the parallel information provided for odontocetes as a whole. The majority of takes by harassment of beaked whales in the NWTT Study Area are caused by sources from the MFAS bin (which includes hull-mounted sonar) because they are high level narrowband sources that fall within the 1–10 kHz range, which overlap a more sensitive portion (though not the most sensitive) of the MF hearing range. Also, of the sources expected to result in take, they are used in a large portion of exercises (see Tables 3 and 4). Most of the takes (95 percent) from the MF1 bin in the NWTT Study Area would result from received levels between 142 and 160 dB SPL. For the remaining active sonar bin types, the percentages are as follows: LF4 = 99 percent between 118 and 148 dB SPL, MF4 = 97 percent between 124 and 148 dB SPL, MF5 = 99 percent between 100 and 148 dB SPL, and HF4 = 97 percent between 100 and 154 dB SPL. Given the levels they are exposed to and beaked whale sensitivity, some responses would be of a lower severity, but many would likely be considered moderate, but still of generally short duration.

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

Beaked whales have been documented to exhibit avoidance of human activity or respond to vessel presence (Pirotta *et al.,* 2012). Beaked whales were observed to react negatively to survey vessels or low altitude aircraft by quick diving and other avoidance maneuvers, and none were observed to approach vessels (Wursig *et al.,* 1998). It has been speculated for some time that beaked whales might have unusual sensitivities to sonar sound due to their likelihood of stranding in conjunction with MFAS use, although few definitive causal relationships between MFAS use and strandings have been documented (see *Potential Effects of Specified Activities on Marine Mammals and their Habitat* section).

Research and observations show that if beaked whales are exposed to sonar or other active acoustic sources, they may startle, break off feeding dives, and avoid the area of the sound source to levels of 157 dB re: 1 µPa, or below (McCarthy *et al.,* 2011). Acoustic monitoring during actual sonar exercises revealed some beaked whales continuing to forage at levels up to 157 dB re: 1 µPa (Tyack *et al.,* 2011). Stimpert *et al.* (2014) tagged a Baird's beaked whale, which was subsequently exposed to simulated MFAS. Changes in the animal's dive behavior and locomotion were observed when received level reached 127 dB re: 1 µPa. However, Manzano-Roth *et al.* (2013) found that for beaked whale dives that continued to occur during MFAS activity, differences from normal dive profiles and click rates were not detected with estimated received levels up to 137 dB re: 1 µPa while the animals were at depth during their dives. In research done at the Navy's fixed tracking range in the Bahamas, animals were observed to leave the immediate area of the anti-submarine warfare training exercise (avoiding the sonar acoustic footprint at a distance where the received level was ''around 140 dB SPL'', according to Tyack *et al.* (2011)), but return within a few days after the event ended (Claridge and Durban, 2009; McCarthy *et al.,* 2011; Moretti *et al.,* 2009, 2010; Tyack *et al.,* 2010, 2011). Tyack *et al.* (2011) report that, in reaction to sonar playbacks, most beaked whales stopped echolocating, made long slow ascent to the surface, and moved away from the sound. A similar behavioral response study conducted in Southern California waters during the 2010–2011 field season found that Cuvier's beaked whales exposed to MFAS displayed behavior ranging from initial orientation changes to avoidance responses characterized by energetic fluking and swimming away from the source (DeRuiter *et al.,* 2013b). However, the authors did not detect similar responses to incidental exposure to distant naval sonar exercises at comparable received levels, indicating that context of the exposures (*e.g.,* source proximity, controlled source ramp-up) may have been a significant factor. The study itself found the results inconclusive and meriting further investigation. Cuvier's beaked whale responses suggested particular sensitivity to sound exposure consistent with results for Blainville's beaked whale.

Populations of beaked whales and other odontocetes on the Bahamas and other Navy fixed ranges that have been operating for decades appear to be stable. Behavioral reactions (avoidance of the area of Navy activity) seem likely in most cases if beaked whales are exposed to anti-submarine sonar within a few tens of kilometers, especially for prolonged periods (a few hours or more) since this is one of the most sensitive marine mammal groups to anthropogenic sound of any species or group studied to date and research indicates beaked whales will leave an area where anthropogenic sound is present (De Ruiter *et al.,* 2013; Manzano-Roth *et al.,* 2013; Moretti *et al.,* 2014; Tyack *et al.,* 2011). Research involving tagged Cuvier's beaked whales in the SOCAL Range Complex reported on by Falcone and Schorr (2012, 2014) indicates year-round prolonged use of the Navy's training and testing area by these beaked whales and has documented movements in excess of hundreds of kilometers by some of those animals. Given that some of these animals may routinely move hundreds of kilometers as part of their normal pattern, leaving an area where sonar or other anthropogenic sound is present may have little, if any, cost to such an animal. Photo identification studies in the SOCAL Range Complex, a Navy range that is utilized for training and testing, have identified approximately 100 Cuvier's beaked whale individuals with 40 percent having been seen in one or more prior years, with re-sightings up to seven years apart (Falcone and Schorr, 2014). These results indicate long-term residency by individuals in an intensively used Navy training and testing area, which may also suggest a lack of long-term consequences as a result of exposure to Navy training and testing activities. More than eight years of passive acoustic monitoring on the Navy's instrumented range west of San Clemente Island documented no significant changes in annual and monthly beaked whale echolocation clicks, with the exception of repeated fall declines likely driven by natural beaked whale life history functions (DiMarzio *et al.,* 2018). Finally, results from passive acoustic monitoring estimated that regional Cuvier's beaked whale densities were higher than indicated by NMFS' broad scale visual surveys for the United States West Coast (Hildebrand and McDonald, 2009).

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

Baird's and Cuvier's Beaked Whales and Mesoplodon Species (California/Oregon/Washington Stocks)

The CA/OR/WA stocks of Baird's beaked whale, Cuvier's beaked whale, and *Mesoplodon* species are not listed as endangered or threatened species under the ESA, and have been identified as ''stable,'' ''decreasing,'' and ''increasing,'' respectively, in the SARs. There are no biologically important areas for beaked whales in the NWTT Study Area. No mortality or Level A harassment from sonar or explosives is expected or proposed for authorization.

No methods are available to distinguish between the six species of *Mesoplodon* beaked whales from the CA/OR/WA stocks (Blainville's beaked whale (*M. densirostris*), Perrin's beaked whale (*M. perrini*), Lesser beaked whale (*M. peruvianus*), Stejneger's beaked whale (*M. stejnegeri*), Gingko-toothed beaked whale (*M. gingkodens*), and Hubbs' beaked whale (*M. carlhubbsi*)) when observed during at-sea surveys (Carretta *et al.,* 2019). Bycatch and stranding records from the region indicate that Hubb's beaked whale is the most commonly encountered (Carretta *et al.,* 2008, Moore and Barlow, 2013). As indicated in the SAR, no species-specific abundance estimates are available, the abundance estimate includes all CA/OR/WA *Mesoplodon* species, and the six species are managed as one unit. Due to the lack of species-specific abundance estimates it is not possible to predict the take of individual species and take estimates are identified as *Mesoplodon* species. Therefore our analysis considers these *Mesoplodon* species together.

Regarding the magnitude of Level B harassment takes (TTS and behavioral disruption), the number of estimated total instances of take compared to the abundance is 36 to 78 percent. This information indicates that up to 78 percent of the individuals in these stocks are likely to be impacted, depending on the stock, though the more likely scenario is that a smaller portion than that would be taken, and a subset of them would be taken on a few days, with no indication that these days would be sequential. Regarding the severity of those individual Level B harassment takes by behavioral disruption, we have explained that the duration of any exposure is expected to be between minutes and hours (*i.e.,* relatively short) and the received sound levels largely below 166 dB, though with beaked whales, which are considered somewhat more sensitive, this could mean that some individuals will leave preferred habitat for a day (*i.e.,* moderate level takes). However, while interrupted feeding bouts are a known response and concern for odontocetes, we also know that there are often viable alternative habitat options nearby. Regarding the severity of TTS takes, they are expected to be low-level, of short duration, and mostly not in a frequency band that would be expected to interfere with beaked whale communication or other important low-frequency cues, and that the associated lost opportunities and capabilities are not at a level that would impact reproduction or survival. As mentioned earlier in the odontocete overview, we anticipate more severe effects from takes when animals are exposed to higher received levels or sequential days of impacts.

Altogether, none of these species are listed as threatened or endangered under the ESA, only a portion of the stocks are anticipated to be impacted, and any individual beaked whale is likely to be disturbed at a moderate or sometimes low level. This low magnitude and low to moderate severity of harassment effects is not expected to result in impacts on individual reproduction or survival, let alone annual rates of recruitment or survival. No mortality and no Level A harassment is anticipated or proposed for authorization. For these reasons, we have preliminarily determined, in consideration of all of the effects of the Navy's activities combined, that the proposed authorized take would have a negligible impact on the CA/OR/WA stocks of beaked whales.

Dolphins and Small Whales

This section builds on the broader odontocete discussion above and brings together the discussion of the different types and amounts of take that different dolphin and small whale species and stocks would likely incur, the applicable mitigation for stocks, and the status of the species and stocks to support the preliminary negligible impact determinations for each species or stock. For all dolphin and small whale stocks discussed here except for the CA/OR/WA stocks of Northern right whale dolphin and Pacific white-sided dolphin there is no predicted PTS from sonar or explosives, and no mortality or tissue damage from sonar or explosives is anticipated or proposed for authorization. For the CA/OR/WA stocks of Northern right whale dolphin and Pacific white-sided dolphin no mortality or tissue damage from sonar or explosives is anticipated or proposed for authorization and one Level A harassment by PTS from testing activities is predicted for each stock.

