DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 218

[Docket No. 261113–0006]

RIN 0648–BO60

Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to Military Readiness Activities in the Mariana Islands Training and Testing Study Area

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

ACTION: Proposed rule; proposed letter of authorization; request for comments.

SUMMARY: NMFS has received a request from the U.S. Department of the Navy (including the U.S. Navy and the U.S. Marine Corps; Navy) and on behalf of the U.S. Coast Guard (Coast Guard), U.S. Army (Army), and U.S. Air Force (Air Force) (hereafter, Navy, Coast Guard, Army, and Air Force are collectively referred to as the Action Proponents) for Incidental Take Regulations (ITR) and an associated Letter of Authorization (LOA) pursuant to the Marine Mammal Protection Act (MMPA). The requested regulations would govern the authorization of take of marine mammals incidental to training and testing activities and modernization and sustainment of ranges conducted in the Mariana Islands Training and Testing (MITT) Study Area over the course of 7 years from July 2027 through July 2034. NMFS requests comments on this proposed rule. NMFS will consider public comments prior to making any final decision on the promulgation of the requested ITR and issuance of the LOA; agency responses to public comments will be summarized in the final rule, if issued. The Action Proponents' activities are considered military readiness activities pursuant to the MMPA, as amended by the National Defense Authorization Act for Fiscal Year 2004 (2004 NDAA) and the NDAA for Fiscal Year 2019 (2019 NDAA).

DATES: Comments and information must be received no later than December 18, 2026.

ADDRESSES: A plain language summary of this proposed rule is available at: *https://www.regulations.gov/docket/NOAA-NMFS-2026-2014.* You may submit comments on this document, identified by NOAA–NMFS–2026–2014, by any of the following methods:

- *Electronic Submission:* Submit all electronic public comments via the Federal e-Rulemaking Portal. Visit *https://www.regulations.gov* and type NOAA–NMFS–2026–2014 in the Search box. Click on the ''Comment'' icon, complete the required fields, and enter or attach your comments.
- *Mail:* Submit written comments to Ben Laws, Incidental Take Program Supervisor, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service, 1315 East-West Highway, Silver Spring, MD 20910–3225.
- *Fax:* (301) 713–0376; Attn: Ben Laws.

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 at: *https://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 Action Proponents' Incidental Take Authorization (ITA) application and supporting documents, as well as a list of the references cited in this document, may be obtained online at: *https://www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-military-readiness-activities.* In case of problems accessing these documents, please call the contact listed below (see **FOR FURTHER INFORMATION CONTACT**).

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

SUPPLEMENTARY INFORMATION:

Purpose and Need for Regulatory Action

This proposed rule, if promulgated, would provide a framework under the authority of the MMPA (16 U.S.C. 1361 *et seq.*) to allow for the authorization of take of marine mammals incidental to the Action Proponents' training and testing activities and modernization and sustainment of ranges (which qualify as military readiness activities) involving the use of active sonar and other transducers and explosives (also referred to as ''in-water detonations'') and vessel movement in the MITT Study Area (hereafter Study Area). The Study Area consists primarily of the Mariana Islands Range Complex (MIRC) and the Transit Corridor connecting the Study Area with the Hawaii portion of the Hawaii-California Training and Testing Study Area as well as high-seas areas to the west and north of the MIRC. The Study Area includes the at-sea areas of the MIRC and adjacent airspace, Navy pierside locations and port transit channels, bays, harbors, inshore waterways, and amphibious landing areas. Land components associated with the range complexes are generally not included in the Study Area with the exception of certain land-based activities conducted on Farallon de Medinilla (FDM) (see appendix A (Military Readiness Activities Descriptions) of the 2026 MITT Draft Supplemental Environmental Impact Statement/Overseas Environmental Impact Statement (2026 MITT Draft SEIS/OEIS) for more information). However, activities conducted at FDM are not expected to affect marine mammals and are not discussed further.

Legal Authority for the Proposed Action

The MMPA prohibits the take of marine mammals with certain exceptions. Sections 101(a)(5)(A) and (D) of the MMPA (16 U.S.C. 1371(a)(5)(A), (D)) 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 proposed or, if the taking is limited to harassment, a notice of a proposed authorization is provided to the public for review and the opportunity to submit comment.

Authorization for incidental takings shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s) and will not have an unmitigable adverse impact on the availability of the species or stock(s) for taking for subsistence uses (where relevant). If such findings are made, NMFS must prescribe the permissible methods of taking; 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 the species or stocks for taking for certain subsistence uses (collectively referred to as ''mitigation''); and

requirements pertaining to the monitoring and reporting of the takings. The MMPA defines ''take'' to mean to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal (16 U.S.C. 1362(13)). The Preliminary Analysis and Negligible Impact Determination section discusses the definition of ''negligible impact.''

The 2004 NDAA (Pub. L. 108–136) amended section 101(a)(5) of the MMPA to remove the ''small numbers'' and ''specified geographical region'' provisions, 16 U.S.C. 1371(a)(5)(F), and amended the definition of ''harassment'' in section 3(18)(B) of the MMPA as applied to a ''military readiness activity'' to read as follows: ''(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]'' (16 U.S.C. 1362(18)(B)). The 2004 NDAA also amended the MMPA to establish in section 101(a)(5)(A)(iii) that ''[f]or a military readiness activity . . . , 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.'' 16 U.S.C. 1371(a)(5)(A)(iii). On August 13, 2018, the 2019 NDAA (Pub. L. 115–232) amended the MMPA to allow incidental take regulations (ITRs) for military readiness activities to be issued for up to 7 years. 16 U.S.C. 1371(a)(5)(A)(ii).

Summary of Major Provisions Within the Proposed Rule

The major provisions of this proposed rule are as follows:

- The proposed authorization of take of marine mammals by Level A harassment and/or Level B harassment by the Action Proponent in the course of the specified activities in the Study Area;
- The proposed use of defined powerdown and shutdown zones (based on activity);
- Proposed measures to reduce the likelihood of vessel strikes;
- Proposed activity limitations in certain areas and times that are biologically important (*i.e.,* for reproduction) for marine mammals;
- The proposed implementation of a Notification and Reporting Plan (for dead, live stranded, or marine mammals struck by any vessel engaged in military readiness activities); and
- The proposed implementation of a robust monitoring plan to improve our understanding of the environmental effects resulting from the Action Proponents' training and testing activities and modernization and sustainment of ranges.

This proposed rule includes an adaptive management component that allows for timely modification of mitigation, monitoring, and/or reporting measures based on new information, when appropriate.

Summary of Request

On February 23, 2026, NMFS received an application from the Action Proponents requesting authorization to take marine mammals, by Level A and Level B harassment, incidental to training, testing, and modernization and sustainment of ranges (characterized as military readiness activities) including the use of sonar and other transducers and in-water detonations in the Study Area. The Action Proponents are requesting one 7-year LOA for all training and testing activities. In response to our comments and following information exchange, the Action Proponents submitted a final revised application that we deemed adequate and complete on April 21, 2026. On April 28, 2026, we published a notice of receipt (NOR) of application in the **Federal Register** (91 FR 22810), requesting comments and information related to the Action Proponents' request for 30 days. During the 30-day public comment period on the NOR, we did not receive any public comments.

NMFS has previously promulgated ITRs pursuant to the MMPA relating to similar military readiness activities in areas located within the Study Area. NMFS published regulations effective beginning August 3, 2010 (75 FR 45527, August 3, 2010), August 3, 2015 (80 FR 46112, August 3, 2015), and from July 31, 2020, through July 30, 2027 (85 FR 46302, July 31, 2020)). For this proposed rulemaking, the Action Proponents propose to conduct substantially similar training and testing activities within the Study Area that were conducted over the past 16 years under the previous rules.

The Action Proponents' application reflects the most up-to-date compilation of training and testing activities and modernization and sustainment of ranges deemed necessary to accomplish military readiness requirements. The types and numbers of activities included in the proposed rule account for interannual variability in training and testing to meet evolving or emergent military readiness requirements. As explained herein, these proposed regulations also consolidate several actions conducted by the Navy that were previously authorized by NMFS and include some new military readiness activities carried out by the Action Proponents. In particular, these proposed regulations would cover incidental take during military readiness activities in the Study Area that would occur for a 7-year period following the expiration of the existing MMPA authorization on July 30, 2027 (85 FR 46302). In this proposed rule, we have undertaken a comprehensive assessment of the risks/impacts of all military training and testing activities on marine mammals likely to be present within the entire range of the Study Area.

Description of Proposed Activity

Overview

The Action Proponents request authorization to take marine mammals incidental to conducting military readiness activities. The Action Proponents have determined that acoustic and explosive stressors are likely to result in take of marine mammals in the form of Level A and B harassment. Detailed descriptions of these activities are provided in chapter 2 and appendix A (Military Readiness Activities Descriptions) of the 2026 MITT Draft SEIS/OEIS (*https://www.nepa.navy.mil/mitteis/*) and in the Action Proponents' application (*https://www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-military-readiness-activities*). A summary is provided below.

The Navy's statutory mission is to organize, train, equip, and maintain combat-ready naval forces for the peacetime promotion of the national security interests and prosperity of the United States and for prompt and sustained combat incident to operations essential to the prosecution of a naval campaign. This mission is mandated by Federal law (10 U.S.C. 8062; 10 U.S.C. 8063), which requires the readiness of the naval forces of the United States. The Navy executes this responsibility by establishing and executing at-sea training and testing, often in designated operating areas (OPAREAs) and testing and training ranges. The Navy must be able to access and use these areas and associated sea and air space 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 vessels, aircraft, weapons, combat systems, sensors, and related equipment, and conducts scientific research activities to achieve and maintain military readiness.

The mission of the Coast Guard is to ensure the maritime safety, security, and stewardship of the United States. To advance this mission, the Coast Guard must ensure its personnel can qualify and train jointly with, and independently of, the Navy and other services in the effective and safe operational use of Coast Guard vessels, aircraft, and weapons under realistic conditions. These activities help ensure the Coast Guard can safely assist in the defense of the United States by protecting the United States' maritime safety, security, and natural resources in accordance with its national defense mission (14 U.S.C. 102). The Coast Guard successfully achieves their mission in part by conducting training within the Study Area to develop, sharpen, and maintain tactics, coordination, and personnel readiness.

In addition to training of Navy and Coast Guard forces, the specified activities include Air Force and Army activities within the Study Area where those activities are similar to Navy activities and are scheduled on Navy-controlled ranges.

Dates and Duration

The specified activities would occur at any time during the 7-year period of validity of the regulations. The proposed number of military readiness activities are described in the *Detailed Description of the Specified Activity* section (table 1 through table 4).

Geographic Region

The Study Area is comprised of three components: (1) the MIRC; (2) additional areas on the high seas; and (3) a transit corridor between the MIRC and the Hawaii Range Complex (HRC) as depicted in figure 1. The MIRC includes the waters south of Guam to north of Pagan (Commonwealth of the Northern Mariana Islands; CNMI) and from the Pacific Ocean east of the Mariana Islands to the Philippine Sea to the west, encompassing 1,721,376.21 square kilometers (km^2) (501,873 square nautical miles) of open ocean (figure 1). It also includes additional areas of the high seas: the area to the north of the MIRC that is within the U.S. Exclusive Economic Zone (EEZ) of the CNMI and the areas to the west of the MIRC. The transit corridor is outside the geographic boundaries of the MIRC and represents a great circle route (*i.e.,* the shortest distance) across the high seas for Navy ships transiting between the MIRC and the HRC. Although not part of any defined range complex, the transit corridor is important to the Navy in that it provides available air, sea, and undersea space where vessels and aircraft conduct training and testing while in transit. While in transit and along the corridor, vessels and aircraft would, at times, conduct basic and routine unit-level activities such as gunnery and sonar training. Ships also conduct sonar maintenance, which includes active sonar transmissions.

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

The MIRC includes approximately 137,196 km^2 of special use airspace. This airspace is almost entirely over the ocean (except W13A) and includes warning areas and restricted areas (R; see figure 2.2–1 of the 2026 MITT Draft SEIS/OEIS). Warning Areas (W)-517 and W–12 include approximately 40,472 km^2 of special use airspace; W–11 (A/B) is approximately 36,014 km^2 of special use airspace, and W–13 (A/B/C) is approximately 61,738 km^2 of special use airspace. The restricted area airspace over or near land areas within the MIRC includes approximately 8,447 km^2 of special use airspace and restricted areas R7201 and R7201A, which extends in a 22.2 km radius around FDM.

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

Additionally, the Study Area includes pierside locations in the Apra Harbor Naval Complex (see figure 2–3 of the application) where surface ship and submarine sonar maintenance and testing occur. Activities in Apra Harbor include channels and routes to and from the Navy port in the Apra Harbor Naval Complex and associated wharves and facilities within the Navy port.

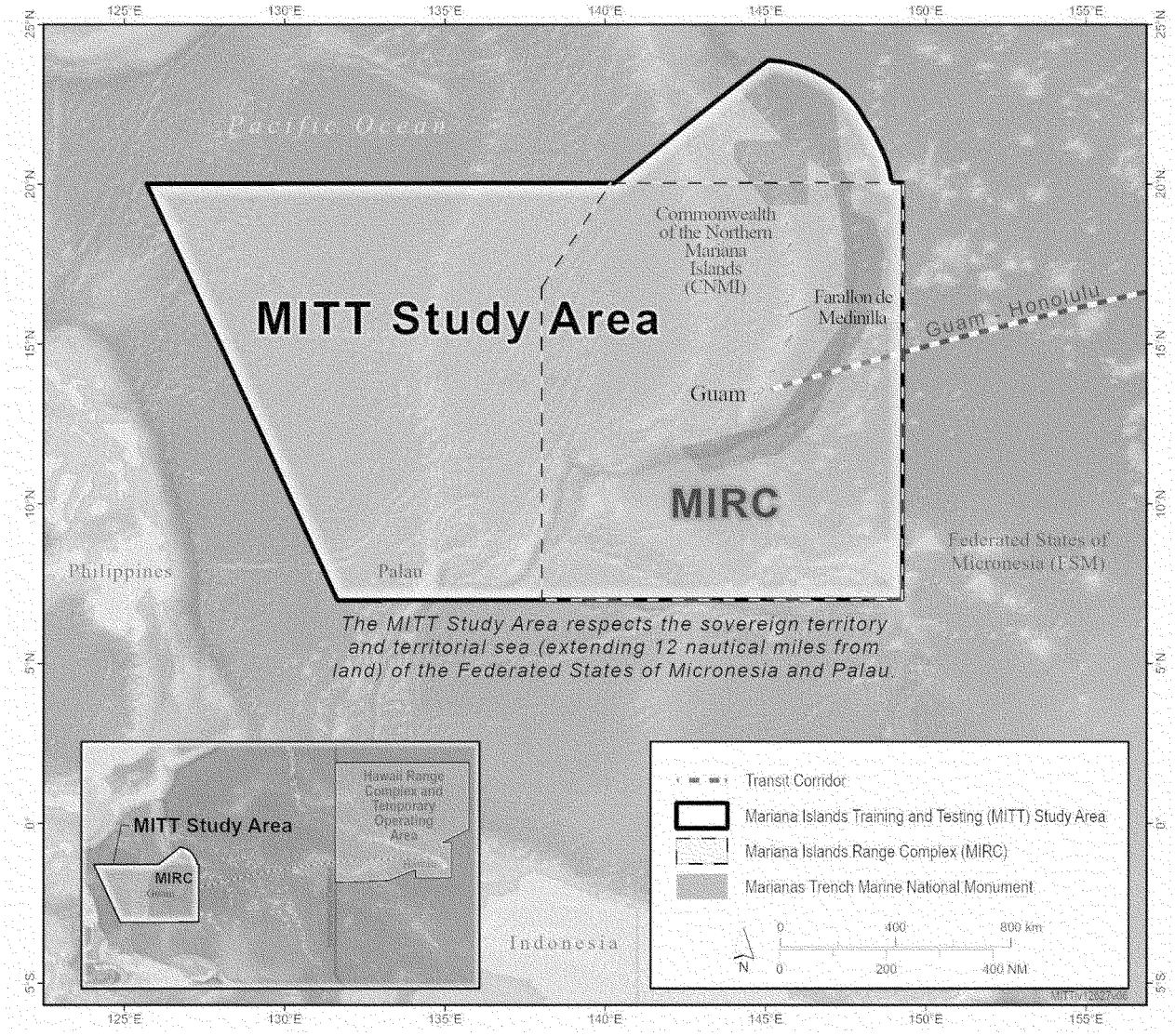


Figure 1 – Map of the Study Area

Detailed Description of the Specified Activity

The Action Proponents propose to conduct military readiness activities within the Study Area and have been conducting military readiness activities in the Study Area since the 1940s. The tempo and types of military readiness activities have varied interannually due to the introduction of new technologies, the evolving nature of international events, advances in warfighting doctrine and procedures, and changes in force structure (organization of vessels, weapons, and personnel). Such developments influence the frequency, duration, intensity, and location of required military readiness activities.

Primary Mission Areas

The Action Proponents categorize their activities into functional warfare areas called primary mission areas. For the Navy, these activities generally fall into eight primary mission areas (Coast Guard mission areas are discussed below). Most military readiness activities conducted in MITT are categorized under one of these primary mission areas; activities that do not fall within one of these areas are listed as ''other activities.'' The Navy testing community also categorizes most, but not all, of its testing activities under these primary mission areas. The Navy testing community has three additional categories of activities: vessel evaluation, unmanned systems (*i.e.,* unmanned surface vehicles (USVs), unmanned underwater vehicles (UUVs)), and acoustic and oceanographic science and technology.

The mission areas with activities that may result in take of marine mammals (and stressors associated with training and testing activities within those mission areas) include the following:

- Anti-submarine warfare (ASW; sonar and other transducers);
- Mine warfare (sonar and other transducers, in-water detonations);
- Surface warfare (sonar and other transducers, in-water detonations);
- Unmanned systems (sonar and other transducers, in-water detonations);
- Vessel evaluation (sonar and other transducers, in-water detonations); and
- Other training and testing activities (sonar and other transducers).

The Action Proponents describe and analyze the effects of their activities within the application (*see also* the 2026 MITT Draft SEIS/OEIS for additional details). In their assessment, the Action Proponents concluded that sonar and other transducers and explosives (in-water detonations) were the stressors most likely to result in impacts on

marine mammals that qualify as harassment as defined under the MMPA. Therefore, the Action Proponents' application provides their assessment of potential effects from these stressors in terms of the primary warfare mission areas in which they would be conducted. Air warfare, amphibious warfare, electronic warfare, expeditionary warfare, strike warfare, acoustic and oceanographic science and technology, and range modernization and sustainment do not use sonars, in-water explosives, or any other stressors that would result in take of marine mammals, and therefore, are not considered further herein.

The Coast Guard has four major national defense missions:

- Maritime intercept operations;
- Deployed port operations/security and defense;
- Peacetime engagement; and
- Environmental defense operations (including oil and hazardous substance response).

The Coast Guard manages 6 major operational mission programs with 11 statutory missions, which includes defense readiness. As part of the Coast Guard's defense mission, 14 U.S.C. 1 states the Coast Guard is ''at all times an armed force of the United States.'' As part of the Joint Forces, the Coast Guard maintains its readiness to carry out military operations in support of the policies and objectives of the U.S. government. As an armed force, the Coast Guard trains and operates in the joint military arena at any time and functions as a specialized service under the Navy in time of war or when directed by the President. Coast Guard service members are trained to respond immediately to support military operations and national security. Federal law created the framework for the relationship between the Navy and the Coast Guard (10 U.S.C. 101; 14 U.S.C. 2(7); 22 U.S.C. 2761; 50 U.S.C. 3004). To meet these statutory requirements and effectively carry out these missions, the Coast Guard's air and surface units train using realistic scenarios, including training with the Navy in their primary mission areas. Every Coast Guard unit is trained to support all statutory missions and, thus, trained to meet all mission requirements, which includes their defense mission requirements. Since all Coast Guard's missions generally entail the deployment of cutters or boats and either fixed-wing or rotary aircraft, the Coast Guard training requirements for one mission generally overlap with the training requirements of other missions. Thus, when the Coast Guard is training for its defense mission, the same skill sets are utilized for its other statutory missions.

The Coast Guard's defense mission does not involve use of low- or mid-frequency active sonar (LFAS or MFAS), missiles, or underwater detonations that would result in harassment of marine mammals; therefore, we do not consider the defense mission of the Coast Guard further herein.

Below, we provide additional detail for each of the applicable primary mission areas.

Anti-Submarine Warfare—

The mission of ASW is to locate, neutralize, and defeat hostile submarine forces that threaten Navy forces. ASW is based on the principle that surveillance and attack aircraft, ships, and submarines all search for hostile submarines. These forces operate together or independently to gain early warning and detection and to localize, track, target, and attack submarine threats.

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

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

Mine Warfare—

The mission of mine warfare is to detect, classify, and avoid or neutralize (*i.e.,* disable) mines to protect U.S. ships and submarines and to maintain free access to ports and shipping lanes. Mine warfare training falls into two primary categories: (1) mine detection and classification and (2) mine countermeasure and neutralization. Mine warfare also includes offensive mine laying to gain control of or deny the enemy access to sea space. Naval mines can be laid by ships, submarines, UUVs, or aircraft.

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

Testing and development of mine warfare systems is conducted to improve sonar, laser, and magnetic detectors intended to hunt, locate, and record the positions of mines for avoidance or subsequent neutralization. Mine warfare testing and development falls into two primary categories: (1) mine detection and classification and (2) mine countermeasure and neutralization testing. Mine detection and classification testing involves the use of air, surface, and subsurface vessels and uses sonar, including towed and side-scan sonar, and unmanned vehicles to locate and identify objects underwater. Mine detection and classification systems are sometimes used in conjunction with a mine neutralization system. Mine countermeasure and neutralization testing uses air, surface, and subsurface platforms and systems to evaluate the effectiveness of neutralizing mine threats. Most mine 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 rotary-wing aircraft or a manned or USV-based system that may deploy a towed neutralization system. 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, and surface warfare entails offensive action against surface and subsurface targets while

also defending against enemy forces. In 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 Action Proponent surface-to-surface gunnery and missile exercises; air-to-surface gunnery, bombing, 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. Testing events may be integrated into training activities to test aircraft or aircraft systems in the delivery of ordnance on a surface target. In most cases, the tested systems are used in the same manner in which they are used for training activities.

Unmanned Systems—

USV system testing primarily uses autonomous systems designed to augment current and future platforms to help deter maritime threats. The vehicles employ a variety of sensors designed to extend the reach of manned vessels. Refer to appendix A (Military Readiness Activities Descriptions) of the 2026 MITT Draft SEIS/OEIS for more information on this activity.

Vessel Evaluation—

Undersea warfare testing, as part of vessel evaluation activities, evaluates a vessel's ability to detect, track, and engage undersea targets. Testing also includes assessing equipment vulnerability and ordnance lethality. Refer to appendix A (Military Readiness Activities Descriptions) of the 2026 MITT Draft SEIS/OEIS for more information on these activities.

Other Training Activities—

Other training activities are conducted in the Study Area that fall outside of the primary mission areas but support overall readiness. These activities include UUV training, submarine navigation training, and maintenance of ship and submarine sonar at piers and at-sea. Refer to appendix A (Military Readiness Activities Descriptions) of the 2026 MITT Draft SEIS/OEIS for more information on these activities

Overview of Training Activities Within the Study Area

The Action Proponents routinely train in the Study Area in preparation for national defense missions. Training activities and exercises covered in this proposed rule are briefly described below and in more detail within the 2026 MITT Draft SEIS/OEIS. Table 1 summarizes the major training exercises (MTE) and smaller integrated/coordinated training activities by scale, duration, and estimated sonar hours for the purposes of exercise reporting requirements. Each training activity described meets a requirement that can be traced ultimately to requirements set forth by the National Command Authority.[1]

Within the Navy, a MTE is comprised of multiple unit-level range exercises conducted by several units operating together while commanded and controlled by a single commander. These units are collectively referred to as carrier and expeditionary strike groups. These exercises typically employ an exercise scenario developed to train and evaluate the strike group in tactical naval tasks. In a MTE, most of the operations and activities being directed and coordinated by the strike group commander are identical in nature to the operations conducted during individual, crew, and smaller unit-level training events. However, in MTEs, these disparate training tasks are conducted in concert rather than in isolation. Some integrated or coordinated ASW exercises are similar in that they are composed of several unit-level exercises but are generally on a smaller scale than a MTE, are shorter in duration, use fewer assets, and use fewer hours of hull-mounted sonar per exercise. Coordinated training exercises involve multiple units working together to meet unit-level training requirements, whereas integrated training exercises involve multiple units working together in preparation for deployment. Coordinated exercises involving the use of sonar are presented under the category of ASW. The ASW portions of these exercises are considered together in coordinated activities for the sake of acoustic modeling. When other training objectives are being met, those activities are described via unit-level training in each of the relevant primary mission areas.

With a smaller fleet of approximately 250 cutters worldwide, Coast Guard activities are not as extensive as Navy activities due to differing mission requirements. However, the Coast Guard does train with the Navy and conducts some of the same training as the Navy. The Coast Guard does not conduct any exercises similar in scale to Navy MTEs/integrated exercises, and the use of mid- or low-frequency sonar, missiles, and underwater detonations are examples of actions that are not a part of the Coast Guard's mission requirements. Coast Guard training generally occurs close to the vessel homeport or close to shore, on established Navy training and testing ranges, or in transit to a scheduled patrol/mission. There are approximately 1,600 Coast Guard vessels (cutters up to 127.4 meters (m) and boats less than 19.8 m), and the largest cutters would be underway for 3–4 months, whereas the smaller cutters would be underway from a few days to 4 weeks. Within the Oceania District, Coast Guard Forces Micronesia/Sector Guam, there are approximately six cutters and an unspecified number of small boats homeported in Santa Rita, Guam. Cutters are defined as vessels larger than 19.8 m in length. The Coast Guard operates approximately 1,400 boats worldwide, defined as any vessel less than 19.8 m in length, which generally operate near shore and on inland waterways.

The MTEs and integrated/coordinated training activities analyzed for this request are Navy-led exercises in which the Coast Guard may participate and are described in table 1. For additional information on these activities see appendix A (Military Readiness Activities Descriptions) of the 2026 MITT Draft SEIS/OEIS. In addition to participating in Navy-led exercises, Coast Guard, Army, and Air Force training activities include unit-level activities conducted independently of, and not in coordination with, the Navy.

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[1] National Command Authority is a term used by the United States military and government to refer to the ultimate lawful source of military orders. The term refers collectively to the President of the United States (as commander-in-chief) and the United States Secretary of War.