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

Table 55. Annual estimated takes by Level B harassment, Level A harassment, and mortality for dolphins and small whales in the NWTT 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 (NMFS SARs)*	Instances of total take as percentage of abundance
		Level B Harassment		Level A Harassment		Mortality			
Species	Stock	Behavioral Disturbance	TTS (may also include disturbance)	PTS	Tissue Damage				
Family Delphinidae (dolphins)									
Common bottlenose dolphin	CA/OR/WA Offshore	8	0	0	0	0	8	1,924	<1
Killer whale	Eastern North Pacific Alaskan Resident	34	0	0	0	0	34	2,347	1
	West Coast Transient	210	22	0	0	0	232	243	95
	Eastern North Pacific Offshore	152	5	0	0	0	157	300	52
	Eastern North Pacific Southern Resident	49	2	0	0	0	51	75	68
Northern right whale dolphin	CA/OR/WA	20,671	1,029	1	0	0	21,701	26,556	82
Pacific white-sided dolphin	North Pacific	101	0	0	0	0	101	26,880	<1
	CA/OR/WA	19,593	1,372	1	0	0	20,966	26,814	78
Risso's dolphin	CA/OR/WA	6,080	275	0	0	0	6,355	6,336	100
Short-beaked common dolphin	CA/OR/WA	2,103	46	0	0	0	2,149	969,861	<1
Short-finned pilot whale	CA/OR/WA	87	1	0	0	0	88	836	11
Striped dolphin	CA/OR/WA	763	20	0	0	0	783	29,211	3

*Presented in the 2019 draft SARs or most recent SAR.

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

Research and observations show that if delphinids are exposed to sonar or other active acoustic sources they may react in a number of ways depending on their experience with the sound source and what activity they are engaged in at the time of the acoustic exposure. Delphinids may not react at all until the sound source is approaching within a few hundred meters to within a few kilometers depending on the environmental conditions and species. Some dolphin species (the more surface-dwelling taxa—typically those with ''dolphin'' in the common name, such as bottlenose dolphins, spotted dolphins, spinner dolphins, rough-toothed dolphins, *etc.,* but not Risso's dolphin), especially those residing in more industrialized or busy areas, have demonstrated more tolerance for disturbance and loud sounds and many of these species are known to approach vessels to bow-ride. These species are often considered generally less sensitive to disturbance. Dolphins and small whales that reside in deeper waters and generally have fewer interactions with human activities are more likely to demonstrate more typical avoidance reactions and foraging interruptions as described above in the odontocete overview.

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

Killer Whales (Eastern North Pacific Alaskan Resident, West Coast Transient, Eastern North Pacific Offshore, and Eastern North Pacific Southern Resident Stocks)

With the exception of the Eastern North Pacific Southern Resident stock (Southern Resident killer whale DPS) which is listed as endangered under the ESA, killer whale stocks in the NWTT Study Area are not listed under the ESA. ESA-designated critical habitat for the Southern Resident killer whale DPS overlaps with the NWTT Study area in the Strait of Juan de Fuca. No biologically important areas for killer whales have been identified in the NWTT Study Area. The Eastern North Pacific Southern Resident stock is small (75 individuals) and has been decreasing in recent years. The Eastern North Pacific Offshore stock is reported as ''stable'', and the other stocks have unknown population trends. No mortality or Level A harassment is anticipated or proposed for authorization for any of these stocks.

The proposed Marine Species Coastal, Olympic Coast National Marine Sanctuary, Stonewall and Heceta Bank Humpback Whale, Point St. George Humpback Whale, and Puget Sound and Strait of Juan de Fuca Mitigation Areas overlap with important Eastern North Pacific Southern Resident (Southern Resident DPS) killer whale foraging and migration habitat. Procedural mitigation along with the mitigation measures implemented in each of these areas include no MF1 MFAS use seasonally or limited MFAS use year round, no explosive training, *etc.* (see details for each area in the *Proposed Mitigation Measures* section), would reduce the severity of impacts to Eastern North Pacific Southern Resident (Southern Resident DPS) killer whales by reducing interference in feeding and migration that could result in lost feeding opportunities or necessitate additional energy expenditure to find other good foraging opportunities or migration routes.

Regarding the magnitude of Level B harassment takes (TTS and behavioral disruption), the number of estimated total instances of take compared to the abundance ranges from 1 percent (Eastern North Pacific Alaskan Resident) to 95 percent (West Coast Transient). The number of estimated total instances of take compared to the abundance for the Eastern North Pacific Southern Resident is 68 percent. This information indicates that only a very small portion of the Eastern North Pacific Alaskan Resident stock is likely impacted and repeated exposures of individuals are not anticipated. This information also indicates that a few to up to 95 percent of individuals of the remaining three stocks could be impacted, if each were taken only one day per year, though the more likely scenario is that a smaller portion than that would be taken, and a subset of them would be taken multiple days with no indication that these days would be sequential. Regarding the severity of those individual Level B harassment takes by behavioral disruption, we have explained that the duration of any exposure is expected to be between minutes and hours (*i.e.,* relatively short) and the received sound levels largely below 172 dB (*i.e.,* of a lower, to occasionally moderate, level and less likely to evoke a severe response). Regarding the severity of TTS takes, they are expected to be low-level, of short duration, and mostly not in a frequency band that would be expected to interfere with killer whale communication or other important low-frequency cues, and that the associated lost opportunities and capabilities are not at a level that would impact reproduction or survival.

Altogether, with the exception of the Eastern North Pacific Southern Resident stock which is listed as endangered under the ESA, these killer whale stocks are not listed under the ESA. Only a portion of these killer whale stocks is anticipated to be impacted, and any individual is likely to be disturbed at a low-moderate level, with the taken individuals likely exposed on one day or a few days. Even acknowledging the small and declining stock size of the Eastern North Pacific Southern Resident stock, this low magnitude and severity of harassment effects is unlikely to result in impacts on individual reproduction or survival, much less annual rates of recruitment or survival of any of the stocks. No mortality or Level A harassment is anticipated or proposed for authorization for any of the stocks. For these reasons, we have preliminarily determined, in consideration of all of the effects of the Navy's activities combined, that the proposed authorized take would have a negligible impact on these killer whale stocks.

All other dolphin and small whale stocks

None of these stocks is listed under the ESA and their stock statuses are considered ''unknown,'' except for the CA/OR/WA stock of short-beaked common dolphin which is described as ''increasing''. No biologically important areas for these stocks have been identified in the NWTT Study Area. No mortality or serious injury is anticipated or proposed for authorization. With the exception of one Level A harassment PTS take to the CA/OR/WA stocks of Northern right whale dolphin and Pacific white-sided dolphin, no Level A harassment by PTS or tissue damage is expected or proposed for authorization for these stocks.

Regarding the magnitude of Level B harassment takes (TTS and behavioral disruption), the number of estimated total instances of take compared to the abundance ranges from less than 1 percent (North Pacific stock of Pacific white-sided dolphins, CA/OR/WA Offshore stock of common bottlenose dolphins, and CA/OR/WA stock of short-beaked common dolphin) to 100 percent (CA/OR/WA stock of Risso's dolphins). All stocks except for the CA/OR/WA stocks of Risso's dolphin, Pacific white-sided dolphin, and Northern right whale dolphin have estimated total instances of take compared to the abundances less than or equal to 11 percent. This information indicates that only a small portion of these stocks is likely impacted and repeated exposures of individuals are not anticipated. The CA/OR/WA stocks of Risso's dolphins, Pacific white-sided dolphin, and Northern right whale dolphin have estimated total instances of take compared to the abundances that range from 78 to 100 percent. This information indicates that up to 100 percent of the individuals of these stocks could be impacted, if each were taken only one day per year, though the more likely scenario is that a smaller portion than that would be taken, and a subset of them would be taken on a few days, with no indication that these days would be sequential. Regarding the severity of those individual Level B harassment takes by behavioral disruption, we have explained that the duration of any exposure is expected to be between minutes and hours (*i.e.,* relatively short) and the received sound levels largely below 172 dB (*i.e.,* of a lower, to occasionally moderate, level and less likely to evoke a severe response). However, while interrupted feeding bouts are a known response and concern for odontocetes, we also know that there are often viable alternative habitat options nearby. Regarding the severity of TTS takes, they are expected to be low-level, of short duration, and mostly not in a frequency band that would be expected to interfere with dolphin and small whale communication or other important low-frequency cues, and that the associated lost opportunities and capabilities are not at a level that would impact reproduction or survival. For these same reasons (low level and frequency band), while a small permanent loss of hearing sensitivity (PTS) may include some degree of energetic costs for compensating or may mean some small loss of opportunities or detection capabilities, at the expected scale the estimated one Level A harassment take by PTS for the CA/OR/WA stocks of Northern right whale dolphin and Pacific white-sided dolphin would be unlikely to impact behaviors, opportunities, or detection capabilities to a degree that would interfere with reproductive success or survival of that individual. Thus the one Level A harassment take by PTS for these stocks would be unlikely to affect rates of recruitment and survival for the stock.

Altogether, though the status of these stocks is largely unknown, none of these stocks is listed under the ESA and any individual is likely to be disturbed at a low-moderate level, with the taken individuals likely exposed on one to a few days. This low magnitude and severity of harassment effects is not expected to result in impacts on individual reproduction or survival. One individual each from the CA/OR/WA stocks of Northern right whale dolphin and Pacific white-sided dolphin could be taken by PTS annually of likely low severity. A small permanent loss of hearing sensitivity (PTS) may include some degree of energetic costs for compensating or may mean some small loss of opportunities or detection capabilities, but at the expected scale the estimated Level A harassment takes by PTS for the CA/OR/WA stocks of Northern right whale dolphin and Pacific white-sided dolphin would be unlikely to impact behaviors, opportunities, or detection capabilities to a degree that would interfere with reproductive success or survival of any individuals, let alone annual rates of recruitment or survival. No mortality is anticipated or proposed for authorization. For these reasons, we have preliminarily determined, in consideration of all of the effects of the Navy's activities combined, that the proposed authorized take would have a negligible impact on these stocks of small whales and dolphins.

Porpoises

This section builds on the broader odontocete discussion above and brings together the discussion of the different types and amounts of take that different porpoise species or stocks would likely incur, the applicable mitigation, and the status of the species and stock to support the negligible impact determinations for each species or stock. For porpoises, there is no anticipated M/SI or tissue damage from sonar or explosives for any species.

In Table 56 below for porpoises, we indicate the total annual numbers of take by mortality, Level A harassment and Level B harassment, and a number indicating the instances of total take as a percentage of abundance.

Table 56 -- Annual estimated takes by Level B harassment, Level A harassment, and mortality for porpoises in the NWTT 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 (NMFS SARs)*	Instances of total take as percentage of abundance
		Level B Harassment		Level A Harassment		Mortality			
Species	Stock	Behavioral Disturbance	TTS (may also include disturbance)	PTS	Tissue Damage				
Family Phocoenidae (porpoises)									
Dall's porpoise	Alaska	179	459	0	0	0	638	83,400	<1
	CA/OR/WA	13,407	20,290	98	0	0	33,795	25,750	131
Harbor porpoise	Southeast Alaska	92	38	0	0	0	130	1,354	10
	Northern OR/WA Coast	31,602	20,810	103	0	0	52,515	21,487	244
	Northern CA/ Southern OR	1,691	348	86	0	0	2,125	35,769	6
	Washington Inland Waters	15,146	14,397	180	0	0	29,723	11,233	265

*Presented in the 2019 draft SARs or most recent SAR.