Table 1 -- MTEs and Integrated/Coordinated Training Activities Analyzed within the Study Area

Training type	Exercise group	Description	Scale	Duration	Location	Exercise examples	Modeled hull-mounted sonar per exercise
Major Training Exercise	Large Integrated ASW	Larger-scale, longer duration integrated ASW exercises	Up to three Carrier Strike Groups in coordination with other Services, 2 or more submarines, multiple ASW aircraft	Typically, a 10-day exercise	Study Area	Joint Multi-Strike Group Exercise (*e.g.*, Valiant Shield)	>500 hours
Integrated/Coordinated Training	Small Integrated ASW	Small-scale, short duration integrated ASW exercises	Approximately 3-6 surface ASW units, at least 1 submarine, 2-6 ASW aircraft	Generally, <5 days	Study Area, Apra Habor	SWATT, NUWTAC	50-100 hours
Integrated/Coordinated Training	Medium Coordinated ASW	Medium-scale, short duration, coordinated ASW exercises	Approximately 2-4 surface ASW units, possibly a submarine, 2-5 ASW aircraft	Generally, 3-10 days	Study Area	GuamEx	<100 hours
Integrated/Coordinated Training	Small Coordinated ASW	Small-scale, short duration, coordinated ASW exercises	Approximately 2-4 surface ASW units, possibly a submarine, 1-2 ASW aircraft	Generally, 2-4 days	Study Area	Group Sail	<50 hours

Note: ASW = Anti-Submarine Warfare, SWATT = Surface Warfare Advanced Tactical Training, NUWTAC = Naval Undersea Warfare Training Assessment Course, GuamEx = Guam Exercise

Table 2 -- Proposed Training Activities Analyzed within the Study Area

Stressor Category	Activity type	Activity name	Description	Source bin class	Location	Annual number of activities	7-year number of activities
Acoustic	Major Training Exercises Large Integrated Anti-Submarine Warfare Training	Joint Multi-Strike Group Exercise	Typically, a 10-day joint exercise, in which up to three carrier strike groups would conduct training exercises simultaneously.	LF to HF, MF to HF, LFH, MFH, MFM, HFH, MF1, MF1C	Study Area; MIRC >3 nmi (5.6 km) from Land	1	7
Acoustic	Small Integrated Anti-Submarine Warfare Training	Surface Warfare Advanced Tactical Training (SWATT)	Multiple ships and aircraft coordinate the use of sensors, including sonobuoys, to search, detect, and track a threat submarine. SWATT exercises are not dedicated anti-submarine warfare exercises and involve multiple warfare areas.	MF to HF, LFH, MFH, MFM, MF1, MF1C	MIRC; Study Area >3 nmi (5.6 km) from Land	1	7
Acoustic	Small Integrated Anti-Submarine Warfare Training	Small Integrated Anti-Submarine Warfare Training – Navy Undersea Warfare Training Assessment Course/Multi-Sail	Multiple ships, aircraft, and submarines integrate the use of their sensors, including sonobuoys, to search for, detect, classify, localize, and track a threat submarine.	MF to HF, LFH, MFH, MFM, MF1, MF1C	Study Area; MIRC >3 nmi (5.6 km) from Land	7	49
Acoustic	Medium Coordinated Anti-Submarine Warfare Training	Medium Coordinated Anti-Submarine Warfare Training	Typically, a 3–10-day exercise with multiple ships, aircraft, and submarines integrating the use of their sensors,	LF to HF, MF to HF, MFH, MFM,	Study Area; MIRC >3 nmi (5.6 km) from Land	5	35

			including sonobuoys, to search, detect, and track threat submarines.	HFH, MF1, MF1C			
Acoustic	Small Coordinated Anti-Submarine Warfare Training	Independent Deployer Certification Exercise/Tailored Surface Warfare Training[1]	Multiple ships, aircraft, and submarines conduct integrated multi-warfare training with a surface warfare emphasis for a duration of 14 days. Serves as a ready-to-deploy certification for individual surface ships tasked with surface warfare missions.	LF to HF, MF to HF, MFH, MFM, HFH, MF1, MF1C	Study Area; MIRC >3 nmi (5.6 km) from Land	5	35
Acoustic	Anti-Submarine Warfare	Anti-Submarine Warfare Torpedo Exercise Helicopter	Helicopter crews search for, track, and detect submarines. Recoverable air launched torpedoes are employed against submarine targets.	MFH, MFM, HFH	Study Area; MIRC >3 nmi (5.6 km) from Land	1	7
Acoustic	Anti-Submarine Warfare	Anti-Submarine Warfare Torpedo Exercise – Maritime Patrol Aircraft	Maritime patrol aircraft crews search for, track, and detect submarines. Recoverable air launched torpedoes are employed against submarine targets.	MFM, HFH	Study Area; MIRC >3 nmi (5.6 km) from Land	1-2	10
Acoustic	Anti-Submarine Warfare	Anti-Submarine Warfare Torpedo Exercise – Ship	Surface ship crews search for, track, and detect submarines. Exercise torpedoes are used during this exercise.	MF to HF, HFH, MF1, MF1C	Study Area; MIRC >3 nmi (5.6 km) from Land	6-8	48
Acoustic	Anti-Submarine Warfare	Anti-Submarine Warfare Torpedo Exercise – Submarine	Submarine crews search for, track, and detect submarines. Exercise torpedoes are used during this exercise.	LF to HF, MFH, HFH	Study Area; MIRC >3 nmi (5.6 km) from Land	1-2	10
Acoustic	Anti-Submarine Warfare	Anti-Submarine Warfare Tracking Exercise – Helicopter	Helicopter crews search for, track, and detect submarines.	MFH, MFM	Study Area; MIRC >3 nmi (5.6 km) from Land	16	112
Acoustic	Anti-Submarine Warfare	Anti-Submarine Warfare Tracking Exercise – Maritime Patrol Aircraft	Maritime patrol aircraft crews search for, track, and detect submarines.	MFM	Study Area; MIRC >3 nmi (5.6 km) from Land	45-60	360
Acoustic	Anti-Submarine Warfare	Anti-Submarine Warfare Tracking Exercise – Ship	Surface ship crews search for, track, and detect submarines. Exercise torpedoes may be used during this event.	MF to HF, MF1, MF1C	Study Area >3 nmi (5.6 km) from Land; MIRC	90	630
Acoustic	Anti-Submarine Warfare	Anti-Submarine Warfare Tracking Exercise – Submarine	Submarine crews search for, track, and detect submarines.	MFH, HFH	Study Area; MIRC; Transit Lane >3 nmi (5.6 km) from Land	14	98
Acoustic and Explosive	Mine Warfare	Civilian Port Defense – Homeland Security Anti-	Maritime security personnel train to protect civilian ports and harbors against enemy	E4, MFH, HFM, HFH	CNMI and Guam Nearshore	1	7

		Terrorism/Force Protection Exercises	efforts to interfere with access to those ports.				
Explosive	Mine Warfare	Mine Neutralization Explosive Ordnance Disposal	Personnel disable threat mines using explosive charges.	E5, E6	Agat Bay Mine Neutralization Site; Outer Apra Harbor UNDET Site; Piti UNDET Site	20	140
Acoustic	Mine Warfare	Surface Ship Object Detection	Ship crews detect and avoid mines while navigating restricted areas or channels using active sonar.	MF1K	CNMI and Guam Nearshore	20-30	170
Explosive	Mine Warfare	Underwater Demolition Qualification and Certification	Navy divers conduct various levels of training and certification in placing underwater demolition charges.	E5, E6	Agat Bay Mine Neutralization Site; Outer Apra Harbor UNDET Site; Piti UNDET Site	45	315
Explosive	Surface Warfare	Bombing Exercise Air-to-Surface	Fixed-wing aircrews deliver bombs against surface targets.	E10, E12, E9	Study Area: MIRC >50 nmi (92.6 km) from Land	39	273
Explosive	Surface Warfare	Fast Attack Craft and Fast Inshore Attack Craft	Navy and USCG ships, helicopters, and Unmanned Systems defend against small boat attacks.	E5	Study Area; MIRC >3 nmi (5.6 km) from Land	22-33	187
Explosive	Surface Warfare	Gunnery Exercise Surface-to-Surface Boat Medium Caliber	Small boat crews fire medium-caliber guns at surface targets.	E1	Study Area SUA >12 nmi (22.2 km) from land	9-24	108
Explosive	Surface Warfare	Gunnery Exercise Surface-to-Surface Ship Medium Caliber	Surface ship crews fire medium-caliber guns at surface targets.	E1	Study Area; MIRC >12 nmi (22.2 km) from Land; Transit Lane	104-150	866
Explosive	Surface Warfare	Gunnery Exercise Surface-to-Surface Ship Large Caliber	Surface ship crews fire large-caliber guns at surface targets.	E3, E5	Study Area; MIRC >12 nmi (22.2 km) from Land; Transit Lane	180-257	1,491
Explosive	Surface Warfare	Maritime Security Operations	Helicopter, surface ship, and small boat crews conduct a suite of maritime security operations at sea, to include visit, board, search, and seizure; maritime interdiction operations; maritime interdiction operations; maritime infrastructure protection and harbor defense; ship force protection; anti-piracy operations; and drug interdiction by the USCG.	E2	Study Area; MIRC	117-139	885

Explosive	Surface Warfare	Missile Exercise Air-to-Surface	Fixed-wing and helicopter aircrews fire air-to-surface missiles at surface targets.	E10, E6, E7, E9	Study Area >12 nmi (22.2 km)	38-50	302
Explosive	Surface Warfare	Missile Exercise Air-to-Surface – Rocket	Helicopter aircrews fire both precision-guided and unguided rockets at surface targets.	E3	Study Area SUA	35-47	281
Explosive	Surface Warfare	Missile Exercise Surface-to-Surface	Surface ship crews defend against surface threats (ships or small boats) and engage them with missiles.	E9	Study Area; MIRC >50 nmi (92.6 km) from Land	8-9	59
Acoustic and Explosive	Surface Warfare	Sinking Exercise	Aircraft, ship, and submarine crews deliberately sink a seaborne target, usually a decommissioned ship made environmentally safe for sinking according to U.S. Environmental Protection Agency standards, with a variety of ordnance.	HFH, E11, E12, E5, E8, E9	Study Area; MIRC >50 nmi (92.6 km) from Land	1-2	10
Acoustic	Surface Warfare	Surface Warfare Torpedo Exercise (Submarine)	Submarine crews search for, detect, and track a surface ship simulating a threat surface ship with the goal of determining a firing solution that could be used to launch a torpedo with the intent to simulate destroying the targets.	HFH	Study Area; MIRC >3 nmi (5.6 km) from Land	1-5	19
Acoustic	Other Training Activities	Submarine Navigation	Submarine crews operate sonar for navigation and detection while transiting into and out of port during reduced visibility.	MFH, HFH	Study Area; MIRC	50	350
Acoustic	Other Training Activities	Submarine Sonar Maintenance	Maintenance of submarine sonar and other system checks are conducted pierside or at sea.	MFH	Study Area; MIRC; Inner Apra Harbor; Transit Lane	92	644
Acoustic	Other Training Activities	Surface Ship Sonar Maintenance	Maintenance of surface ship sonar and other system checks are conducted pierside or at sea.	MF1, MF1K	Study Area; MIRC; Inner Apra Harbor; Transit Lane	51	357
Acoustic	Other Training Activities	Unmanned Underwater Vehicle Training - Certification and Development Exercises	UUV certification involves training with unmanned platforms to ensure 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.	MF to HF, HFM, VHFH	Study Area; MIRC; CNMI and Guam Nearshore	65-70	470

Note: LF = Low Frequency, MF = Mid-Frequency, HF = High Frequency, LFH = Low Frequency High, MFH = Mid Frequency High, MFM = Mid Frequency Mid, HFH = High Frequency High, HFM = High Frequency Mid, VHFH = Very High Frequency High, MITT = Mariana Islands Training and Testing, MIRC = Mariana Islands Range Complex, CNMI = Commonwealth of the Northern Mariana Islands, SUA = Special Use Airspace, UNDET = Underwater Demolition

[1] All ASW acoustic sources which may be used during Independent Deployer Certification Exercise/Tailored Surface Warfare Training have been accounted for in the modeling and analysis of ASW unit-level training events presented in the 2026 MITT Draft SEIS/OEIS.

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Overview of Testing Activities Within the Study Area

While this proposed rule includes an evaluation of proposed training activities by all Action Proponents, all testing activities evaluated in this proposed rule would only be conducted by the Navy. The Navy's testing community engages in a broad spectrum of research, development, testing, and evaluation activities as part of the acquisition process and in support of the fleet. These activities include, but are not limited to, basic and applied scientific research and technology development; testing, evaluation, and maintenance of systems (*e.g.,* missiles, radar, and sonar) and platforms (*e.g.,* surface ships, submarines, and aircraft); and acquisition of systems and platforms to support Navy missions and give a technological edge over adversaries. The individual commands within the research and acquisition community considered in the application are Naval Air Systems Command (NAVAIR), Naval Sea Systems Command (NAVSEA), and Office of Naval Research (ONR). Although included in the testing community, proposed ONR activities do not involve any stressors that could result in harassment of marine mammals, and therefore, are not analyzed further in this proposed rule.

The Action Proponents operate in an ever-changing strategic, tactical, financially constrained, and time-constrained environment. Testing activities occur in response to emerging science or fleet operational needs. For example, future Navy studies to develop a better understanding of ocean currents may be designed based on advancements made by non-government researchers not yet published in the scientific literature. Similarly, the Navy may be required to conduct specific operations in a geographic area where those operations have never been conducted before, which may require modifications to Navy assets to account for local environmental conditions. Such modifications must be tested in the field to ensure they meet fleet needs and requirements. Accordingly, generic descriptions of some of these activities are the best that can be articulated in a long-term, comprehensive document.

Some testing activities are similar to training activities conducted by the fleet (*e.g.,* both the fleet and the research and acquisition community fire torpedoes). While the firing of a torpedo might look identical to an observer, the difference is in the purpose of the firing. The fleet might fire the torpedo to practice the procedures for such a firing, whereas the research and acquisition community might be assessing a new torpedo

guidance technology or testing it to ensure the torpedo meets performance specifications and operational requirements (see appendix A (Military Readiness Activities Descriptions) of the 2026 MITT Draft SEIS/OEIS for more detailed descriptions of the activities).

The majority of testing activities conducted by NAVAIR are similar to fleet training activities, and many platforms and systems currently being tested are already being used by the fleet or are expected to be integrated into fleet and Coast Guard operations. However, some testing activities may be conducted in different locations or in a different manner than comparable fleet training activities. As a result, the environmental analysis for these testing events may differ from that of similar training activities.

NAVAIR activities include, but are not limited to, the testing of new aircraft platforms, weapons, and systems that have not yet been integrated into the fleet or Coast Guard. In addition to initial testing, most aircraft and weapon systems that have already been delivered to the fleet require follow-on testing throughout their lifecycle. This testing is often conducted in conjunction with maintenance, upgrades, and software revisions to ensure continued functionality and performance as designed. Table 3 summarizes the proposed testing activities for NAVAIR analyzed within the Study Area.

Table 3 -- Proposed NAVAIR Testing Activities Analyzed within the Study Area

Stressor Category	Activity name	Description	Source bin class	Location	Number of activities 1-year	Number of activities 7-year
Anti-Submarine Warfare						
Acoustic	ASW Torpedo Test – Aircraft	Evaluates anti-submarine warfare systems onboard rotary-wing and fixed-wing aircraft and the ability to search for, detect, classify, localize, track, and attack a submarine or similar target.	MFM, HFH	Study Area; MIRC >3 nmi (5.6 km) from Land	10	70
Acoustic	ASW Tracking Test – Fixed-Wing	The test evaluates the sensors and systems used by fixed-wing 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.	LFM, LFH, MFM	Study Area; MIRC >3 nmi (5.6 km) from Land	3	21
Acoustic	ASW Tracking Test – Rotary Wing	The test evaluates the sensors and systems used to detect and track submarines and to ensure that rotary-wing systems used to deploy the tracking systems perform to specifications.	MFH, MFM	Study Area; MIRC >3 nmi (5.6 km) from Land	5	35
Surface Warfare						
Explosive	Air-to-Surface Missile Test	Test may involve both fixed-wing and rotary-wing aircraft launching missiles at surface maritime targets to evaluate the weapons system or as part of another systems integration test.	E6, E9	Study Area; MIRC >12 nmi (22.2 km) from Land	6-7	45
Note: LF = low-frequency, MF = mid-frequency, HF = high-frequency, L = low, M= medium, H = high (*e.g.*, MFL = mid-frequency low source level).						

NAVSEA activities are generally aligned with the primary mission areas used by the fleets and include, but are not limited to, new ship construction, life cycle support, and other weapon system development and testing. Testing activities are conducted throughout the life of a Navy ship, from construction through deactivation from the fleet, to verification of performance and mission capabilities. Activities include pierside and at-sea testing of ship systems, including sonar, weapons, and unmanned systems; tests to determine how the ship performs at sea (sea trials); development and operational test and evaluation programs for new technologies and systems; and testing on all ships and systems that have undergone overhaul or maintenance. Table 4 summarizes the proposed testing activities for NAVSEA analyzed within the Study Area.

Table 4 -- Proposed NAVSEA Testing Activities Analyzed within the Study Area

Stressor Category	Activity name	Description	Source bin class	Location	Number of activities 1-year	Number of activities 7-year
Anti-Submarine Warfare						
Acoustic	Pierside Sonar Testing	Pierside testing to ensure systems are fully functional in a controlled pierside environment prior to at-sea test activities and complete any required troubleshooting.	MFH, HFM	Inner Apra Harbor	6-12	84
Acoustic	At-Sea Sonar Testing	At-sea testing to ensure systems are fully functional in an open ocean environment.	MFH	Study Area; MIRC >3 nmi (5.6 km) from Land	6-12	84
Mine Warfare						
Acoustic and Explosive	Mine Countermeasure and Neutralization Testing	Air, surface, and subsurface vessels neutralize threat mines and mine-like objects.	MFM, HFH, E4	Agat Bay Mine Neutralization; Piti Floating Mine Neutralization; Helicopter Laser Hazard Area	3	21
Unmanned System						
Explosive	Unmanned Surface Vehicle System Testing	Testing involves the production or upgrade of unmanned surface vehicles. This may include testing mine detection capabilities, evaluating the basic functions of individual platforms, or conducting complex events with multiple vehicles.	E9	Study Area. Activities involving explosives will occur >12 nmi (22.2 km) from land.	1	7
Vessel Evaluation						
Acoustic and Explosive	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.	MF to HF, MFH, MFM, HFH, E7	Study Area. Activities involving explosives will occur >12 nmi (22.2 km) from land.	16-21	75
Note: MFM – Mid Frequency Mid, HFH – High Frequency High, MFH – Mid Frequency High, MITT – Mariana Islands Training and Testing; MIRC – Mariana Islands Range Complex.						

Vessel Movement

Vessels used as part of the proposed activities include both surface and sub-surface operations of both manned and unmanned vessels (USVs, UUVs). Vessels used as part of the Action Proponents' activities include ships, submarines, unmanned vessels, and boats ranging in size from small, 26.7 m rigid hull inflatable boats to aircraft carriers with lengths up to 332.8 m. Unmanned systems may include vehicles ranging from 1.2–4.9 m, but typical size of USVs is 11–100 m while UUVs are 10–30 m in length. The Marine Corps operates small boats from 3–15.2 m in length and include small unit riverine craft, rigid hull inflatable boats and amphibious combat vehicles. Coast Guard vessels range in size from small boats between 3.9 and 19.8 m to large cutters with lengths up to 127.4 m.

Large Navy ships greater than 107 m generally operate at speeds in the range of 18.5–27.8 kilometers per hour (km/hr) for fuel conservation. Submarines generally operate at lower speeds in transit and even lower speeds for certain tactical maneuvers. Small craft (considered in this proposed rule to be less than 18 m in length) have much more variable speeds (dependent on the mission). While these speeds for large Navy vessels are representative of most events, some of the Action Proponents' vessels may need to temporarily operate outside of these parameters. For example, to produce the required relative wind speed over the flight deck, an aircraft carrier vessel group engaged in flight operations must adjust its speed through the water accordingly. The Navy also anticipates testing large USVs, some of which would be at high speed. 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 would be stopped or moving slowly ahead to maintain steerage. The Coast Guard currently operates approximately 250 cutters worldwide. Cutters usually carry a motor surf boat and/or a rigid-hulled inflatable boat.

The Coast Guard operates approximately 1,400 boats worldwide, defined as any vessel less than 20 m in length. These boats generally operate near shore and on inland waterways. The most common is 7.6 m long, of which the Coast Guard has more than 350; the shortest is 4 m.

The number of vessels used in the Study Area varies based on military readiness requirements, deployment schedules, annual budgets, and other unpredictable factors. Most military readiness activities involve the use of vessels. These activities could be widely dispersed throughout the Study Area but would typically be conducted near naval ports, piers, and range areas. Activities involving vessel movements occur intermittently and are variable in duration, ranging from a few hours to multiple weeks.

Action Proponent vessel traffic would especially be concentrated near the U.S. Naval Base Guam. There is no seasonal differentiation in vessel use. Large vessel movement primarily occurs with the majority of the traffic flowing between the installation and the OPAREAS. Support craft would be more concentrated in the coastal waters in the areas of the naval installation, ports, and ranges.

Additionally, the Action Proponents would operate a variety of smaller craft within the Study Area. Small craft types, sizes, and speeds vary. During military readiness activities, speeds generally range from 18.5 to 25.9 km/hr; however, vessels can and would, on occasion, operate within the entire spectrum of their specific operational capabilities. During modernization and sustainment of ranges activities, vessels would operate more slowly, typically

5.6 km/hr or less. In all cases, the Action Proponents would operate the vessels/craft in a safe manner consistent with the local conditions.

The Action Proponents fully considered the possibility of vessel strike, conducted an analysis, and determined that requesting take of marine mammals by vessel strike was not warranted. Although the Navy did not request take for vessel strike, NMFS also fully analyzed the potential for vessel strike of marine mammals as part of this rulemaking. This stressor is discussed in detail below. NMFS also concluded that take of marine mammals by vessel strike is unlikely to occur, and therefore, has not proposed authorizing take by vessel strike. Please see the Vessel Strike section for NMFS' analysis.

Foreign Navies

In furtherance of national security objectives, foreign militaries may participate in multinational training and testing events in the Study Area. Foreign military activities that are planned by and under the substantial control and responsibility of the Action Proponents are included in the specified activity. These participants could be in various training or testing events described in appendix A (Military Readiness Activities Descriptions) of the 2026 MITT Draft SEIS/OEIS, and their effects are analyzed in this proposed rule. However, when foreign military vessels and aircraft operate independently within the Study Area as sovereign vessels outside the planning, control, and responsibility of the Action Proponents, those activities are not considered part of the specified activity. There are many reasons why foreign military vessels may traverse U.S. waters or come into a U.S. port, or foreign aircraft may enter U.S. airspace, not all of which are at the request of any of the Action Proponents. Foreign military vessels and aircraft operate pursuant to their own national authorities and have independent rights under customary international law, embodied in the principle of sovereign immunity, to engage in various activities on the world's oceans and in associated airspace.

When foreign militaries are participating in a U.S. Navy-led exercise or event, foreign military use of sonar and explosives, when combined with the Action Proponents' use of sonar and explosives, would not result in exceedance of the analyzed levels (within each Navy Acoustic Effects Model (NAEMO) modeled sonar and explosive bin) used for estimating predicted impacts, which formed the basis of our acoustic impacts effects analysis that was used to estimate take in this proposed rule. Please see the Proposed Mitigation Measures section and Proposed Reporting section of this proposed rule for information about mitigation and reporting related to foreign navy activities in the Study Area.

Standard Operating Procedures

For training and testing to be effective, Action Proponent personnel must be able to safely use their sensors, platforms, weapons, and other devices to their optimum capabilities and as intended for use in missions and combat operations. The Action Proponents have developed standard operating procedures through decades of experience to provide for safety and mission success. While standard operating procedures are designed for the safety of personnel and equipment and to ensure the success of training and testing activities, their implementation often yields additional benefits on environmental, socioeconomic, public health and safety, and cultural resources.

Because standard operating procedures are essential to safety and mission success, the Action Proponents consider them to be part of the proposed activities and they are included in the environmental analysis (see table 1–6 of the application). Standard operating procedures that are recognized as providing a potential secondary benefit on marine mammals during training and testing activities are:

- Vessel safety;
- Weapons firing safety;
- 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 impacts. Information on mitigation measures is provided in the Proposed Mitigation Measures section.

Description of Stressors

The Action Proponents use a variety of sensors, platforms, weapons, and other devices. Military readiness activities using these systems may introduce sound and energy into the environment. The proposed military readiness activities were evaluated to identify specific components that would act as stressors by having direct or indirect impacts on marine mammals and their habitat. 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 within the Study Area. Each description contains a list of activities that may generate the stressor. Stressor/resource interactions that were determined to have impacts that do not qualify as take under the MMPA (*i.e.,* vessel, aircraft, or weapons noise) were not carried forward for analysis in the application. NMFS reviewed the Action Proponents' analysis and conclusions on de minimis sources (*i.e.,* those that are not likely to result in the take of marine mammals) and finds them complete and supportable (see section 3.7.4 of the technical report ''Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase IV Training and Testing'' (U.S. Department of the Navy, 2024), hereafter referred to as the Acoustic Impacts Technical Report). Of note, neither ship shock trials, pile driving, or airgun use is proposed in the Study Area.

Acoustic Stressors

Acoustic stressors include acoustic signals emitted into the water for a specific purpose, such as sonar and other transducers (*i.e.,* devices that convert energy from one form to another—in this case, into sound waves) as well as incidental sources of broadband sound produced as a byproduct of vessel movement, aircraft transits, 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.

To better organize and facilitate the analysis of approximately 300 sources of underwater sound used for training and testing by the Action Proponents, including sonars and other transducers and explosives, a series of source classifications, or source bins, were used. The acoustic source classification bins do not include the broadband noise such as that produced incidental to vessel and aircraft transits, weapons firing, and bow shocks. Noise produced from vessels and aircraft are not carried forward because those activities were found to have de minimis or no acoustic impacts, as stated above. Of note, the source bins used in this analysis have been revised from previous (Phase III) acoustic modeling to more efficiently group similar sources and use the parameters of the bin for propagation, making a comparison to previous bins impossible in most cases as some

sources are modeled at different propagation parameters. For example, in previous analyses, non-impulsive narrowband sound sources were grouped into bins that were defined by their acoustic properties (*i.e.,* frequency, source level, beam pattern, and duty cycle) or, in some cases, their purpose or application. In the current analysis, these sources are binned based only on their acoustic properties and not on their purpose or application. As such, sources that previously fell into a single ''purpose-based'' bin now, in many cases, fall into multiple bins while sources with similar acoustic parameters that were previously sorted into separate bins due to different purposes now share a bin. Therefore, the acoustic source bins used in the current analysis do not represent a one-for-one replacement with previous bins, making direct comparison not possible in most cases.

The use of source classification bins provides the following benefits:

- Allows new sensors or munitions to be used 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 that impacts are not underestimated, 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 (NEW)) 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 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 (*i.e.,* listen). In this proposed rule, the terms sonar and other transducers will be used to indicate active sound sources unless otherwise specified.

The Action Proponents employ 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, seafloor 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 technical report ''Acoustic Concepts and Summary of Best Available Science to Support Assessing Effects on Fishes, Marine Mammals, and Reptiles due to Acoustic and Explosive Stressors'' (U.S. Department of the Navy, 2026), hereafter referred to as the Acoustic and Explosives Concepts Technical Report, explains how these factors affect the propagation of acoustic energy through the water. Because of the complexity of analyzing sound propagation in the ocean environment, the Action Proponents rely on acoustic models in their environmental analyses that consider sound source characteristics and varying ocean conditions across the Study Area. For additional information on how propagation is accounted for, see the Acoustic Impacts Technical Report.

The sound sources and platforms typically used in military readiness activities analyzed in the application are described in appendix A (Military Readiness Activities Descriptions) of the 2026 MITT Draft SEIS/OEIS. Sonars and other transducers used to obtain and transmit information underwater during military readiness activities generally fall into several categories of use described below.

Anti-Submarine Warfare—

Sonar used during ASW training and testing would impart the greatest amount of acoustic energy of any category of sonar and other transducers analyzed in this proposed rule. Types of sonars used to detect 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 ASW sonars are mid-frequency (1–10 kHz) because mid-frequency sound balances sufficient resolution to identify targets with distance over which threats can be identified. However, some sources may use higher or lower frequencies. Duty cycles can vary widely from rarely used to continuously active. ASW sonars can be wide-ranging in a search mode or highly directional in a track mode.

Most ASW activities involving submarines or submarine targets would occur in waters greater than 182.9 m deep due to safety concerns about running aground at shallower depths. Sonars used for ASW activities would typically be used beyond 22.2 km 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 (MF1K) (*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. 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 60.9 m, and at established training or testing minefields or temporary minefields close to strategic ports and harbors. Kingfisher mode on vessels is most likely to be used when transiting to and from port. Sound sources used for imaging would be used throughout the Study Area.

Navigation and Safety—

Similar to commercial and private vessels, the Action Proponents' 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 (*e.g.,* underwater modems), provide location (pingers), or send a single brief release signal to seafloor-mounted devices (acoustic release) may be used throughout the Study Area. These sources typically have low duty cycles and are usually only used when it is necessary to send a detectable acoustic message.

Classification of Sonar and Other Transducers—

Sonars and other transducers are grouped into bins based on their acoustic properties. Sonars and other transducers are now grouped into bins based on the frequency or bandwidth, source level, duty-cycle, and three-dimensional beam coverage. Unless stated otherwise, a reference distance of 1 microPascal (re 1 µPa) at 1 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 or above 1 kHz, up to and including 10 kHz;
  - High-frequency sources operate above 10 kHz, up to and including 100 kHz;
  - Very high-frequency sources operate above 100 kHz but below 200 kHz; and
  - Broadband (frequencies spanning more than two octaves);
- Sound pressure level (SPL):
  - Greater than 160 decibels (dB) re 1 µPa, but less than 185 dB re 1 µPa;
  - Equal to 185 dB re 1 µPa and up to 205 dB re 1 µPa; and
  - Greater than 205 dB re 1 µPa.