The majority of takes by harassment of harbor porpoises in the NWTT Study Area are caused by sources from the MFAS bin (which includes hull-mounted sonar) because they are high level sources at a frequency (1–10 kHz), which overlaps a more sensitive portion (though not the most sensitive) of the HF hearing range, and of the sources expected to result in take, they are used in a large portion of exercises (see Tables 3 and 4). Most of the takes (90 percent) from the MF1 bin in the NWTT Study Area would result from received levels between 148 and 166 dB SPL. For the remaining active sonar bin types, the percentages are as follows: LF4 = 99 percent between 124 and 142 dB SPL, MF4 = 97 percent between 124 and 148 dB SPL, MF5 = 97 percent between 118 and 142 dB SPL, and HF4 = 97 percent between 118 and 160 dB SPL. Given the levels they are exposed to and harbor porpoise sensitivity, some responses would be of a lower severity, but many would likely be considered moderate, but still of generally short duration.

Harbor porpoises have been shown to be particularly 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 (approximately 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. Accordingly, harbor porpoises have been assigned a lower Level B behavioral harassment threshold, *i.e.,* a more distant distance cutoff (40 km for high source level, 20 km for moderate source level) and, as a result, the number of harbor porpoise taken by Level B behavioral harassment through exposure to LFAS/MFAS/HFAS in the NWTT Study Area is generally higher than the other species. As mentioned earlier in the odontocete overview, we anticipate more severe effects from takes when animals are exposed to higher received levels or sequential days of impacts; occasional low to moderate behavioral reactions are unlikely to affect reproduction or survival. Some takes by Level B behavioral harassment could be in the form of a longer (several hours or a day) and more moderate response, but unless they are repeated over more than several sequential days, impacts to reproduction or survival are not anticipated. Even where some smaller number of animals could experience effects on reproduction (which could happen to a small number), for the reasons explained below this would not affect rates of recruitment or survival, especially given the status of the stocks.

While harbor porpoises have been observed to be especially sensitive to human activity, the same types of responses have not been observed in Dall's porpoises. Dall's porpoises are typically notably longer than, and weigh more than twice as much as, harbor porpoises, making them generally less likely to be preyed upon and likely differentiating their behavioral repertoire somewhat from harbor porpoises. Further, they are typically seen in large groups and feeding aggregations, or exhibiting bow-riding behaviors, which is very different from the group dynamics observed in the more typically solitary, cryptic harbor porpoises, which are not often seen bow-riding. For these reasons, Dall's porpoises are not treated as an especially sensitive species (versus harbor porpoises which have a lower behavioral harassment threshold and more distant cutoff) but, rather, are analyzed similarly to other odontocetes (with takes from the sonar bin in the NWTT Study Area resulting from the same received levels reported in the *Odontocete* section above). Therefore, the majority of Level B takes are expected to be in the form of milder responses compared to higher level exposures. As mentioned earlier in this section, we anticipate more severe effects from takes when animals are exposed to higher received levels.

All Porpoise Stocks

These Dall's and harbor porpoise stocks are not listed under the ESA and the status of these stocks is considered ''unknown.'' There are no biologically important areas for Dall's and harbor porpoises in the NWTT Study Area. However, a known important feeding area for harbor porpoises overlaps with the Stonewall and Heceta Bank Humpback Whale Mitigation Area. No MF1 MFAS or explosives would be used in this mitigation area from May 1— November 30, which would reduce the severity of impacts to harbor porpoises by reducing interference in feeding that could result in lost feeding opportunities or necessitate additional energy expenditure to find other good opportunities. No mortality or Level A harassment from tissue damage is expected or proposed to be authorized for any of these stocks.

Regarding the magnitude of Level B harassment takes (TTS and behavioral disruption), the number of estimated total instances of take compared to the abundance ranges from less than 1 percent for the Alaska stock of Dall's porpoises to 265 percent for the Washington Inland Waters stock of harbor porpoises. The Alaska stock of Dall's porpoises, and Southeast Alaska and Northern California/Southern Oregon stocks of harbor porpoises have estimated total instances of take compared to the abundances less than or equal to 10 percent. This information indicates that only a small portion of these stocks is likely impacted and repeated exposures of individuals are not anticipated. The CA/OR/WA stock of Dall's porpoises and the Northern Washington/Oregon Coast and Washington Inland Waters stocks of harbor porpoises have estimated total instances of take compared to the abundances that range from 131 to 265 percent. This information indicates that all individuals of these stocks could be impacted, if each were taken two to three days per year, though the more likely scenario is that a smaller portion would be taken, and a subset of those would be on more days (maybe 5 or 6), with no indication that these days would be sequential. Given this and the larger number of total takes (totally and to individuals), it is more likely (probabilistically) that some small number of individuals could be interrupted during foraging in a manner and amount such that impacts to the energy budgets of females (from either losing feeding opportunities or expending considerable energy to find alternative feeding options) could cause them to forego reproduction for a year. Energetic impacts to males are generally meaningless to population rates unless they cause death, and it takes extreme energy deficits beyond what would ever be likely to result from these activities to cause the death of an adult marine mammal. However, foregone reproduction (especially for only one year within seven, which is the maximum predicted because the small number anticipated in any one year makes the probability that any individual will be impacted in this way twice in seven years very low) has far less of an impact on population rates than mortality and a small number of instances would not be expected to adversely impact annual rates of recruitment or survival. All indications are that the number of times in which reproduction would be likely to be foregone would not affect the stocks' annual rates of recruitment or survival.

Regarding the severity of those individual Level B harassment takes by behavioral disruption for harbor porpoises, we have explained that the duration of any exposure is expected to be between minutes and hours (*i.e.,* relatively short) and the received sound levels largely below 166 dB, which for harbor porpoise (which have a lower behavioral Level B harassment threshold) would mostly be considered a moderate level. Regarding the severity of those individual Level B harassment takes by behavioral disruption for Dall's porpoises, we have explained that the duration of any exposure is expected to be between minutes and hours (*i.e.,* relatively short) and the received sound levels largely below 172 dB (*i.e.,* of a lower, to occasionally moderate, level and less likely to evoke a severe response). Regarding the severity of TTS takes, they are expected to be low-level, of short duration, and mostly not in a frequency band that would be expected to interfere with communication or other important low-frequency cues. The associated lost opportunities and capabilities are not at a level that would impact reproduction or survival.

No Level A harassment by PTS is anticipated or proposed for the Southeast Alaska stock of harbor porpoise or the Alaska stock of Dall's porpoise. For the remaining porpoise stocks, for the same reasons explained above for TTS (low level and the likely frequency band), while a small permanent loss of hearing sensitivity may include some degree of energetic costs for compensating or may mean some small loss of opportunities or detection capabilities, the estimated annual Level A harassment takes by PTS for these three stocks of harbor porpoises and one stock of Dall's porpoises (86 to 180) would be unlikely to impact behaviors, opportunities, or detection capabilities to a degree that would interfere with reproductive success or survival for most individuals. Because of the higher number of PTS takes, however, we acknowledge that a few animals could potentially incur permanent hearing loss of a higher degree that could potentially interfere with their successful reproduction and growth. Given the large population sizes of these stocks, even if these occurred, it would not adversely impact rates of recruitment or survival.

Altogether, the status of the harbor porpoise stocks is unknown, however harbor porpoises are not listed as endangered or threatened under the ESA. Because harbor porpoises are particularly sensitive, it is likely that a fair number of the Level B behavioral responses of individuals will be of a moderate nature. Additionally, as noted, some portion of the stocks may be taken repeatedly on up to several days within a year, however this is not anticipated to affect the stocks' annual rates of recruitment or survival. Some individuals (86 to 180) from the Northern Oregon/Washington Coast, Northern California/Southern Oregon, and Washington Inland Waters stocks of harbor porpoises could be taken by PTS annually of likely low severity. A small permanent loss of hearing sensitivity (PTS) may include some degree of energetic costs for compensating or may mean some small loss of opportunities or detection capabilities, but at the expected scale the estimated Level A harassment takes by PTS for these stocks would be unlikely to impact behaviors, opportunities, or detection capabilities to a degree that would interfere with reproductive success or survival of any individuals, let alone annual rates of recruitment or survival. No mortality is anticipated or proposed for authorization. For these reasons, we have preliminarily determined, in consideration of all of the effects of the Navy's activities combined, that the proposed authorized take would have a negligible impact on all four stocks of harbor porpoises. Altogether, the status of the Dall's porpoise stocks is unknown, however Dall's porpoises are not listed as endangered or threatened under the ESA. Any individual Dall's porpoise is likely to be disturbed at a low-moderate level, with the taken individuals likely exposed on one to a few days. This low magnitude and severity of Level B harassment effects is not expected to result in impacts on individual reproduction or survival, much less annual rates of recruitment or survival. Some individuals (98) from the CA/OR/WA stock of Dall's porpoises could be taken by PTS annually of likely low severity. A small permanent loss of hearing sensitivity (PTS) may include some degree of energetic costs for compensating or may mean some small loss of opportunities or detection capabilities, but at the expected scale the estimated Level A harassment takes by PTS for this stock would be unlikely to impact behaviors, opportunities, or detection capabilities to a degree that would interfere with reproductive success or survival of any individuals, let alone annual rates of recruitment or survival. No mortality is anticipated or proposed for authorization. For these reasons, we have preliminarily determined, in consideration of all of the effects of the Navy's activities combined, that the proposed authorized take would have a negligible impact on these stocks of Dall's porpoises.

Pinnipeds

This section builds on the broader discussion above and brings together the discussion of the different types and amounts of take that different species and stocks would likely incur, the applicable mitigation, and the status of the species and stocks to support the negligible impact determinations for each species or stock. We have described (earlier in this section) the unlikelihood of any masking having effects that would impact the reproduction or survival of any of the individual marine mammals affected by the Navy's activities. We have also described above in the *Potential Effects of Specified Activities on Marine Mammals and their Habitat* section the unlikelihood of any habitat impacts having effects that would impact the reproduction or survival of any of the individual marine mammals affected by the Navy's activities. For pinnipeds, there is no mortality or serious injury and no Level A harassment from tissue damage from sonar or explosives anticipated or proposed to be authorized for any species. Here, we include information that applies to all of the pinniped species.