Active sonar and other transducer use that was quantitatively analyzed in the Study Area are shown in table 5. While general parameters or source characteristics are shown in the table, actual source parameters are classified.

Table 5 -- Sonar and Other Transducers Quantitatively Analyzed in the Study Area

Source type	Source category	Description	Unit	Training and testing annual	Training and testing 7-year total
Broadband	LF to HF	<205 dB	Counts	42-52	324
Broadband	MF to HF	<205 dB	Hours	886-907	6,264
Low-frequency acoustic	LFM	185 dB to 205 dB	Hours	15	105
Low-frequency acoustic	LFH	>205 dB	Counts	243	1,698
Mid-frequency acoustic (not including hull-mounted)	MFM	185 dB to 205 dB	Counts	1,424-1,616	10,547
Mid-frequency acoustic (not including hull-mounted)	MFH	>205 dB	Hours	536-686	4,804
Hull-mounted surface ship sonar	MF1C	Hull-mounted surface ship sonar with duty cycle >80% (previously MF11)	Hours	256-258	1,797
Hull-mounted surface ship sonar	MF1K	Hull-mounted surface ship sonar in Kingfisher mode	Hours	23-33	188
Hull-mounted surface ship sonar	MF1	Hull-mounted surface ship sonar	Hours	1,386-1,392	9,720
High-frequency acoustic	HFM	185 dB to 205 dB	Hours	208-235	1,585
High-frequency acoustic	HFH	>205 dB	Counts	58-93	511
High-frequency acoustic	HFH	>205 dB	Hours	1,518-1,628	11,392
Very high-frequency acoustic	VHFH	>205 dB	Hours	130-140	940

Note: LF = low frequency, MF = mid frequency, HF = high frequency, dB = decibels, L = low, M = medium, H = high (*e.g.*, MFL = mid-frequency low source level), when following "MF1" C = Continuous, defined as duty cycle >80%, K = Kingfisher mode.

Explosive Stressors

This section describes the characteristics of explosions during military readiness activities. The activities analyzed in the application that use explosives are described in appendix A (Military Readiness Activities Descriptions) of the 2026 MITT Draft SEIS/OEIS, and terminology and metrics used when describing explosives are included in the Acoustic and Explosives Concepts Technical Report.

The near-instantaneous rise from ambient to an extremely high peak pressure is what makes an explosive shock wave potentially damaging. Farther from an explosive, the peak pressures decay and the explosive waves propagate as an impulsive, broadband sound. Several parameters influence the effect of an explosive: the weight of the explosive warhead, the type of explosive material, the boundaries and characteristics of the propagation medium, and the detonation depth in water. The NEW, the explosive power of a charge expressed as the equivalent weight of trinitrotoluene (commonly referred to as

TNT), accounts for the first two parameters. The effects of these factors are explained in the Acoustic and Explosives Concepts Technical Report.

Explosions in Water—

Explosive detonations during military readiness activities are associated with high-explosive munitions, including, but not limited to bombs, missiles, rockets, naval gun shells, torpedoes, mines, and demolition charges. Explosive detonations during military readiness activities involving the use of high-explosive munitions, including bombs, missiles, and naval gun shells, would occur in the air or near the water's surface. Explosive detonations associated with torpedoes and explosive sonobuoys would occur in the water column; mine neutralization and demolition charges would be detonated in the water column or on the ocean floor.

To better organize and facilitate the analysis of explosives used by the Action Proponents during military readiness activities that would detonate in water or at the water surface, explosive classification bins were developed. The use of explosive classification bins provides the same benefits as described for acoustic source classification bins in the Sonar and Other Transducers section. Explosives detonated in water are binned by NEW. Table 6 shows explosives use that was quantitatively analyzed in the Study Area. A range of annual use indicates that occurrence is anticipated to vary annually. The 7-year total takes that variability into account.

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Table 6 -- Explosive Sources Quantitatively Analyzed Proposed for Use Underwater or at the Water Surface

Bin	Net explosive weight (lb.)	Example explosive source	Training and testing annual	Training and testing 7-year
E1	0.1-0.25	Medium-caliber projectile	635-1,080	5,780
E2	>0.25-0.5	Grenade	200	1,400
E3	>0.5-2.5	57 mm (2.24-inch) projectiles, 2.75-inch (7 cm) rockets	870-1,896	9,168
E4	>2.5-5	Mine neutralization charge	41	287
E5	>5-10	5-inch (12.7 cm) projectile	974-1,314	7,838
E6	>10-20	Hellfire missile	86-116	692
E7	>20-60	Air-to-surface missile	4-16	40
E8	>60-100	250 lb. (113 kg) bomb; lightweight torpedo	1-2	10
E9	>100-250	500 lb. (228 kg) bomb	135-143	969
E10	>250-500	1,000 lb. (454 kg) bomb	44	308
E11	>500-675	Heavyweight Torpedo	2-4	20
E12	>675-1,000	2,000 lb. (907 kg) bomb	33-34	234

Note: > = greater than, mm = millimeter, cm = centimeter, lb. = pound, kg = kilogram

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Propagation of explosive pressure waves in water is highly dependent on environmental characteristics such as bathymetry, seafloor 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. The Acoustic and Explosives Concepts Technical Report 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 Action Proponents rely on acoustic models in their environmental analyses that consider sound source characteristics and varying ocean conditions across the Study Area.

Vessel Strike

NMFS also considered the likelihood that vessel movement during military readiness activities could result in an incidental, but not intentional, strike of a marine mammal in the Study Area, which has the potential to result in serious injury or mortality. Vessel strikes are not specific to any specific military readiness activity but rather, a limited, sporadic, and incidental result of the Action Proponents' vessel movement during military readiness activities within the Study Area. Vessel strikes from commercial, recreational, and military vessels are known to seriously injure and occasionally kill cetaceans (Abramson *et al.,* 2011; Berman-Kowalewski *et al.,* 2010; Calambokidis, 2012; Crum *et al.,* 2019; Douglas *et al.,* 2008; Laggner 2009; Van der Hoop *et al.,* 2012; Van der Hoop *et al.,* 2013), although reviews of the literature on vessel 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 (Blondin *et al.,* 2025; Conn and Silber, 2013; Garrison *et al.,* 2025; Gende *et al.,* 2011; Redfern *et al.,* 2019; Silber *et al.,* 2010; Szesciorka *et al.,* 2019; Vanderlaan and Taggart, 2007; Wiley *et al.,* 2016). For large vessels, speed and angle of approach can influence the severity of a strike.

The Action Proponents' vessels transit at speeds that are optimal for fuel conservation or to meet training and testing requirements. Starcovic and Mintz (2021) analyzed military and non-military vessel traffic in the Navy's Pacific Study Areas, including MITT, using ship positional data gathered from 2014–2018 for vessels greater than 19.8 m in length. Average vessel speeds in the Study Area were between 9.26 and 18.52 km/hr adjacent to Guam and the islands in the CNMI for both military and non-military vessels, likely reflecting the typically low-speed vessel movement approaching and departing ports (*e.g.,* Apra Harbor). Military vessel speeds averaged 18.52 to 27.78 km/hr offshore of the islands and increased to 27.78 to 37.04 km/hr farther offshore in the center of the Study Area, west of Guam and the CNMI.

Data on the speeds of small boats (approximately 18 m or less for purposes of this analysis) were analyzed in the HCTT Study Area, but similar data was not available for the Study Area (U.S. Department of the Navy, unpublished data). The data shows that small boats traveled at more variable speeds ranging from 0 up to 96.3 km/hr, depending on the activity and the type of vessel. Submarines generally operated at speeds ranging from 14.82 to 24.08 km/hr. Similar vessel speeds are anticipated to be used by those vessels in the Study Area when those vessels are used in similar training or testing activities. A description of representative vessels proposed for use during the military readiness activities is included in table 3.0–8 in chapter 3 (Affected Environment and Environmental Consequences) of the 2026 MITT Draft SEIS/OEIS.

While these speeds for large Navy vessels are representative of most events, some of the Action Proponents' vessels may 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. There are specific events, including high speed tests of newly constructed vessels, where the Action Proponents' vessel would operate at higher speeds. By comparison, there are other instances when the Action Proponents vessel would be stopped or moving slowly ahead to maintain steerage, such as launch and recovery of a small rigid hull inflatable boat; vessel boarding, search, and seizure training events; or retrieval of a target.

Large Navy vessels (>121.9 m) and Coast Guard vessels within the offshore areas of range complexes and testing ranges operate differently from commercial vessels, which may reduce potential vessel strikes of large whales. 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 stop within a distance appropriate to the prevailing circumstances and conditions. The Action Proponents use Lookouts to avoid collisions, and Lookouts are trained to spot marine mammals so that vessels may change course or take other appropriate action to avoid collisions.

In the Study Area, NMFS has no documented vessel strikes of marine mammals by the Action Proponents. As such, the quantitative approach to assess the likelihood of vessel strikes used in the 2024 and 2025 incidental take rulemakings for Action Proponent activities in the Atlantic Fleet Training and Testing (AFTT) and Hawaii-California Training and Testing (HCTT) Study Areas, which starts with the number of Action Proponent strikes that have occurred in the study area in question, was not applied in the Study Area. Based on this lack of strikes, the Action proponents do not anticipate vessel strikes and have not requested authorization to take marine mammals by serious injury or mortality within the Study Area during training and testing activities. As such, and in consideration of other factors described below, NMFS agrees with the Action Proponents' conclusion.

Regarding large whales, sperm whales are the only species with a year-round occurrence in the Study Area. No large whales occur in high densities in the Study Area nor are there any known records of vessel strike of large whales in the Study Area by any industry. Further, in comparison to other military readiness Study Areas (*e.g.,* AFTT and HCTT), Action Proponent vessel traffic is much lower in the Study Area. The Action Proponents would be required to implement vessel strike avoidance measures, as described in the Activity-Based Mitigation for Physical Disturbance and Strike Stressors section of this proposed rule.

Based on all of these considerations, NMFS has preliminarily determined that take by vessel strike of large whales is unlikely and supported by multiple factors, including the lack of vessel strike reports of large whales in regional NMFS stranding records (1962–2025) for the Mariana Islands (including no strikes by Action Proponent vessels in the Study Area), the relatively low density of large marine mammals in the Mariana Islands, and the seasonal nature of most species (blue whales, humpback whales, fin whales, and sei whales). In addition, there are relatively small numbers of Action Proponent vessels across a large expanse of offshore waters in the Study Area, and procedural mitigation measures would further minimize potential vessel strike.

When generally compared to mysticetes, odontocetes are more capable of physically avoiding a vessel strike, and since some species occur in large groups, they are more easily seen when they are closer to the water surface. The smaller size and maneuverability of dolphins, small whales (not including large whale calves), porpoises, and pinnipeds generally make vessel strike very unlikely. For as long as records have been kept, neither the Navy nor the Coast Guard have any record of any small whales or pinnipeds being struck by a vessel as a result of military readiness activities. Over the same time period, NMFS, the Navy, and the Coast Guard have only one record of a dolphin being struck by a vessel as a result of Navy or Coast Guard activities. The dolphin was accidentally struck by a Navy small boat in fall 2021 in Saint Andrew's Pass, Florida. Other than this one reported strike of a dolphin in 2021, NMFS has never received any reports from other LOA or IHA holders indicating that these species have been struck by vessels. Worldwide vessel strike records show little evidence of strikes of these groups or marine mammals from the shipping sector and larger vessels (though for many species, records do exist (*e.g.,* West *et al.,* 2024;

Van Waerebeek *et al.,* 2007)), and the majority of the Action Proponents' 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 Action Proponents' assessment that vessel strike is not likely to occur for either large whales or smaller marine mammals.

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

Marine mammal species and their associated stocks that have the potential to occur in the Study Area are presented in table 7 along with each stock's Endangered Species Act (ESA) and MMPA statuses, abundance estimate and associated coefficient of variation (CV) value, minimum abundance estimate, potential biological removal (PBR), annual mortality or serious injury (M/SI), and potential occurrence in the Study Area. The Action Proponents request authorization to take individuals of 27 species by Level B harassment and, for a subset of those species (19 species), Level A harassment, incidental to military readiness activities from the use of sonar and other transducers and in-water detonations in the Study Area. There are no areas of critical habitat designated under the ESA, National Marine Sanctuaries, or unusual mortality events for marine mammals in the Study Area. There are areas known to be important for humpback whale breeding and calving, which are described in the *Humpback Whale Reproductive Areas* section.

Sections 3 and 4 of the application and the ''Biological Resources Background Information Technical Report for the Mariana Islands Training and Testing Study Area'' (U.S. Department of the Navy, 2026b; hereafter referred to as the Biological Resources Technical Report) summarize available information regarding status and trends, distribution and habitat preferences, and behavior and life history of the potentially affected species. NMFS fully considered all of this information, and we refer the reader to these descriptions instead of reprinting the information herein. Additional information regarding population trends and threats may be found in NMFS' Stock Assessment Reports (SARs) (*https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessments*) and more general information about these species (*e.g.,* physical and behavioral descriptions) may be found on NMFS' website at: *https://www.fisheries.noaa.gov/find-species.* Table 7 incorporates the best available science, including data from the 2024 Pacific and Alaska Marine Mammal Stock Assessment Reports (Carretta *et al.,* 2026; Young *et al.,* 2026) (see *https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessments*), as well as monitoring data from the Navy's marine mammal research efforts (see *https://www.navymarinespeciesmonitoring.us/*).