In Table 57 below for pinnipeds, we indicate the total annual numbers of take by mortality, Level A harassment and Level B harassment, and a number indicating the instances of total take as a percentage of abundance.

Table 57 -- Annual estimated takes by Level B harassment, Level A harassment, and mortality for pinnipeds in the NWTT 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 (NMFS SARs)*	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			
Suborder Pinnipedia									
Family Phocidae (eared seals and sea lions)									
California sea lion	U.S.	23,756	342	1	0	0	24,099	257,606	9
Guadelupe fur seal	Mexico to California	1,482	13	0	0	0	1,495	34,187	4
Northern fur seal	Eastern Pacific	11,462	130	0	0	0	11,592	620,660	2
	California	231	1	0	0	0	232	14,050	2
Steller sea lion	Eastern U.S.	2,231	7	0	0	0	2,238	43,201	5
Family Phocidae (true seals)									
Harbor seal	Southeast Alaska (Clarence Strait)	2,077	275	0	0	0	2,352	27,659	9
	OR/WA Coast	540	640	2	0	0	1,182	24,732	5
	Washington Northern Inland Waters	870	377	5	0	0	1,252	8,198 [1]	15
	Hood Canal	38,430	23,040	1	0	0	61,471	1,933 [1]	3,084
	Southern Puget Sound	3,274	3,564	4	0	0	6,842	4,068 [1]	168
Northern Elephant seal	California	4,134	710	4	0	0	4,848	179,000	3

*Presented in the 2019 draft SARs or most recent SAR.

[1] Recent survey data in the inland waters has not been incorporated into the SARs for these specific stocks, therefore we have used recent Navy Abundance (COA-1) estimates for these stocks for the NID analysis.

The majority of takes by harassment of pinnipeds in the NWTT Study Area are caused by sources from the MFAS bin (which includes hull-mounted sonar) because they are high level sources at a frequency (1–10 kHz) which overlaps the most sensitive portion of the pinniped hearing range, and of the sources expected to result in take, they are used in a large portion of exercises (see Tables 3 and 4). Most of the takes (97 percent) from the MF1 bin in the NWTT Study Area would result from received levels between 166 and 178 dB SPL. For the remaining active sonar bin types, the percentages are as follows: LF4 = 97 percent between 130 and 160 dB SPL, MF4 = 99 percent between 142 and 172 dB SPL, MF5 = 97 percent between 130 and 160 dB SPL, and HF4 = 99 percent between 100 and 172 dB SPL. Given the levels they are exposed to and pinniped sensitivity, most responses would be of a lower severity, with only occasional responses likely to be considered moderate, but still of generally short duration.

As mentioned earlier in this section, we anticipate more severe effects from takes when animals are exposed to higher received levels. Occasional milder takes by Level B behavioral harassment are unlikely to cause long-term consequences for individual animals or populations, especially when they are not expected to be repeated over sequential multiple days. For all pinnipeds, harassment takes from explosives (behavioral, TTS, or PTS if present) comprise a very small fraction of those caused by exposure to active sonar.

Because the majority of harassment take of pinnipeds results from narrowband sources in the range of 1–10 kHz, the vast majority of threshold shift caused by Navy sonar sources will typically occur in the range of 2–20 kHz. This frequency range falls within the range of pinniped hearing, however, pinniped vocalizations typically span a somewhat lower range than this (<0.2 to 10 kHz) and threshold shift from active sonar will often be in a narrower band (reflecting the narrower band source that caused it), which means that TTS incurred by pinnipeds would typically only interfere with communication within a portion of a pinniped's range (if it occurred during a time when communication with conspecifics was occurring). As discussed earlier, it would only be expected to be of a short duration and relatively small degree. Many of the other critical sounds that serve as cues for navigation and prey (*e.g.,* waves, fish, invertebrates) occur below a few kHz, which means that detection of these signals will not be inhibited by most threshold shifts either. The very low number of takes by threshold shifts that might be incurred by individuals exposed to explosives would likely be lower frequency (5 kHz or less) and spanning a wider frequency range, which could slightly lower an individual's sensitivity to navigational or prey cues, or a small portion of communication calls, for several minutes to hours (if temporary) or permanently.

Regarding behavioral disturbance, research and observations show that pinnipeds in the water may be tolerant of anthropogenic noise and activity (a review of behavioral reactions by pinnipeds to impulsive and non-impulsive noise can be found in Richardson *et al.* (1995) and Southall *et al.* (2007)). Available data, though limited, suggest that exposures between approximately 90 and 140 dB SPL do not appear to induce strong behavioral responses in pinnipeds exposed to non-pulse sounds in water (Costa *et al.,* 2003; Jacobs and Terhune, 2002; 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 (Blackwell *et al.,* 2004; Harris *et al.,* 2001; 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 that are taken by Level B harassment in the NWTT Study Area, 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, which would have no effect on reproduction or survival. 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 of any of these species to levels of sound that may cause Level B harassment are unlikely to result in hearing impairment or to significantly disrupt foraging behavior. Thus, even repeated Level B harassment of some small subset of individuals of an overall stock is unlikely to result in any significant realized decrease in fitness to those individuals that would result in any adverse impact on rates of recruitment or survival for the stock as a whole.

Of these stocks, only Guadalupe fur seals are listed as threatened under the ESA and the SAR indicates the stock is ''increasing.'' No critical habitat under the ESA is designated for the Guadalupe fur seal. The other stocks are not ESA-listed. Biologically important areas have not been identified for pinnipeds. There are active UMEs for Guadalupe fur seals and California sea lions. Since 2015 there have been 400 strandings of Guadalupe fur seals (including live and dead seals). The California sea lion UME is anticipated to be closed soon as elevated strandings occurred from 2013–2016. All of the other pinniped stocks are considered ''increasing,'' ''stable,'' or ''unknown'' except for Northern fur seals (Eastern Pacific stock), which is considered ''declining''. No mortality or Level A harassment from tissue damage is anticipated or proposed for authorization. All the pinniped species discussed in this section would benefit from the procedural mitigation measures described earlier in the *Proposed Mitigation Measures* section.

Regarding the magnitude of Level B harassment takes (TTS and behavioral disruption), for Guadalupe fur seals, the estimated instances of takes as compared to the stock abundance is 4 percent. This information indicates that only a small portion of individuals in the stock are likely impacted and repeated exposures of individuals are not anticipated. With the exception of the Hood Canal and Southern Puget Sound stocks of harbor seals, for the remaining stocks the number of estimated total instances of take compared to the abundance is 2–15 percent. Given the ranges of these stocks (*i.e.,* large ranges, but with individuals often staying in the vicinity of haulouts), this information indicates that a small portion of individuals in the stock are likely impacted and repeated exposures of individuals are not anticipated. For the Southern Puget Sound stock of harbor seals, the number of estimated total instances of take compared to the abundance is 168 percent. This information indicates that all individuals in this stock could be impacted, if each were taken up to 1–2 days per year, though the more likely scenario is that a smaller portion than that would be taken, and a subset of them would be taken on 3 or 4 days, with no indication that these days would be sequential.

For the Hood Canal stock of harbor seals, the number of estimated total instances of take compared to the abundance is 3,084 percent. This information indicates that all individuals of this stock could be impacted, if each were taken up to 31 days per year, though the more likely scenario is that a subset of them would be taken on fewer than 31 days and a subset would be taken on more than 31 days, and for those taken on a higher number of days, some of those days may be sequential. Though the majority of impacts are expected to be of a lower to sometimes moderate severity, the repeated takes over a potentially fair number of sequential days for some individuals in the Hood Canal stock of harbor seals makes it more likely that some number of individuals could be interrupted during foraging in a manner and amount such that impacts to the energy budgets of females (from either losing feeding opportunities or expending considerable energy to find alternative feeding options) could cause them to forego reproduction for a year (energetic impacts to males are generally meaningless to population rates unless they cause death, and it takes extreme energy deficits beyond what would ever be likely to result from these activities to cause the death of an adult marine mammal). As noted previously, however, foregone reproduction (especially for only one year within seven, which is the maximum predicted because the small number anticipated in any one year makes the probability that any individual will be impacted in this way twice in seven years very low) has far less of an impact on population rates than mortality and a relatively small number of instances of foregone reproduction would not be expected to adversely affect the stock through effects on annual rates of recruitment or survival. Regarding the severity of those individual takes by Level B behavioral harassment for all pinniped stocks, we have explained that the duration of any exposure is expected to be between minutes and hours (*i.e.,* relatively short) and the received sound levels largely below 178 dB, which is considered a relatively low to occasionally moderate level for pinnipeds. However, as noted, for the Hood Canal stock, some of these takes could occur on some number of sequential days.

Regarding the severity of TTS takes, they are expected to be low-level, of short duration, and mostly not in a frequency band that would be expected to interfere with pinniped communication or other important low-frequency cues, and that the associated lost opportunities and capabilities are not at a level that would impact reproduction or survival. For these same reasons (low level and frequency band), while a small permanent loss of hearing sensitivity may include some degree of energetic costs for compensating or may mean some small loss of opportunities or detection capabilities, the 1–5 estimated Level A harassment takes by PTS for California sea lions, Northern elephant seals, and the Washington Northern inland waters, Hood Canal, OR/WA Coast, and Southern Puget Sound stocks of harbor seals would be unlikely to impact behaviors, opportunities, or detection capabilities to a degree that would interfere with reproductive success or survival of any individuals.

Altogether, all pinniped stocks are considered ''increasing,'' ''stable,'' or ''unknown'' except for Northern fur seals (Eastern Pacific stock), which is considered ''declining'' but is not listed under the ESA. Only the Guadalupe fur seal is listed under the ESA, with a population that is considered increasing. No mortality for pinnipeds is anticipated or proposed for authorization. For nearly all pinniped stocks (with the exception of the Hood Canal harbor seals) only a portion of the stocks are anticipated to be impacted and any individual is likely to be disturbed at a low-moderate level. Even considering the effects of the UMEs on the Guadalupe fur seal and California sea lion stocks, this low magnitude and severity of harassment effects is not expected to result in impacts on individual reproduction or survival, much less annual rates of recruitment or survival. For the Hood Canal stock of harbor seals, a fair portion of individuals will be taken by Level B harassment (at a moderate or sometimes low level) over a comparatively higher number of days within a year, and some smaller portion of those individuals may be taken on sequential days, however this is not expected to adversely affect the stock through effects on annual rates of recruitment or survival. Accordingly, we do not anticipate the relatively small number of individual harbor seals that might be taken over repeated days within the year in a manner that results in one year of foregone reproduction to adversely affect the stock through effects on rates of recruitment or survival, given the status of the stock. For these reasons, in consideration of all of the effects of the Navy's activities combined, we have preliminarily determined that the proposed authorized take would have a negligible impact on all stocks of pinnipeds.

Preliminary Determination

Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the proposed monitoring and mitigation measures, NMFS preliminarily finds that the total marine mammal take from the Specified Activities will have a negligible impact on all affected marine mammal species or stocks.

Subsistence Harvest of Marine Mammals

In order to issue an incidental take authorization, NMFS must find that the specified activity will not have an ''unmitigable adverse impact'' on the subsistence uses of the affected marine mammal species or stocks by Alaskan Natives. 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.

To our knowledge there are no relevant subsistence uses of the affected marine mammal stocks or species implicated by this action. Therefore, NMFS has preliminarily determined that the total taking of affected species or stocks would not have an unmitigable adverse impact on the availability of the species or stocks for taking for subsistence purposes. However, we have limited information on marine mammal subsistence use in the Western Behm Canal area of southeastern Alaska and seek additional information pertinent to making the final determination.

Classification

Endangered Species Act

There are seven marine mammal species under NMFS jurisdiction that are listed as endangered or threatened under the ESA with confirmed or possible occurrence in the NWTT Study Area: Blue whale, fin whale, humpback whale (Mexico and Central America DPSs), sei whale, sperm whale, killer whale (Southern Resident killer whale DPS), and Guadalupe fur seal. The Southern Resident killer whale has critical habitat designated under the ESA in the NWTT Study Area. NMFS has recently published two proposed rules, proposing new or revised ESA-designated critical habitat for humpback whales (84 FR 54354; October 9, 2019) and Southern Resident killer whales (84 FR 49214; September 19, 2019).

The Navy will consult with NMFS pursuant to section 7 of the ESA for NWTT Study Area activities. NMFS will also consult internally on the issuance of the regulations and LOAs under section 101(a)(5)(A) of the MMPA.

National Marine Sanctuaries Act

NMFS will work with NOAA's Office of National Marine Sanctuaries to fulfill our responsibilities under the National Marine Sanctuaries Act as warranted and will complete any NMSA requirements prior to a determination on the issuance of the final rule and LOAs.

National Environmental Policy Act

To comply with the National Environmental Policy Act of 1969 (NEPA; 42 U.S.C. 4321 *et seq.*) and NOAA Administrative Order (NAO) 216–6A, NMFS must evaluate our proposed actions and alternatives with respect to potential impacts on the human environment. Accordingly, NMFS plans to adopt the NWTT SEIS/OEIS for the NWTT 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 under the

MMPA. NMFS is a cooperating agency on the 2019 NWTT DSEIS/OEIS and has worked extensively with the Navy in developing the document. The 2019 NWTT DSEIS/OEIS was made available for public comment at *https://www.nwtteis.com* in April, 2019. We will review all comments submitted in response to this notice prior to concluding our NEPA process or making a final decision on the MMPA rule and request for LOAs.

Regulatory Flexibility Act

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

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

List of Subjects in 50 CFR Part 218

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

Dated: April 17, 2020.

Samuel D. Rauch III,

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

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

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

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

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

■ 2. Revise subpart O to read as follows:

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

Sec.

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

§ 218.140 Specified activity and geographical region.

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

(b) The taking of marine mammals by the Navy is only authorized if it occurs within the NWTT Study Area, which is composed of established maritime operating and warning areas in the eastern North Pacific Ocean region, including areas of the Strait of Juan de Fuca, Puget Sound, and Western Behm Canal in southeastern Alaska. The Study Area includes air and water space within and outside Washington state waters, and outside state waters of Oregon and Northern California. The eastern boundary of the Offshore Area portion of the Study Area is 12 nautical miles (nmi) off the coastline for most of the Study Area, including southern Washington, Oregon, and Northern California. The Offshore Area includes the ocean all the way to the coastline only along that part of the Washington coast that lies beneath the airspace of W–237 and the Olympic Military Operating Area (MOA) and the Washington coastline north of the Olympic MOA. The Study Area includes four existing range complexes and facilities: The Northwest Training Range Complex (NWTRC), the Keyport Range Complex, the Carr Inlet Operations Area, and the Southeast Alaska Acoustic Measurement Facility (SEAFAC). In addition to these range complexes, the Study Area also includes Navy pierside locations where sonar maintenance and testing occurs as part of overhaul, modernization, maintenance, and repair activities at Naval Base Kitsap, Bremerton; Naval Base Kitsap, Bangor; and Naval Station Everett.

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

(1) Anti-submarine warfare;

(2) Expeditionary warfare;

(3) Mine warfare;

(4) Surface warfare; and

(5) Other training and testing activities.

§ 218.141 Effective dates.

Regulations in this subpart are effective from November 9, 2020 through November 8, 2027.

§ 218.142 Permissible methods of taking.

(a) Under Letters of Authorization (LOAs) issued pursuant to §§ 216.106 of this chapter and 218.146, the Holder of the LOAs (hereinafter "Navy") may incidentally, but not intentionally, take marine mammals within the area described in § 218.140(b) by Level A harassment and Level B harassment associated with the use of active sonar and other acoustic sources and explosives, as well as serious injury or mortality associated with vessel strikes, provided the activity is in compliance with all terms, conditions, and requirements of this subpart and the applicable LOAs.

(b) The incidental take of marine mammals by the activities listed in § 218.140(c) is limited to the following species:

TABLE 1 TO § 218.142

Species	Stock
Blue whale	Eastern North Pacific.
Fin whale	Northeast Pacific.
Fin whale	California/Oregon/Washington.
Sei whale	Eastern North Pacific.
Minke whale	Alaska.
Minke whale	California/Oregon/Washington.
Humpback whale	Central North Pacific.
Humpback whale	California/Oregon/Washington.
Gray whale	Eastern North Pacific.
Bottlenose dolphin	California/Oregon/Washington Offshore.
Killer whale	Alaska Resident.
Killer whale	Eastern North Pacific Offshore.
Killer whale	West Coast Transient.
Killer whale	Southern Resident.
Northern right whale dolphin	California/Oregon/Washington.
Pacific white-sided dolphin	North Pacific.
Pacific white-sided dolphin	California/Oregon/Washington.
Risso's dolphin	California/Oregon/Washington.
Short-beaked common dolphin	California/Oregon/Washington.
Short-finned pilot whale	California/Oregon/Washington.
Striped dolphin	California/Oregon/Washington.
Pygmy sperm whale	California/Oregon/Washington.
Dwarf sperm whale	California/Oregon/Washington.
Dall's porpoise	Alaska.
Dall's porpoise	California/Oregon/Washington.
Harbor porpoise	Southeast Alaska.
Harbor porpoise	Northern Oregon & Washington Coast.
Harbor porpoise	Northern California/Southern Oregon.
Harbor porpoise	Washington Inland Waters.
Sperm whale	California/Oregon/Washington.
Baird's beaked whale	California/Oregon/Washington.
Cuvier's beaked whale	California/Oregon/Washington.
Mesoplodon species	California/Oregon/Washington.
California sea lion	U.S. Stock.
Steller sea lion	Eastern U.S.
Guadalupe fur seal	Mexico.
Northern fur seal	Eastern Pacific.
Northern fur seal	California.
Harbor seal	Southeast Alaska—Clarence Strait.
Harbor seal	Oregon & Washington Coastal.
Harbor seal	Washington Northern Inland Waters.
Harbor seal	Hood Canal.
Harbor seal	Southern Puget Sound.
Northern elephant seal	California.

§ 218.143 Prohibitions.

Notwithstanding incidental takings contemplated in § 218.142(a) and authorized by LOAs issued under §§ 216.106 of this chapter and 218.146, no person in connection with the activities listed in § 218.140(c) may:

(a) Violate, or fail to comply with, the terms, conditions, and requirements of this subpart or an LOA issued under §§ 216.106 of this chapter and 218.146;

(b) Take any marine mammal not specified in § 218.142(b);

(c) Take any marine mammal specified in § 218.142(b) in any manner other than as specified in the LOAs; or

(d) Take a marine mammal specified in § 218.142(b) if NMFS determines such taking results in more than a negligible impact on the species or stocks of such marine mammal.

§ 218.144 Mitigation requirements.

When conducting the activities identified in § 218.140(c), the mitigation measures contained in any LOAs issued under §§ 216.106 of this chapter and 218.146 must be implemented. These mitigation measures include, but are not limited to:

(a) *Procedural mitigation.* Procedural mitigation is mitigation that the Navy must implement whenever and wherever an applicable training or testing activity takes place within the NWTT Study Area for acoustic stressors (*i.e.,* active sonar, weapons firing noise), explosive stressors (*i.e.,* sonobuoys, torpedoes, medium-caliber and large-caliber projectiles, missiles, bombs, mine countermeasure and neutralization activities, mine neutralization involving Navy divers), 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, non-explosive bombs and mine shapes).

(1) *Environmental awareness and education.* Appropriate Navy personnel (including civilian personnel) involved in mitigation and training or testing activity reporting under the specified activities will complete one or more modules of the U.S Navy Afloat Environmental Compliance Training Series, as identified in their career path training plan. Modules include: Introduction to the U.S. Navy Afloat Environmental Compliance Training Series; Marine Species Awareness Training; U.S. Navy Protective Measures Assessment Protocol; and U.S. Navy Sonar Positional Reporting System and Marine Mammal Incident Reporting.

(2) *Active sonar.* Active sonar includes low-frequency active sonar, mid-frequency active sonar, and high-frequency active sonar. For vessel-based activities, mitigation applies only to sources that are positively controlled and deployed from manned surface vessels (*e.g.,* sonar sources towed from manned surface platforms). For aircraft-based activities, mitigation applies only to sources that are positively controlled and deployed from manned aircraft that do not operate at high altitudes (*e.g.,* rotary-wing aircraft). Mitigation does not apply to active sonar sources deployed from unmanned aircraft or aircraft operating at high altitudes (*e.g.,* maritime patrol aircraft).