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Table 7 -- Marine Mammal Occurrence within the Study Area [1]

Common name	Scientific name	Stock	ESA/MMPA status; Strategic (Y/N) [2]	Stock abundance (CV, Nmin, most recent abundance survey) [3]	PBR	Annual M/SI [4]
Order Artiodactyla – Cetacea – Mysticeti (baleen whales)						
Family Balaenopteridae (rorquals)						
Blue whale	*Balaenoptera musculus*	Central North Pacific	E, D, Y	133 (1.09, 63, 2010)	0.1	0
Bryde's whale	*Balaenoptera edeni*	NSD	-, N/A, N/A	N/A	UNK	UNK
Fin whale	*Balaenoptera physalus*	NSD	E, N/A, N/A	N/A	UNK	UNK
Humpback whale	*Megaptera novaeangliae*	Western North Pacific	E, D, Y	1,084 (0.088, 1,007, 2006)	3.4 [5]	5.82
Minke whale	*Balaenoptera acutorostrata*	NSD	-, N/A, N/A	N/A	UNK	UNK
Omura's whale	*Balaenoptera omurai*	NSD	-, N/A, N/A	N/A	UNK	UNK
Sei whale	*Balaenoptera borealis*	NSD	E, N/A, N/A	N/A	UNK	UNK
Odontoceti (toothed whales, dolphins, and porpoises)						
Family Physeteridae						
Sperm whale	*Physeter macrocephalus*	NSD	E, N/A, N/A	N/A	UNK	UNK
Family Kogiidae						
Dwarf sperm whale	*Kogia sima*	NSD	-, N/A, N/A	N/A	UNK	UNK
Pygmy sperm whale	*Kogia breviceps*	NSD	-, N/A, N/A	N/A	UNK	UNK
Family Ziphiidae (beaked whales)						
Blainville's beaked whale	*Mesoplodon densirostris*	NSD	-, N/A, N/A	N/A	UNK	UNK
Deraniyagala Beaked Whale	*Mesoplodon hotaula*	NSD	-, N/A, N/A	N/A	UNK	UNK
Ginkgo-toothed Beaked Whale	*Mesoplodon ginkgodens*	NSD	-, N/A, N/A	N/A	UNK	UNK
Goose-beaked whale	*Ziphius cavirostris*	NSD	-, N/A, N/A	N/A	UNK	UNK
Longman's beaked whale	*Indopacetus pacificus*	NSD	-, N/A, N/A	N/A	UNK	UNK
Family Delphinidae						
False killer whale	*Pseudorca crassidens*	NSD	-, N/A, N/A	N/A	UNK	UNK
Killer whale	*Orcinus orca*	NSD	-, N/A, N/A	N/A	UNK	UNK
Melon-headed whale	*Peponocephala electra*	NSD	-, N/A, N/A	N/A	UNK	UNK

Pygmy killer whale	*Feresa attenuata*	NSD	-, N/A, N/A	N/A	UNK	UNK
Short-finned pilot whale	*Globicephala macrorhynchus*	NSD	-, N/A, N/A	N/A	UNK	UNK
Bottlenose dolphin	*Tursiops truncatus*	NSD	-, N/A, N/A	N/A	UNK	UNK
Fraser's dolphin	*Lagenodelphis hosei*	NSD	-, N/A, N/A	N/A	UNK	UNK
Pantropical spotted dolphin	*Stenella attenuata*	NSD	-, N/A, N/A	N/A	UNK	UNK
Risso's dolphin	*Grampus griseus*	NSD	-, N/A, N/A	N/A	UNK	UNK
Rough-toothed dolphin	*Steno bredanensis*	NSD	-, N/A, N/A	N/A	UNK	UNK
Spinner dolphin	*Stenella longirostris*	NSD	-, N/A, N/A	N/A	UNK	UNK
Striped dolphin	*Stenella coeruleoalba*	NSD	-, N/A, N/A	N/A	UNK	UNK

Note: N/A = Not Applicable, NSD = No Stock Designated, UNK = Unknown. Abundance estimates and other data for the Central North Pacific stock of blue whale and Western North Pacific stock of humpback whale are from the Pacific (Carretta *et al.*, 2026) and Alaska SARs (Young *et al.*, 2026), respectively.

[1] Information on the classification of marine mammal species can be found on the web page for The Society for Marine Mammalogy's Committee on Taxonomy (*https://marinemammalscience.org/science-and-publications/list-marine-mammal-species-subspecies/*; Committee on Taxonomy (2022)).

[2] 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 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. MMPA status information is N/A to species for which no stock is designated.

[3] NMFS marine mammal stock assessment reports online at: *https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-region.* CV is coefficient of variation; Nmin is the minimum estimate of stock abundance. For populations that are not recognized stocks under the MMPA, stock abundance information is listed as N/A. Navy Marine Species Density Database estimates are presented in the **Preliminary Analysis and Negligible Impact Determination** section of this proposed rule.

[4] These values, found in NMFS' SARs, represent annual levels of human-caused mortality plus serious injury 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.

[5] For this stock, PBR is currently set at 0.2 for U.S. waters and 3.4 for the stock's entire range. As the Study Area extends beyond U.S. waters, we present the analysis using the PBR for the stock's entire range.

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Species Not Included in the Analysis

The species carried forward for analysis (see table 7) are those likely to be found in the 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). These species include the North Pacific right whale (*Eubalaena japonica*), the western subpopulation of gray whale (*Eschrichtius robustus*), short-beaked common dolphin (*Delphinus delphis*), Indo-Pacific bottlenose dolphin (*Tursiops aduncus*), northern elephant seal (*Mirounga angustirostris*), and Hawaiian monk seal (*Monachus schauinslandi*). The reasons for not including each of these species are explained below, and these species are not discussed further beyond the explanation provided here. Additional details can be found in the 2015 MITT FEIS/OEIS.

The North Pacific right whale population is estimated to be 31 individuals (Young *et al.,* 2024). Contemporary sightings of North Pacific right whales have mostly occurred in the central North Pacific and Bering Sea. Sightings have been reported as far south as central Baja California in the eastern North Pacific, as far south as Hawaii in the central North Pacific, and as far north as the sub-Arctic waters of the Bering Sea and the Sea of Okhotsk

in the summer. Migration patterns of the North Pacific right whale are unknown, although it is thought the whales spend the summer in far northern feeding grounds and migrate south to warmer waters, such as southern California, during the winter. Due to their known home range, it is unlikely that a North Pacific right whale would occur in the Study Area. North Pacific right whales have not been previously documented in the Study Area.

There currently are no data that suggest the western subpopulation of gray whales would transit the Study Area when migrating from the western to eastern Pacific. Given the known range of this population (Carretta *et al.,* 2024), nearshore affinity, and extralimital occurrence in tropical waters, it is highly unlikely that this species would occur in the Study Area (Weller *et al.,* 2002; Wiles, 2005; Nambu *et al.,* 2010). In addition, no gray whales have been previously documented in the Study Area.

The short-beaked common dolphin occurs worldwide in temperate, tropical, and subtropical seas. The range of this species may extend entirely across the tropical and temperate north Pacific; however, this species prefers areas with large seasonal changes in surface temperature and thermocline depth (the point between warmer surface water and colder water) (Au and Perryman, 1985). In tropical waters, they are typically sighted in upwelling-modified waters such as those in the eastern tropical Pacific (Au and Perryman, 1985; Ballance and Pitman, 1998; Reilly, 1990). The absence of known areas of major upwelling in the western tropical Pacific suggests that common dolphins do not occur in the Study Area. In addition, no short-beaked common dolphins have been previously documented in the Study Area.

The Indo-Pacific bottlenose dolphin generally occurs over shallow coastal waters on the continental shelf. Although typically associated with continental margins, they do occur around oceanic islands; however, the Study Area is not included in their known geographic range, and there are no documented sightings there. In addition, no Indo-Pacific bottlenose dolphins have been previously documented in the Study Area.

The likelihood of a Hawaiian monk seal occurring in the Study Area is extremely low. There are no confirmed records of Hawaiian monk seals in the Micronesia region; although, Reeves *et al.* (1999) and Eldredge (2003) have noted occurrence records for unidentified seal species in the Marshall and Gilbert Islands. It is possible that Hawaiian monk seals wander from the Hawaiian Islands to appear at the Marshall or Gilbert Islands in the Micronesia region. However, the Marshall Islands are located approximately 1,900 km from Guam, and the Gilbert Islands are located even farther to the east. No Hawaiian monk seals have been previously documented in the Study Area.

Northern elephant seals spend several months at sea feeding and travel as far north as the Gulf of Alaska and forage in the mid-Pacific as far south as approximately 40 degrees north latitude. Vagrant individuals do sometimes range to the western north Pacific (*e.g.,* Kiyota *et al.,* 1992). Although northern elephant seals may wander great distances, it is very unlikely that they would travel to Japan and then continue traveling to the Study Area. No Northern elephant seals have been previously documented in the Study Area.

Below, we consider 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.

Humpback Whale Reproductive Areas

Humpback whales in the Mariana Islands/Ogasawara-Northern Pacific unit of the Western North Pacific stock winter off the Mariana Archipelago, Ogasawara, Japan, and other areas not yet identified. They migrate to summer feeding areas off the Commander Islands, the Bering Sea and Aleutian Islands (Oleson *et al.,* 2022).

Humpback whale breeding and calving have been documented in the Study Area, particularly in the shallow waters (mostly within the 200-m isobath) offshore of Saipan at Marpi Reef and Chalan Kanoa Reef. Surveys conducted by NMFS' Pacific Islands Fisheries Science Center during the winter months (January to March) from 2015–2020 included 22 encounters with mother/calf pairs with a total of 14 mother/calf pairs. All calves were considered born within the current season, and one was a neonate (Hill *et al.,* 2020a). Surveys and passive acoustic hydrophone recordings in the Mariana Islands have confirmed the presence of mother-calf pairs, non-calf whales, and singing males in the Study Area (Hill *et al.,* 2016a; Hill *et al.,* 2018; Munger *et al.,* 2014; Munger *et al.,* 2015; Norris *et al.,* 2012; Oleson and Hill, 2010a; Oleson *et al.,* 2015; Uyeyama *et al.,* 2012). These surveys have documented behaviors (*e.g.,* escorting, competitive groups) consistent with known humpback whale reproductive activities in other locations (Gabriele *et al.,* 2017; Pack *et al.,* 2017). In 2018, NMFS confirmed that the waters around Saipan are a newly identified ''breeding location'' for humpback whales (Hill *et al.,* 2018). In summary, the available data confirms the shallow waters surrounding Marpi Reef and Chalan Kanoa Reef are important to breeding and calving humpback whales.

Marine Mammal Hearing Groups

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. Not all marine mammal species have equal hearing capabilities (*e.g.,* Richardson *et al.,* 1995b; Wartzok and Ketten, 1999; Au and Hastings, 2008; Erbe *et al.,* 2025). To reflect this, Southall *et al.* (2007) and Southall *et al.* (2019c) recommended that marine mammals be divided into hearing groups based on directly measured (behavioral or auditory evoked potential techniques) or estimated hearing ranges (*e.g.,* behavioral response data, anatomical modeling). NMFS (2024) generalized hearing ranges were chosen based on the approximately 65-dB threshold from the composite audiograms, previous analysis in NMFS (2018), and/or data from Southall *et al.* (2007) and Southall *et al.* (2019c). We note that the names of two hearing groups and the generalized hearing ranges of all marine mammal hearing groups have been recently updated (NMFS, 2024) as reflected below in table 8.

Table 8 -- Marine Mammal Hearing Groups (NMFS, 2024)

Hearing Group	Generalized Hearing Range*
Low-frequency (LF) cetaceans (baleen whales)	7 Hz to 36** kHz
High-frequency (HF) cetaceans (dolphins, toothed whales, beaked whales, bottlenose whales)	150 Hz to 160 kHz
Very High-frequency (VHF) cetaceans (true porpoises, *Kogia,* river dolphins, Cephalorhynchid, *Lagenorhynchus cruciger* and *L. australis*)	200 Hz to 165 kHz

* Represents the generalized hearing range for the entire group as a composite (*i.e.*, all species within the group), where individual species' hearing ranges are typically not as broad. Generalized hearing range chosen based on the ~65-dB threshold from composite audiogram, previous analysis in NMFS (2018), and/or data from Southall *et al.* (2007) and Southall *et al.* (2019c). Additionally, animals are able to detect very loud sounds above and below that "generalized" hearing range.

** The Navy split the LF functional hearing group into LF and VLF based on Houser *et al.* (2024) while NMFS Updated Technical Guidance (NMFS, 2024) does not include these data. NMFS is aware of these data and data collected during a final field season by Houser *et al.* (in prep) have implications for the generalized hearing range for low-frequency cetaceans and their weighting function; however, as described in the 2024 Updated Technical Guidance, it is premature for us to propose any changes to our current Updated Technical Guidance. Mysticete hearing data is identified as a special circumstance that could merit reevaluating the acoustic criteria for low-frequency cetaceans in the 2024 Updated Technical Guidance once the data from the final field season is published. Therefore, we anticipate that once the data are published, it will likely necessitate updating this document (*i.e.*, likely after the data gathered in the summer 2024 field season and associated analysis are published).

For more detail concerning these groups and associated frequency ranges, please see NMFS (2024) for a review of available information.

Of note, the Navy adjusted the LF cetacean hearing group using data from recent hearing measurements in minke whales (Houser *et al.,* 2024). These data support separating mysticetes (the LF cetaceans marine mammal hearing group in table 8) into two hearing groups, which the Navy designates as ''very low-frequency (VLF) cetaceans'' and ''low-frequency (LF) cetaceans,'' which follows the recommendations of Southall *et al.* (2019c). Within the Navy's adjusted hearing groups, the VLF cetacean group contains the larger mysticetes (*i.e.,* blue, pygmy blue, fin, right, and bowhead whales) and the LF cetacean group contains the mysticete species not included in the VLF group (*e.g.,* minke, humpback, gray, pygmy right whales). Although there have been no direct measurements of hearing sensitivity in the larger mysticetes included in Navy's VLF hearing group, an audible frequency range of approximately 10 Hz to 30 kHz has been estimated from measured vocalization frequencies, observed responses to playback of sounds, and anatomical analyses of the auditory system. The upper frequency limit of hearing in Navy's LF hearing group has been estimated as 64 kHz, based on direct measurements of auditory evoked potentials in minke whales (Houser *et al.,* 2024).

Potential Effects of Specified Activities on Marine Mammals and Their Habitat

This section provides a discussion of the ways in which components of the specified activity may impact marine mammals and their habitat. The Estimated Take of Marine Mammals section later in this document includes a quantitative analysis of the number of individuals that are expected to be taken by this activity. The 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 or stock through effects on annual rates of recruitment or survival.

The Action Proponents have requested authorization for the take of marine mammals that may occur incidental to training and testing activities in the Study Area. The Action Proponents analyzed potential impacts to marine mammals from acoustic and explosive sources in the application. NMFS carefully reviewed the information provided by the Action Proponents and concurs with their synthesis of science, along with independently reviewing applicable scientific research and literature and other information to evaluate the potential effects of the Action Proponents' activities on marine mammals, which are presented in this section (see also appendix C in the 2026 MITT Draft SEIS/OEIS for additional information).