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

(B) For sources that are not hull mounted, One Lookout on the ship or aircraft conducting the activity.

(ii) *Mitigation zone and requirements.* (A) Prior to the initial start of the activity (*e.g.,* when maneuvering on station), Navy personnel must observe the mitigation zone for floating vegetation and marine mammals; if floating vegetation or a marine mammals is observed, Navy personnel must relocate or delay the start of active sonar transmission until the mitigation zone is clear of floating vegetation or until the conditions in paragraph (a)(2)(ii)(D) of this section are met for marine mammals.

(B) During the activity, for low-frequency active sonar at or above 200 dB and hull-mounted mid-frequency active sonar, Navy personnel must observe the mitigation zone for marine mammals. If a marine mammal is observed within 1,000 yd of the sonar source, Navy personnel must power down active sonar transmission by 6 dB. If a marine mammal is observed within 500 yd of the sonar source, Navy personnel must power down active sonar transmission an additional 4 dB (10 dB total). Navy personnel must cease transmission if a cetacean or pinniped in the NWTT Offshore Area or Western Behm Canal is observed within 200 yd of the active sonar source and must cease transmission if a pinniped in NWTT Inland Waters is observed within 100 yd of the active sonar source (except if hauled out on, or in the water near, man-made structures and vessels).

(C) During the activity, for low-frequency active sonar below 200 dB, mid-frequency active sonar sources that are not hull-mounted, and high-frequency sonar, Navy personnel must observe the mitigation zone for marine mammals. Navy personnel must cease transmission if a cetacean in the NWTT Offshore Area, NWTT Inshore Area, or Western Behm Canal is observed within 200 yd of the sonar source. Navy personnel must cease transmission if a pinniped in the NWTT Offshore Area or Western Behm Canal is observed within 200 yd of the sonar source and must cease transmission if a pinniped in NWTT Inland Waters is observed within 100 yd of the active sonar source (except if hauled out on, or in the water near, man-made structures and vessels).

(D) Commencement/recommencement conditions after a marine mammal sighting before or during the activity. Navy personnel must allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing or powering up active sonar transmission) until one of the following conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the sonar source; the mitigation zone has been clear from any additional sightings for 10 minutes (min) for aircraft-deployed sonar sources or 30 min for vessel-deployed sonar sources; for mobile activities, the active sonar source has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting; or for activities using hull-mounted sonar where a dolphin(s) is observed in the mitigation zone, the Lookout concludes that the dolphin(s) is deliberately closing in on the ship to ride the ship's bow wave, and are therefore out of the main transmission axis of the sonar (and there are no other marine mammal sightings within the mitigation zone).

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

(i) *Number of Lookouts and observation platform.* One Lookout must be positioned on the ship conducting the firing. Depending on the activity, the Lookout could be the same as the one provided for under ''Explosive medium-caliber and large-caliber projectiles'' or under ''Small-, medium-, and large-caliber non-explosive practice munitions'' in paragraphs (a)(6)(i) and (a)(13)(i) of this section.

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

(B) Prior to the initial start of the activity, Navy personnel must observe the mitigation zone for floating vegetation and marine mammals; if floating vegetation or a marine mammal is observed, Navy personnel must relocate or delay the start of weapons firing until the mitigation zone is clear of floating vegetation or until the conditions in paragraph (a)(3)(ii)(D) of this section are met for marine mammals.

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

(D) Commencement/recommencement conditions after a marine mammal sighting before or during the activity. Navy personnel must allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing weapons firing) until one of the following conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the firing ship; the mitigation zone has been clear from any additional sightings for 30 min; or for mobile activities, the firing ship has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting.

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

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

(B) Prior to the initial start of the activity (*e.g.,* during deployment of a sonobuoy field, which typically lasts 20–30 min), Navy personnel must conduct passive acoustic monitoring for marine mammals and use information from detections to assist visual observations. Navy personnel also must visually observe the mitigation zone for floating vegetation and marine mammals; if floating vegetation or a marine mammal is observed, Navy personnel must relocate or delay the start of sonobuoy or source/receiver pair detonations until the mitigation zone is clear of floating vegetation or until the conditions in paragraph (a)(4)(ii)(D) of this section are met for marine mammals.

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

(D) Commencement/recommencement conditions after a marine mammal sighting before or during the activity. Navy personnel must allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing detonations) until one of the following conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the sonobuoy; or the mitigation zone has been clear from any additional sightings for 10 min when the activity involves aircraft that have fuel constraints, or 30 min when the activity involves aircraft that are not typically fuel constrained.

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

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

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

(B) Prior to the initial start of the activity (*e.g.,* during deployment of the target), Navy personnel must conduct passive acoustic monitoring for marine mammals and use the information from detections to assist visual observations. Navy personnel also must visually observe the mitigation zone for floating vegetation and marine mammals; if floating vegetation or a marine mammal is observed, Navy personnel must relocate or delay the start of firing until the mitigation zone is clear of floating vegetation or until the conditions in paragraph (a)(5)(ii)(D) of this section are met for marine mammals.

(C) During the activity, Navy personnel must observe the mitigation zone for marine mammals. If a marine mammal is observed, Navy personnel must cease firing.

(D) Commencement/recommencement conditions after a marine mammal sighting before or during the activity. Navy personnel must allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing firing) until one of the following conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended impact location; or the mitigation zone has been clear from any additional sightings for 10 min when the activity involves aircraft that have fuel constraints, or 30 min when the activity involves aircraft that are not typically fuel constrained.

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

(6) *Explosive medium-caliber and large-caliber projectiles.* Gunnery activities using explosive medium-caliber and large-caliber projectiles. Mitigation applies to activities using a surface target.

(i) *Number of Lookouts and observation platform.* One Lookout must be on the vessel conducting the activity. For activities using explosive large-caliber projectiles, depending on the activity, the Lookout could be the same as the one described in ''Weapons firing noise'' in paragraph (a)(3)(i) of this section. If additional platforms are participating in the activity, Navy personnel positioned in those assets (*e.g.,* safety observers, evaluators) must support observing the mitigation zone for marine mammals while performing their regular duties.

(ii) *Mitigation zone and requirements.* (A) 600 yd around the intended impact location for explosive medium-caliber projectiles.

(B) 1,000 yd around the intended impact location for explosive large-caliber projectiles.

(C) Prior to the initial start of the activity (*e.g.,* when maneuvering on station), Navy personnel must observe the mitigation zone for floating vegetation and marine mammals; if floating vegetation or a marine mammal is observed, Navy personnel must relocate or delay the start of firing until the mitigation zone is clear of floating vegetation or until the conditions in paragraph (a)(6)(ii)(E) are met for marine mammals.

(D) During the activity, Navy personnel must observe the mitigation zone for marine mammals; if a marine mammal is observed, Navy personnel must cease firing.

(E) Commencement/recommencement conditions after a marine mammal sighting before or during the activity. Navy personnel must allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing firing) until one of the following conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended impact location; the mitigation zone has been clear from any additional sightings for 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.

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

(7) *Explosive missiles.* Aircraft-deployed explosive missiles. Mitigation applies to activities using a surface target.

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

(ii) *Mitigation zone and requirements.* (A) 2,000 yd around the intended impact location.

(B) Prior to the initial start of the activity (*e.g.,* during a fly-over of the mitigation zone), Navy personnel must observe the mitigation zone for floating vegetation and marine mammals; if floating vegetation or a marine mammal is observed, Navy personnel must relocate or delay the start of firing until the mitigation zone is clear of floating vegetation or until the conditions in paragraph (a)(7)(ii)(D) are met for marine mammals.

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

(D) Commencement/recommencement conditions after a marine mammal sighting before or during the activity. Navy personnel must allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing firing) until one of the following conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended impact location; or the mitigation zone has been clear from any additional sightings for 10 min when the activity involves aircraft that have fuel constraints, or 30 min when the activity involves aircraft that are not typically fuel constrained.

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

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

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

(B) Prior to the initial start of the activity (*e.g.,* when arriving on station), Navy personnel must observe the mitigation zone for floating vegetation and marine mammals; if floating vegetation or a marine mammals is observed, Navy personnel must relocate or delay the start of bomb deployment until the mitigation zone is clear of floating vegetation or until the conditions in paragraph (a)(8)(ii)(D) of this section are met for marine mammals.

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

(D) Commencement/recommencement conditions after a marine mammal sighting before or during the activity. Navy personnel must allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing bomb deployment) until one of the following conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended target; the mitigation zone has been clear from any additional sightings for 10 min; or for activities using mobile targets, the intended target has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting.

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

(9) *Explosive mine countermeasure and neutralization activities*—(i) *Number of Lookouts and observation platform.* (A) One Lookout must be positioned on a vessel or in an aircraft when implementing the smaller mitigation zone.

(B) Two Lookouts must be positioned (one in an aircraft and one on a small boat) when implementing the larger mitigation zone.

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

(ii) *Mitigation zone and requirements.* (A) 600 yd around the detonation site for activities using ≤5 lb net explosive weight.

(B) 2,100 yd around the detonation site for activities using >5–60 lb net explosive weight.

(C) Prior to the initial start of the activity (*e.g.,* when maneuvering on station; typically, 10 min when the activity involves aircraft that have fuel constraints, or 30 min when the activity involves aircraft that are not typically fuel constrained), Navy personnel must observe the mitigation zone for floating vegetation and marine mammals; if floating vegetation or a marine mammal is observed, Navy personnel must relocate or delay the start of detonations until the mitigation zone is clear of floating vegetation or until the conditions in paragraph (ii)(E) are met for marine mammals.

(D) During the activity, Navy personnel must observe the mitigation zone for marine mammals; if a marine mammal is observed, Navy personnel must cease detonations.

(E) Commencement/recommencement conditions after a marine mammal sighting before or during the activity. Navy personnel must allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing detonations) until one of the following conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to detonation site; or the mitigation zone has been clear from any additional sightings for 10 min when the activity involves aircraft that have fuel constraints, or 30 min when the activity involves aircraft that are not typically fuel constrained.

(F) After completion of the activity (typically 10 min when the activity involves aircraft that have fuel constraints, or 30 min when the activity involves aircraft that are not typically fuel constrained), Navy personnel must observe for marine mammals in the vicinity of where detonations occurred; if any injured or dead marine mammals are observed, Navy personnel must follow established incident reporting procedures. If additional platforms are supporting this activity (*e.g.,* providing range clearance), these Navy assets must assist in the visual observation of the area where detonations occurred.

(10) *Explosive mine neutralization activities involving Navy divers*—(i) *Number of Lookouts and observation platform.* (A) Two Lookouts (two small boats with one Lookout each (one of which must be a Navy biologist)).

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

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

(ii) *Mitigation zone and requirements.* (A) 500 yd around the detonation site during activities using >0.5–2.5 lb net explosive weight.

(B) Prior to the initial start of the activity (*e.g.,* starting 30 min before the first planned detonation), Navy personnel must observe the mitigation zone for floating vegetation and marine mammals; if floating vegetation is observed, Navy personnel must relocate or delay the start of detonations until the mitigation zone is clear of floating vegetation. If a marine mammal is observed, Navy personnel must ensure the area is clear of marine mammals for 30 min prior to commencing a detonation. A Navy biologist must serve as the lead Lookout and must make the final determination that the mitigation zone is clear of any floating vegetation or marine mammals prior to the commencement of a detonation. The Navy biologist must maintain radio communication with the unit conducting the event and the other Lookout.

(C) During the activity, Navy personnel must observe the mitigation zone for marine mammals; if a marine mammal is observed, Navy personnel must cease detonations. To the maximum extent practicable depending on mission requirements, safety, and environmental conditions, Navy personnel must position boats near the midpoint of the mitigation zone radius (but outside of the detonation plume and human safety zone), must position themselves on opposite sides of the detonation location (when two boats are used), and must travel in a circular pattern around the detonation location with one Lookout observing inward toward the detonation site and the other observing outward toward the perimeter of the mitigation zone. Navy personnel must only use positively controlled charges (*i.e.,* no time-delay fuses). Navy personnel must use the smallest practicable charge size for each activity. All activities must be conducted in Beaufort sea state number 2 conditions or better and must not be conducted in low visibility conditions.

(D) Commencement/recommencement conditions after a marine mammal sighting before or during the activity. Navy personnel must allow a sighted animal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing detonations) until one of the following conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the detonation site; or the mitigation zone has been clear from any additional sightings for 30 min.

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

(F) At the Hood Canal Explosive Ordnance Disposal Range and Crescent Harbor Explosive Ordnance Disposal Range, Navy personnel must obtain permission from the appropriate designated Command authority prior to conducting explosive mine neutralization activities involving the use of Navy divers.

(G) At the Hood Canal Explosive Ordnance Disposal Range, during February, March, and April (the juvenile migration period for Hood Canal Summer Run Chum), Navy personnel must not use explosives in bin E3 (>0.5–2.5 lb net explosive weight), and must instead use explosives in bin E0 (<0.1 lb net explosive weight).

(H) At the Hood Canal Explosive Ordnance Disposal Range, during August, September, and October (the adult migration period for Hood Canal summer-run chum and Puget Sound Chinook), Navy personnel must avoid the use of explosives in bin E3 (>0.5–2.5 lb net explosive weight), and must instead use explosive bin E0 (<0.1 lb net explosive weight) to the maximum extent practicable unless necessitated by mission requirements.

(I) At the Crescent Harbor Explosive Ordnance Disposal Range, Navy personnel must conduct explosive activities at least 1,000 meters (m) from the closest point of land to avoid or reduce impacts on fish (*e.g.,* bull trout) in nearshore habitat areas.

(11) *Vessel movement.* The mitigation will not be applied if: The vessel's safety is threatened; the vessel is restricted in its ability to maneuver (*e.g.,* during launching and recovery of aircraft or landing craft, during towing activities, when mooring, during Transit Protection Program exercises, and other events involving escort vessels); the vessel is operated autonomously; or when impractical based on mission requirements (*e.g.,* during test body retrieval by range craft).

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

(ii) *Mitigation zone and requirements.* (A) 500 yd around whales for surface vessels other than small boats.

(B) 200 yd around all marine mammals other than whales (except bow-riding dolphins and pinnipeds hauled out on man-made navigational structures, port structures, and vessels) for surface vessels other than small boats.

(C) 100 yd around marine mammals (except bow-riding dolphins and pinnipeds hauled out on man-made navigational structures, port structures, and vessels) for small boats, such as range craft.

(D) During the activity (when underway), Navy personnel must observe the mitigation zone for marine mammals; if a marine mammal is observed, Navy personnel must maneuver to maintain distance.

(E) Prior to Small Boat Attack exercises at Naval Station Everett, Naval Base Kitsap Bangor, or Naval Base

Kitsap Bremerton, Navy event planners must coordinate with Navy biologists during the event planning process. Navy biologists must work with NMFS to determine the likelihood of marine mammal presence in the planned training location. Navy biologists must notify event planners of the likelihood of species presence as they plan specific details of the event (*e.g.,* timing, location, duration). Navy personnel must provide additional environmental awareness training to event participants. The training must alert participating ship crews to the possible presence of marine mammals in the training location. Lookouts must use the information to assist their visual observation of applicable mitigation zones and to aid in the implementation of procedural mitigation.

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

(12) *Towed in-water devices.* Mitigation applies to devices that are towed from a manned surface platform or manned aircraft, or when a manned support craft is already participating in an activity involving in-water devices being towed by unmanned platforms. The mitigation will not be applied if the safety of the towing platform or in-water device is threatened.

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

(ii) *Mitigation zone and requirements.* (A) 250 yd around marine mammals (except bow-riding dolphins and pinnipeds hauled out on man-made navigational structures, port structures, and vessels) for in-water devices towed by aircraft or surface vessels other than small boats.

(B) 100 yd around marine mammals (except bow-riding dolphins and pinnipeds hauled out on man-made navigational structures, port structures, and vessels) for in-water devices towed by small boats, such as range craft.

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

(13) *Small-, medium-, and large-caliber non-explosive practice munitions.* Gunnery activities using small-, medium-, and large-caliber non-explosive practice munitions. Mitigation applies to activities using a surface target.

(i) *Number of Lookouts and observation platform.* One Lookout must be positioned on the platform conducting the activity. Depending on the activity, the Lookout could be the same as the one described for ''Weapons firing noise'' in paragraph (a)(3)(i) of this section.

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

(B) Prior to the initial start of the activity (*e.g.,* when maneuvering on station), Navy personnel must observe the mitigation zone for floating vegetation and marine mammals; if floating vegetation or a marine mammal is observed, Navy personnel must relocate or delay the start until the mitigation zone is clear of floating vegetation or until the conditions in paragraph (a)(13)(ii)(D) of this section are met for marine mammals.

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

(D) Commencement/recommencement conditions after a marine mammal sighting before or during the activity. Navy personnel must allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing firing) until one of the following conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended impact location; the mitigation zone has been clear from any additional sightings for 10 min for aircraft-based firing or 30 min for vessel-based firing; or for activities using a mobile target, the intended impact location has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting.

(14) *Non-explosive missiles.* Aircraft-deployed non-explosive missiles. Mitigation applies to activities using a surface target.

(i) *Number of Lookouts and observation platform.* One Lookout must be positioned in an aircraft.

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

(B) Prior to the initial start of the activity (*e.g.,* during a fly-over of the mitigation zone), Navy personnel must observe the mitigation zone for floating vegetation and marine mammals; if floating vegetation or a marine mammal is observed, Navy personnel must relocate or delay the start of firing until the mitigation zone is clear of floating vegetation or until the conditions in paragraph (a)(14)(ii)(D) of this section are met for marine mammals.

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

(D) Commencement/recommencement conditions after a marine mammal sighting prior to or during the activity. Navy personnel must allow a sighted marine mammal to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing firing) until one of the following conditions has been met: The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended impact location; or the mitigation zone has been clear from any additional sightings for 10 min when the activity involves aircraft that have fuel constraints, or 30 min when the activity involves aircraft that are not typically fuel constrained.

(15) *Non-explosive bombs and mine shapes.* Non-explosive bombs and non-explosive mine shapes during mine laying activities.

(i) *Number of Lookouts and observation platform.* One Lookout must be positioned in an aircraft.

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

(B) Prior to the initial start of the activity (*e.g.,* when arriving on station), Navy personnel must observe the mitigation zone for floating vegetation and marine mammals; if floating vegetation or a marine mammal is observed, Navy personnel must relocate or delay the start of bomb deployment or mine laying until the mitigation zone is clear of floating vegetation or until the conditions in paragraph (a)(15)(ii)(D) of section are met for marine mammals.

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

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

The animal is observed exiting the mitigation zone; the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended target or minefield location; the mitigation zone has been clear from any additional sightings for 10 min; or for activities using mobile targets, the intended target has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting.

(b) *Mitigation areas.* In addition to procedural mitigation, Navy personnel must implement mitigation measures within mitigation areas to avoid or reduce potential impacts on marine mammals.

(1) Mitigation areas for marine mammals for NWTT Study Area for sonar, explosives, and physical disturbance and vessel strikes—(i) *Mitigation area requirements*—(A) *Marine Species Coastal Mitigation Area (year round).* (*1*) Within 50 nmi from shore in the Marine Species Coastal Mitigation Area, Navy personnel must not conduct: Explosive training activities; explosive testing activities (with the exception of explosive Mine Countermeasure and Neutralization Testing activities); and non-explosive missile training activities. Should national security require conducting these activities in the mitigation area, Navy personnel must obtain permission from the appropriate designated Command authority prior to commencement of the activity. Navy personnel must provide NMFS with advance notification and include information about the event in its annual activity reports to NMFS.

(*2*) Within 20 nmi from shore in the Marine Species Coastal Mitigation Area, Navy personnel must not conduct non-explosive large-caliber gunnery training activities and non-explosive bombing training activities. Should national security require conducting these activities in the mitigation area, Navy personnel must obtain permission from the appropriate designated Command authority prior to commencement of the activity. Navy personnel must provide NMFS with advance notification and include information about the event in its annual activity reports to NMFS.

(*3*) Within 12 nmi from shore in the Marine Species Coastal Mitigation Area, Navy personnel must not conduct: Non-explosive small- and medium-caliber gunnery training activities; non-explosive torpedo training activities; and Anti-Submarine Warfare Tracking Exercise—Helicopter, Maritime Patrol Aircraft, Ship, or Submarine training activities. Should national security require conducting these activities in the mitigation area, Navy personnel must obtain permission from the appropriate designated Command authority prior to commencement of the activity. Navy personnel must provide NMFS with advance notification and include information about the event in its annual activity reports to NMFS.