In this proposed rule, NMFS analyzes the potential effects on marine mammals from the activity components that may result in take of marine mammals: exposure to acoustic or explosive stressors including non-impulsive (*i.e.,* sonar and other transducers) and impulsive (*i.e.,* explosives) stressors.

For the purpose of MMPA ITAs, 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, including identification of the number and types of take that could occur 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 the specified activities in the form of mortality, physical injury, sensory impairment (permanent and temporary threshold shifts (TTS) and acoustic masking), physiological responses (particular stress responses), behavioral disturbance, or habitat effects. 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 qualify as a take under the MMPA. 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 on Marine Mammals

The marine soundscape is composed of both ambient and anthropogenic sounds. Ambient sound is defined as the all-encompassing sound in a given place and is usually a composite of sound from many sources both near and far. The sound level of an area is defined by the total acoustical energy being generated by known and unknown sources, which may include physical (*e.g.,* waves, wind, precipitation, earthquakes, ice, atmospheric sound), biological (*e.g.,* sounds produced by marine mammals, fish, and invertebrates), and anthropogenic sound (*e.g.,* vessels, dredging, aircraft, construction).

The sum of the various natural and anthropogenic sound sources at any given location and time—which comprise ambient or background sound—depends not only on the source levels (as determined by current weather conditions and levels of biological and shipping activity) but also on the ability of sound to propagate through the environment. In turn, sound propagation is dependent on the spatially and temporally varying properties of the water column and sea floor and is frequency-dependent. As a result of the dependence on a large number of varying factors, ambient sound levels can be expected to vary widely over both coarse and fine spatial and temporal scales. Sound levels at a given frequency and location can vary by 10–20 dB from day to day (Richardson *et al.,* 1995b). The result is that, depending on the source type and its intensity, sound from the specified activities may be a negligible addition to the local environment or could form a distinctive signal that may affect marine mammals.

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, other auditory injury, non-auditory physical or physiological effects, behavioral disturbance, stress, and masking (Richardson *et al.,* 1995b; Gordon *et al.,* 2003; Nowacek *et al.,* 2007; Southall *et al.,* 2007; Götz *et al.,* 2009; Southall *et al.,* 2019a; Erbe *et al.,* 2025). 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 auditory injury, 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.

Richardson *et al.* (1995b) 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, in the case of explosives, more severe injuries or mortality (Yelverton *et al.,* 1973). Non-auditory physiological effects or injuries that theoretically might occur in marine mammals exposed to high levels of underwater sound or as a secondary effect of extreme behavioral responses (*e.g.,* change in dive profile as a result of an avoidance response) 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).

Hearing

Marine mammals have adapted hearing based on their biology and habitat: amphibious marine mammals (*e.g.,* pinnipeds that spend time on land and underwater) have modified ears that allow them to hear both in-air and in-water, while fully aquatic marine mammals (*e.g.,* cetaceans that are always underwater) have specialized ear adaptations for in-water hearing (Wartzok and Ketten, 1999). These adaptations explain the variation in hearing ability and sensitivity among marine mammals and have led to the characterization of marine mammal functional hearing groups based on those sensitivities: very low-frequency cetaceans (VLF group: blue, fin, right, and bowhead whales), low-frequency cetaceans (LF group: minke, sei, Bryde's, Rice's, humpback, gray, and pygmy right whales), high-frequency (HF) cetaceans (HF group: sperm whales, beaked whales, killer whale, melon-headed whale, false/pygmy killer whale, pilot whales, and some dolphin species), very high-frequency (VHF) cetaceans (VHF group: some dolphin species, porpoises, Amazon River dolphin, *Kogia* species, Baiji, and La Plata dolphin), sirenians (SI) (SI group: manatees, dugongs), otariids (OCW) and other non-phocid marine carnivores (OCA) in water and in air (OCW and OCA groups: sea lion, fur seal, walrus, otter), and phocids in water (PCW) and in air (PCA) (PCW and PCA groups: true seals) (Southall *et al.,* 2019c). In Phase III, VLF and LF cetaceans were part of one, combined LF cetacean hearing group. However, as described in the Navy's report ''Criteria and Thresholds

for U.S. Navy Acoustic and Explosive Effects Analysis (Phase 4)'' (U.S. Department of the Navy, 2025), hereafter referred to as the Criteria and Thresholds Technical Report, Houser *et al.* (2024) recently reported obtaining hearing measurements for minke whales, the first direct measurements for a baleen whale species, using auditory evoked potential methodology. The Action Proponents incorporated these measurements, as well as Southall *et al.* (2019c), into their analysis. They determined that the data support dividing mysticetes into two separate hearing groups: VLF and LF cetaceans, and NMFS concurs (as described further in the Estimated Take of Marine Mammals section), that this approach is appropriate for this action.

The hearing sensitivity of marine mammals is also directional, meaning the angle between an animal's position and the location of a sound source impacts the animal's hearing threshold, thereby impacting an animal's ability to perceive the sound emanating from that source. This directionality is likely useful for determining the general location of a sound, whether for detection of prey, predators, or members of the same species, and can be dependent upon the frequency of the sound (Accomando *et al.,* 2020; Au and Moore, 1984; Byl *et al.,* 2016; Byl *et al.,* 2019; Kastelein *et al.,* 2005; Popov and Supin, 2009).

Acoustic Signaling

An acoustic signal refers to the sound waves used to communicate underwater, and marine mammals use a variety of acoustic signals for socially important functions, such as communicating, as well as biologically important functions, such as echolocating (Richardson *et al.,* 1995b; Wartzok and Ketten, 1999; Erbe *et al.,* 2025). Acoustic signals used for communication are lower frequency (*i.e.,* 20 Hz to 30 kHz) than those signals used for echolocation, which are high-frequency (approximately 10–200 kHz peak frequency) signals used by odontocetes to sense their underwater environment. Lower frequency vocalizations used for communication may have a specific, prominent fundamental frequency (Brady *et al.,* 2021) or have a wide frequency range, depending on the functional hearing group and whether the marine mammal is vocalizing in-water or in-air. Acoustic signals used for echolocation are high-frequency, high-energy sounds with patterns and peak frequencies that are often species-specific (Baumann-Pickering *et al.,* 2013).

Marine mammal species typically produce sounds at frequencies within their own hearing range, though auditory and vocal ranges do not perfectly align (*e.g.,* odontocetes may only hear a portion of the frequencies of an echolocation click). Because determining a species' vocal range is easier than determining a species' hearing range, vocal ranges are often used to infer a species' hearing range when species-specific hearing data are not available (*e.g.,* large whale species).

Hearing Loss and Auditory Injury (AUD INJ)

Marine mammals, like all mammals, lose their ability to hear over time due to age-related degeneration of auditory pathways and sensory cells of the inner ear. This natural, age-related hearing loss is distinct from acute noise-induced hearing loss (Møller, 2013). Noise-induced hearing loss can be temporary (*i.e.,* TTS) or permanent (permanent threshold shift (PTS)), with higher-level sound exposures more likely to cause PTS or other AUD INJ. For marine mammals, AUD INJ is considered to be possible when sound exposures are sufficient to produce 40 dB of TTS measured approximately 4 minutes after exposure (NMFS, 2024; U.S. Department of the Navy, 2025b). Numerous studies have directly examined noise-induced hearing loss in marine mammals by measuring an animal's hearing threshold before and after exposure to intense or long duration sounds. The difference between the post-exposure and pre-exposure hearing thresholds is then used to determine the amount of TTS (in dB) that was produced as a result of the sound exposure (see the Acoustic and Explosives Concepts Technical Report for additional details). The Navy used these studies to generate exposure functions, which are predictions of the onset of TTS or PTS or other AUD INJ based on sound frequency, level, and type (non-impulsive or impulsive), for each marine mammal hearing group (NMFS, 2024; U.S. Department of the Navy, 2025b).

TTS can last from minutes or hours to days (*i.e.,* there is complete recovery back to baseline/pre-exposure hearing threshold), 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 AUD INJ (*e.g.,* neural degeneration), as TTS increases, the likelihood that additional exposure to increased SPL or duration will result in PTS or other injury also increases (see the Acoustic and Explosives Concepts Technical Report for additional discussion). Exposure thresholds for the occurrence of AUD INJ, which include the potential for PTS, as well as situations when AUD INJ occurs without PTS, 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 AUD INJ. The specific upper limit of TTS is based on experimental data showing amounts of TTS that have not resulted in AUD INJ. In other words, we do not need to know the exact functional relationship between TTS and AUD INJ; we only need to know the upper limit for TTS before some AUD INJ is possible. In severe cases of AUD INJ, 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; Finneran, 2015).

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; 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 cumulative 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; Finneran, 2015; Southall *et al.,* 2019). Cumulative SEL is used to predict TTS in marine mammals and is considered a good predictor of TTS for shorter duration exposures than longer duration exposures. The amount of TTS increases with exposure SPL and duration and is correlated with cumulative SEL, but

duration of the exposure has a more significant effect on TTS than would be predicted based on cumulative SEL alone (*e.g.,* Finneran *et al.,* 2010b; Kastak *et al.,* 2007; Kastak *et al.,* 2005; Kastelein *et al.,* 2014a; Mooney *et al.,* 2009a; Popov *et al.,* 2014; Gransier and Kastelein, 2024). 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, TTS increases with cumulative SEL in a non-linear fashion, where lower SEL exposures will elicit a steady rate of TTS increase while higher SEL exposures will either increase TTS more rapidly or plateau (Finneran, 2015; U.S. Department of the Navy, 2025). Additionally, with sound exposures of equal energy, those that had lower SPL with longer duration were found to induce TTS onset at lower levels than those of 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; Kastelein *et al.,* 2014; Kastelein *et al.,* 2015). For example, one short, higher SPL sound exposure may induce the same impairment as one longer 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 loud enough to elicit TTS, or shorter-term exposure to sound levels well above the TTS threshold, can cause AUD INJ, at least in terrestrial mammals (Kryter, 1985; Lonsbury-Martin *et al.,* 1987).

Although TTS increases non-linearly in marine mammals, recovery from TTS typically occurs in a linear fashion with the logarithm of time (Finneran, 2015; Finneran *et al.,* 2010a; Finneran *et al.,* 2010b; Finneran and Schlundt, 2013; Kastelein *et al.,* 2012a; Kastelein *et al.,* 2012b; Kastelein *et al.,* 2013a; Kastelein *et al.,* 2014a; Kastelein *et al.,* 2014b; Kastelein *et al.,* 2014c; Popov *et al.,* 2014; Popov *et al.,* 2013; Popov *et al.,* 2011; Muslow *et al.,* 2023; Finneran *et al.,* 2023). Considerable variation has been measured in individuals of the same species in both the amount of TTS incurred from similar cumulative SELs (Kastelein *et al.,* 2012a; Popov *et al.,* 2013) and the time-to-recovery from TTS (Finneran, 2015; Kastelein *et al.,* 2019). Many of these studies relied on continuous sound exposures, but intermittent, impulsive sound exposures have also been tested. The sound resulting from an explosive detonation is considered an impulsive sound, but no direct measurements of hearing loss from exposure to explosive sources have been made. Few studies (Finneran *et al.,* 2002; Lucke *et al.,* 2009; Sills *et al.,* 2020; Muslow *et al.,* 2023) using impulsive sounds have produced enough TTS to make predictions about hearing loss due to this source type (see U.S. Department of the Navy, 2025). In general, predictions of TTS based on cumulative SEL for this type of sound exposure are likely to overestimate TTS because some recovery from TTS may occur in the quiet periods between impulsive or intermittent sounds—especially when the duty cycle is low. Peak SPL (unweighted) is also used to predict TTS due to impulsive sounds (Southall *et al.,* 2007; Southall *et al.,* 2019c; U.S. Department of the Navy, 2025).

In some cases associated with terrestrial mammal noise studies, intense noise exposures have caused AUD INJ (*e.g.,* loss of cochlear neuron synapses) despite thresholds eventually returning to normal (*i.e.,* it is possible to have AUD INJ without a resulting PTS (*e.g.,* Kujawa and Liberman, 2006, 2009; Fernandez *et al.,* 2015; Ryan *et al.,* 2016; Houser, 2021)). In these situations, however, threshold shifts were 30–50 dB measured 24 hours after the exposure (*i.e.,* there is no evidence that an exposure resulting in less than 40 dB TTS measured a few minutes after exposure can produce AUD INJ). Therefore, an exposure producing 40 dB of TTS, measured a few minutes after exposure, can also be used as an upper limit to prevent AUD INJ (*i.e.,* it is assumed that exposures beyond those capable of causing 40 dB of TTS have the potential to result in AUD INJ (which may or may not result in PTS)).

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 inner ears and resultant changes in the chemical composition of the inner ear fluids (Southall *et al.,* 2007). When AUD INJ occurs, there is physical damage (typically mechanical) to the sound receptors in the ear, whereas TTS represents primarily tissue fatigue (typically metabolic) and is fully reversible (Southall *et al.,* 2007). AUD INJ 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 less than 40 dB of TTS to constitute AUD INJ. The NMFS Acoustic Updated Technical Guidance (NMFS, 2024), which was used in the assessment of effects for this proposed 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.

While many studies have examined noise-induced hearing loss in marine mammals (see Finneran (2015) and Southall *et al.* (2019c) for summaries), published data on the onset of TTS for cetaceans 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, California sea lions, and bearded seals. These studies examine hearing thresholds measured in marine mammals before and after exposure to intense sounds, which 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 Acoustic and Explosive Concepts Technical Report 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, 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 cumulative 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 cumulative SEL begins to break down. Specifically, duration has a more significant effect on TTS than would be predicted on the basis of cumulative SEL alone (Finneran *et al.,* 2010a; Kastak *et al.,* 2005; Mooney *et al.,* 2009b). This means if two exposures have the same cumulative 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 cumulative SEL tends to overestimate the amount of TTS. Despite this, cumulative 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 (Finneran, 2015).

- 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 highest susceptibility, are less hazardous than those at higher frequencies, near the region of highest susceptibility (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 the low frequency end of a species' hearing curve (*i.e.,* audiogram), onset-TTS exposure levels are higher compared to those in the region of best sensitivity.
- TTS can accumulate across multiple intermittent exposures, but the resulting TTS will be less than the TTS from a single, continuous exposure with the same cumulative SEL (Finneran *et al.,* 2010a; Kastelein *et al.,* 2014b, 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 or greater) 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, 2012b, 2013a, 2014b, 2014c; Popov *et al.,* 2013, 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 (*i.e.,* 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 (2018) 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 the 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 AUD INJ on an animal could also range in severity, although it is considered generally more serious than TTS because it is a permanent condition (Reichmuth *et al.,* 2019). 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.