(B) *Olympic Coast National Marine Sanctuary Mitigation Area (year-round).* (*1*) Within the Olympic Coast National Marine Sanctuary Mitigation Area, Navy personnel must not conduct more than 32 hours of MF1 mid-frequency active sonar during training annually and will not conduct non-explosive bombing training activities. Should national security require conducting more than 32 hours of MF1 mid-frequency active sonar during training annually or conducting non-explosive bombing training activities in the mitigation area, Navy personnel must obtain permission from the appropriate designated Command authority prior to commencement of the activity. Navy personnel must provide NMFS with advance notification and include information about the event in its annual activity reports to NMFS.

(*2*) Within the Olympic Coast National Marine Sanctuary Mitigation Area, Navy personnel must not conduct more than 33 hours of MF1 mid-frequency active sonar during testing annually (except within the portion of the mitigation area that overlaps the Quinault Range Site) and must not conduct explosive Mine Countermeasure and Neutralization Testing activities. Should national security require conducting more than 33 hours of MF1 mid-frequency active sonar during testing annually (except within the portion of the mitigation area that overlaps the Quinault Range Site) or conducting explosive Mine Countermeasure and Neutralization Testing activities in the mitigation area, Navy personnel must obtain permission from the appropriate designated Command authority prior to commencement of the activity. Navy personnel must provide NMFS with advance notification and include information about the event in its annual activity reports to NMFS.

(C) *Stonewall and Heceta Bank Humpback Whale Mitigation Area (May 1–November 30).* Within the Stonewall and Heceta Bank Humpback Whale Mitigation Area, Navy personnel must not use MF1 mid-frequency active sonar or explosives during training and testing from May 1 to November 30. Should national security require using MF1 mid-frequency active sonar or explosives during training and testing from May 1 to November 30, Navy personnel must obtain permission from the appropriate designated Command authority prior to commencement of the activity. Navy personnel must provide NMFS with advance notification and include information about the event in its annual activity reports to NMFS.

(D) *Point St. George Humpback Whale Mitigation Area (July 1–November 30).* Within the Point St. George Humpback Whale Mitigation Area, Navy personnel must not use MF1 mid-frequency active sonar or explosives during training and testing from July 1 to November 30. Should national security require using MF1 mid-frequency active sonar or explosives during training and testing from July 1 to November 30, Navy personnel must obtain permission from the appropriate designated Command authority prior to commencement of the activity. Navy personnel must provide NMFS with advance notification and include information about the event in its annual activity reports to NMFS.

(E) *Puget Sound and Strait of Juan de Fuca Mitigation Area (year-round).* (*1*) Within the Puget Sound and Strait of Juan de Fuca Mitigation Area, Navy personnel must obtain approval from the appropriate designated Command authority prior to: The use of hull-mounted mid-frequency active sonar during training while underway or conducting ship and submarine active sonar pierside maintenance or testing.

(*2*) Within the Puget Sound and Strait of Juan de Fuca Mitigation Area for Civilian Port Defense—Homeland Security Anti-Terrorism/Force Protection Exercises, Navy personnel must coordinate with Navy biologists during the event planning process. Navy biologists must work with NMFS to determine the likelihood of gray whale and Southern Resident Killer Whale presence in the planned training location. Navy biologists must notify Navy event planners of the likelihood of species presence as they plan specific details of the event (*e.g.,* timing, location, duration). Navy personnel must ensure environmental awareness of event participants. Environmental awareness will help alert participating ship and aircraft crews to the possible presence of marine mammals in the training location, such as gray whales and Southern Resident Killer Whales.

(F) *Northern Puget Sound Gray Whale Mitigation Area (March 1–May 31).* Within the Northern Puget Sound Gray Whale Mitigation Area, Navy personnel must not conduct Civilian Port Defense—Homeland Security Anti-Terrorism/Force Protection Exercises from March 1 to May 31. Should national security require conducting

Civilian Port Defense—Homeland Security Anti-Terrorism/Force Protection Exercises from March 1 to May 31, Navy personnel must obtain permission from the appropriate designated Command authority prior to commencement of the activity. Navy personnel must provide NMFS with advance notification and include information about the event in its annual activity reports to NMFS.

(ii) [Reserved]

§ 218.145 Requirements for monitoring and reporting.

(a) *Unauthorized take.* Navy personnel must notify NMFS immediately (or as soon as operational security considerations allow) if the specified activity identified in § 218.140 is thought to have resulted in the mortality or serious injury of any marine mammals, or in any Level A harassment or Level B harassment of marine mammals not identified in this subpart.

(b) *Monitoring and reporting under the LOAs.* The Navy must conduct all monitoring and reporting required under the LOAs, including abiding by the U.S. Navy's Marine Species Monitoring Program. Details on program goals, objectives, project selection process, and current projects are available at *www.navymarinespeciesmonitoring.us.*

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

(d) *Annual NWTT Study Area marine species monitoring report.* The Navy must submit an annual report of the NWTT Study Area monitoring describing the implementation and results from the previous calendar year. Data collection methods must be standardized across range complexes and study areas to allow for comparison in different geographic locations. The report must be submitted to the Director, Office of Protected Resources, NMFS, either within three months after the end of the calendar year, or within three months after the conclusion of the monitoring year, to be determined by the Adaptive Management process. NMFS will submit comments or questions on the report, if any, within one month of receipt. The report will be considered final after the Navy has addressed NMFS' comments, or one month after submittal of the draft if NMFS does not provide comments on the draft report. This report will describe progress of knowledge made with respect to intermediate scientific objectives within the NWTT Study Area associated with the Integrated Comprehensive Monitoring Program (ICMP). Similar study questions must be treated together so that progress on each topic can be summarized across all Navy ranges. The report need not include analyses and content that does not provide direct assessment of cumulative progress on the monitoring plan study questions. As an alternative, the Navy may submit a multi-range complex annual monitoring plan report to fulfill this requirement. Such a report will describe progress of knowledge made with respect to monitoring study questions across multiple Navy ranges associated with the ICMP. Similar study questions must be treated together so that progress on each topic can be summarized across multiple Navy ranges. The report need not include analyses and content that does not provide direct assessment of cumulative progress on the monitoring study question. This will continue to allow the Navy to provide a cohesive monitoring report covering multiple ranges (as per ICMP goals), rather than entirely separate reports for the NWTT, Hawaii-Southern California, Gulf of Alaska, and Mariana Islands Study Areas.

(e) *Annual NWTT Study Area training exercise report and testing activity reports.* Each year, the Navy must submit two preliminary reports (Quick Look Report) detailing the status of applicable 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 must submit a detailed report to the Director, Office of Protected Resources, NMFS, within three months after the one-year anniversary of the date of issuance of the LOA. NMFS will submit comments or questions on the report, if any, within one month of receipt. The report will be considered final after the Navy has addressed NMFS' comments, or one month after submittal of the draft if NMFS does not provide comments on the draft report. The NWTT Annual Training Exercise Report and Testing Activity Report can be consolidated with other exercise reports from other range complexes in the Pacific Ocean for a single Pacific Exercise Report, if desired. The annual report must contain information on the total hours of operation of MF1 surface ship hull-mounted mid-frequency active sonar used during training and testing activities in the Olympic Coast National Marine Sanctuary Mitigation Area and a summary of all sound sources used, including within specific mitigation reporting areas as described in paragraph (e)(2) of this section. The analysis in the detailed report must be based on the accumulation of data from the current year's report and data collected from previous annual reports. The annual report will also contain cumulative sonar and explosive use quantity from previous years' reports through the current year. Additionally, if there were any changes to the sound source allowance in a given year, or cumulatively, the report must include a discussion of why the change was made and include analysis to support how the change did or did not affect the analysis in the NWTT SEIS/OEIS and MMPA final rule. The annual report must also include details regarding specific requirements associated with the mitigation areas listed in § 218.144(b). The analysis in the detailed report will be based on the accumulation of data from the current year's report and data collected from previous reports. The final annual/close-out report at the conclusion of the authorization period (year seven) will serve as the comprehensive close-out report and include both the final year annual incidental take compared to annual authorized incidental take as well as a cumulative seven-year incidental take compared to seven-year authorized incidental take. The detailed reports must contain information identified in paragraphs (e)(1) through (3) of this section.

(1) *Summary of sources used.* This section of the report must include the following information summarized from the authorized sound sources used in all training and testing events:

(i) Total annual hours or quantity (per the LOA) of each bin of sonar and other transducers, and

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

(2) *NWTT Study Area Mitigation Areas.* The report must include any Navy activities that occurred as specifically described in areas identified in § 218.144(b). Information included in the classified annual reports may be used to inform future adaptive management of activities within the NWTT Study Area.

(3) *Geographic information presentation.* The reports must present an annual (and seasonal, where practical) depiction of training and

testing bin usage geographically across the NWTT Study Area.

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

§ 218.146 Letters of Authorization.

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

(b) An LOA, unless suspended or revoked, may be effective for a period of time not to exceed the expiration date of this subpart.

(c) If an LOA expires prior to the expiration date of this subpart, the Navy may apply for and obtain a renewal of the LOA.

(d) In the event of projected changes to the activity or to mitigation, monitoring, or reporting (excluding changes made pursuant to the adaptive management provision of § 218.147(c)(1)) required by an LOA issued under this subpart, the Navy must apply for and obtain a modification of the LOA as described in § 218.147.

(e) Each LOA will set forth:

(1) Permissible methods of incidental taking;

(2) Geographic areas for incidental taking;

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

(4) Requirements for monitoring and reporting.

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

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

§ 218.147 Renewals and modifications of Letters of Authorization.

(a) An LOA issued under §§ 216.106 of this chapter and 218.146 for the activity identified in § 218.140(c) may be renewed or modified upon request by the applicant, provided that:

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

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

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

(c) An LOA issued under §§ 216.106 of this chapter and 218.146 may be modified by NMFS under the following circumstances:

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

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

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

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

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

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

(2) 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 218.146, 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.

§ 218.148 [Reserved]

[FR Doc. 2020–08533 Filed 5–22–20; 11:15 am]

BILLING CODE 3510–22–P