As the amount of research on hearing sensitivity has grown, so, too, has the understanding that marine mammals may be able to self-mitigate, or protect, against noise-induced hearing loss. An animal may learn to reduce or suppress their hearing sensitivity when warned of an impending intense sound exposure, or if the duty cycle of the sound source is predictable, as has been demonstrated in some odontocete species (Finneran, 2018; Finneran *et al.,* 2024; Nachtigall and Supin, 2013, 2014, 2015; Nachtigall *et al.,* 2016a, 2016b, 2016c, 2018). This has been shown with several species, including the false killer whale (Nachtigall and Supin, 2013), bottlenose dolphin (Finneran, 2018; Nachtigall and Supin, 2014, 2015; Nachtigall *et al.,* 2016c), beluga whale (Nachtigall *et al.,* 2016a), and harbor porpoise (Nachtigall *et al.,* 2016b; Kastelein *et al.,* 2020). Additionally, Finneran *et al.* (2023, 2024) found that odontocetes that had participated in TTS experiments in the past could have learned from that experience and subsequently protected their hearing during new sound exposure experiments.

Behavioral Responses

Behavioral responses to sound are highly variable and context-specific (Nowacek *et al.,* 2007; Southall *et al.,* 2007, 2019). 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, self-mitigation) 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, 2016; Finneran, 2018; Finneran *et al.,* 2024; Nachtigall and Supin, 2013, 2014, 2015; Nachtigall *et al.,* 2015, 2016a, 2016b, 2018). Related to the sound itself, the perceived proximity 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), familiarity of the sound, and navigational constraints may affect the way an animal responds to the sound (Curé *et al.,* 2025; DeRuiter *et al.,* 2013a; Ellison *et al.,* 2012; Southall *et al.,* 2007; Southall *et al.,* 2021; Wartzok *et al.,* 2003; Wensveen *et al.,* 2025). Individuals (of different age, sex, 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. Southall *et al.* (2007) and Southall *et al.* (2021) have developed and subsequently refined methods developed to categorize and assess the severity of acute behavioral responses, considering impacts to individuals that may consequently impact populations. 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.

Studies by DeRuiter *et al.* (2013a) 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.* (2013b) examined behavioral responses of goose-beaked whales to MF sonar and found that whales responded strongly at low received levels (89–127 dB re 1 µPa) 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 responses.

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.,* whether this is 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 proposed 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 *et al.* (1995b). More recent reviews (Nowacek *et al.,* 2007; DeRuiter *et al.,* 2013a, 2013b; Ellison *et al.,* 2012; Gomez *et al.,* 2016; Erbe *et al.,* 2025) 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 (Southall *et al.,* 2019). The following parts provide examples of behavioral responses to stressors that provide an idea of the variability in 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 (see section 4.5 (Behavioral Reactions) of the Acoustic and Explosives Concepts Technical Report for a comprehensive list of behavioral studies and species-specific findings) or extrapolated from closely related species when no information exists, along with contextual factors.

Responses Due to Sonar and Other Transducers—

Mysticetes responses to sonar and other duty-cycled tonal sounds are

dependent upon the characteristics of the signal, behavioral state of the animal, sensitivity and previous experience of an individual, and other contextual factors including distance of the source, movement of the source, physical presence of vessels, time of year, and geographic location (Goldbogen *et al.,* 2013; Harris *et al.,* 2019a; Harris *et al.,* 2015; Martin *et al.,* 2015; Sivle *et al.,* 2015b). For example, a behavioral response study (BRS) in Southern California demonstrated that individual behavioral state was critically important in determining response of blue whales to Navy sonar. In this BRS, some blue whales engaged in deep (>50 m) feeding behavior had greater dive responses than those in shallow feeding or non-feeding conditions, while some blue whales that were engaged in shallow feeding behavior demonstrated no clear changes in diving or movement even when received levels were high (approximately 160 dB re 1 μPa) from exposures to 3–4 kHz sonar signals, while others showed a clear response at exposures at lower received level of sonar and pseudorandom noise (Goldbogen *et al.,* 2013). Generally, behavioral responses were brief and of low to moderate severity, and the whales returned to baseline behavior shortly after the end of the acoustic exposure (DeRuiter *et al.,* 2017; Goldbogen *et al.,* 2013; Southall *et al.,* 2019c). To better understand the context of these behavioral responses, Friedlaender *et al.* (2016) mapped the prey field of the deep-diving blue whales and found that the response to sound was more apparent for individuals engaged in feeding than those that were not. The probability of a moderate behavioral response increased when the source was closer for these foraging blue whales, although there was a high degree of uncertainty in that relationship (Southall *et al.,* 2019b). In the same BRS, none of the tagged fin whales demonstrated more than a brief or minor response regardless of their behavioral state (Harris *et al.,* 2019a). The fin whales were exposed to both mid-frequency simulated sonar and pseudorandom noise of similar frequency, duration, and source level. They were less sensitive to disturbance than blue whales, with no significant differences in response between behavioral states or signal types. The authors rated responses as low-to-moderate severity with no negative impact to foraging success (Southall *et al.,* 2023).

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. Henderson *et al.* (2019) examined tagged humpback whale dive and movement behavior, including individuals incidentally exposed to Navy sonar during training activities, at the Pacific Missile Range Facility off Kaua'i, Hawaii. Tracking data showed that, regardless of exposure to sonar, individual humpbacks spent limited time, no more than a few days, in the vicinity of Kaua'i. Potential behavioral responses due to sonar exposure were limited and may have been influenced by breeding and social behaviors. 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 began and increased again in the days following the completion of training activities. 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. Harris *et al.* (2019b) utilized acoustically generated minke whale tracks to statistically demonstrate changes in the spatial distribution of minke whale acoustic presence before, during, and after surface ship MFAS training. The spatial distribution of probability of acoustic presence was different in the ''during'' phase compared to the ''before'' phase, and the probability of presence at the center of ship activity during MFAS training was close to zero for both years. The ''after'' phases for both years retained lower probabilities of presence suggesting the return to baseline conditions may take more than 5 days. The results show a clear spatial redistribution of calling minke whales during surface ship MFAS training; however, a limitation of passive acoustic monitoring (PAM) is that one cannot conclude if the whales moved away, went silent, or a combination of the two.

Building on this work, Durbach *et al.* (2021) used the same data and determined that individual minke whales tended to be in either a fast or slow movement behavior state while on the missile range, where whales tended to be in the slow state in baseline or before periods but transitioned into the fast state with more directed movement during sonar exposures. They also moved away from the area of sonar activity on the range, either to the north or east depending on where the activity was located; this explains the spatial redistribution found by Harris *et al.* (2019b). Minke whales were also more likely to stop calling when in the fast state, regardless of sonar activity, or when in the slow state during sonar activity (Durbach *et al.,* 2021). Similarly, minke whale detections were reduced or ceased altogether during periods of sonar use off Jacksonville, Florida (Norris *et al.,* 2012; Simeone *et al.,* 2015; U.S. Department of the Navy, 2013), especially with an increased ping rate (Charif *et al.,* 2015).

Odontocetes have varied, context-dependent behavioral responses to sonar and other transducers. Much of the research on odontocetes has been focused on understanding the impacts of sonar and other transducers on beaked whales because they were hypothesized to be more susceptible to behavioral disturbance after several strandings of beaked whales in which military MFAS was identified as a contributing factor (see *Stranding and Mortality* section). Subsequent BRSs have shown that beaked whales are likely more sensitive to disturbance than most other cetaceans. Many species of odontocetes have been studied during BRSs, including Blainville's beaked whale, goose-beaked whale, Baird's beaked whale, northern bottlenose whale, harbor porpoise, pilot whale, killer whale, sperm whale, false killer whale, melon-headed whale, bottlenose dolphin, rough-toothed dolphin, Risso's dolphin, Pacific white-sided dolphin, and Commerson's dolphin. Observed responses by Blainville's beaked whales, goose-beaked whales, Baird's beaked whales, and northern bottlenose whales (the largest of the beaked whales), to MF sonar sounds include cessation of clicking, decline in group vocal periods, termination of foraging dives, changes in direction to avoid the sound source, slower ascent rates to the surface, longer deep and shallow dive durations, and other unusual dive behaviors (DeRuiter *et al.,* 2013b; Hewitt *et al.,* 2022; Jacobson *et al.,* 2022; Martín López *et al.,* 2025; McCarthy *et al.,* 2011; Miller *et al.,* 2015; Moretti *et al.,* 2014;

Southall *et al.,* 2011; Stimpert *et al.,* 2014; Tyack *et al.,* 2011).

During a BRS in Southern California, a tagged Baird's beaked whale exposed to simulated MFAS within 3 km increased swim speed and modified its dive behavior (Stimpert *et al.,* 2014). One goose-beaked whale was also incidentally exposed to real Navy sonar located over 100 km away in addition to the source used in the controlled exposure study, and the authors did not detect similar responses at comparable received levels. Received levels from the MFAS signals from the controlled (3.4 to 9.5 km) exposures were calculated as 84–144 dB re 1 μPa, and incidental (118 km) exposures were calculated as 78–106 dB re 1 μPa, indicating that context of the exposures (*e.g.,* source proximity, controlled source ramp-up) may have been a significant factor in the responses to the simulated sonars (DeRuiter *et al.,* 2013b).

Long-term tagging work during the same BRS demonstrated that the longer duration dives considered a behavioral response by DeRuiter *et al.* (2013b) fell within the normal range of dive durations found for eight tagged goose-beaked whales on the Southern California Offshore Range (Schorr *et al.,* 2014). However, the longer inter-deep dive intervals found by DeRuiter *et al.* (2013b), which were among the longest found by Schorr *et al.* (2014) and Falcone *et al.* (2017), may indicate a response to sonar. During controlled exposure experiments in an area of the Atlantic Ocean with relatively infrequent sonar use, Southall *et al.* (2026) found a consistent pattern of longer inter-deep-dive intervals in goose-beaked whales exposed to simulated MF sonar beginning at received levels between 100–120 dB re 1 μPa. Williams *et al.* (2017) note that during normal deep dives or during fast swim speeds, beaked whales and other marine mammals use strategies to reduce their stroke rates (*e.g.,* leaping, wave surfing when swimming, interspersing glides between bouts of stroking when diving). The authors determined that in the post-exposure dives by the tagged goose-beaked whales described in DeRuiter *et al.* (2013b), the whales ceased gliding and swam with almost continuous strokes. This change in swim behavior was calculated to increase metabolic costs by about 30.5 percent and increase the amount of energy expending on fast swim speeds from 27–59 percent of their overall energy budget. This repartitioning of energy was detected in the model up to 1.7 hours after the single sonar exposure. Therefore, while the overall post-exposure dive durations were similar, the metabolic energy calculated by Williams *et al.* (2017) was higher. However, Southall *et al.* (2019a) found that prey availability was higher in the western area of the Southern California Offshore Range where goose-beaked whales preferentially occurred, while prey resources were lower in the eastern area and moderate in the area just north of the Range. This high prey availability may indicate that goose-beaked whales need fewer foraging dives to meet energy requirements than would be needed in another area with fewer resources.

During a BRS in Norway, northern bottlenose whales avoided a sonar sound source over a wide range of distances (0.8 to 28 km) and estimated avoidance thresholds ranging from received SPLs of 117 to 126 dB re 1 μPa. The behavioral response characteristics and avoidance thresholds were comparable to those previously observed in beaked whale studies; however, researchers did not observe an effect of distance on behavioral response and found that onset and intensity of behavioral response were better predicted by received SPL. There was one instance where an individual northern bottlenose whale approached the vessel, circled the sound source (source level was only 122 dB re 1 μPa), and resumed foraging after the exposure. Conversely, one northern bottlenose whale exposed to a sonar source was documented performing the longest and deepest dive on record for the species, and continued swimming away from the source for more than 7 hours (Miller *et al.,* 2015; Siegal *et al.,* 2022; Wensveen *et al.,* 2019).

Research on Blainville's beaked whales at the Atlantic Undersea Test and Evaluation Center (AUTEC) range has shown that individuals move off-range during sonar use, only returning after the cessation of sonar transmission (Boyd *et al.,* 2009; Henderson *et al.,* 2015; Jones-Todd *et al.,* 2021; Manzano-Roth *et al.,* 2022; Manzano-Roth *et al.,* 2016; McCarthy *et al.,* 2011; Tyack *et al.,* 2011). Five Blainville's beaked whales estimated to be within 2 to 29 km of the AUTEC range at the onset of active sonar were displaced a maximum of 28–68 km after moving away from the range, although one individual did approach the range during active sonar use. Researchers found a decline in deep dives at the onset of the training and an increase in time spent on foraging dives as whales moved away from the range. Predicted received levels at which presumed responses were observed were comparable to those previously observed in beaked whale studies. Acoustic data indicated that vocal periods were detected on the range within 72 hours after training ended (Joyce *et al.,* 2019). However, Blainville's beaked whales have been documented to remain on-range to forage throughout the year (Henderson *et al.,* 2016), indicating the AUTEC range may be a preferred foraging habitat regardless of the effects of active sonar noise, or it could be that there are no long-term consequences of the sonar activity. In the Southern California Range Complex, researchers conducting photo-identification studies have identified approximately 100 individual goose-beaked whales, with 40 percent having been seen in one or more prior years, with re-sightings up to 7 years apart, indicating a possible on-range resident population (Falcone and Schorr, 2014; Falcone *et al.,* 2009).

The probability of Blainville's beaked whale group vocal periods on the Pacific Missile Range Facility (PMRF) were modeled during periods of (1) no naval activity, (2) naval activity without hull-mounted MFAS, and (3) naval activity with hull-mounted MFAS (Jacobson *et al.,* 2022). At a received level of 150 dB re 1 μPa RMS SPL, the probability of detecting a group vocal period during MFAS use decreased by 77 percent compared to periods when general training activity was ongoing, and by 87 percent compared to baseline (no naval activity) conditions. Jacobsen *et al.* (2022) found a greater reduction in probability of a group vocal period with MFAS than observed in a prior study of the same species at the AUTEC range (Moretti *et al.,* 2014), which may be due to the baseline period in the AUTEC study including naval activity without MFAS, potentially lowering the baseline group vocal period activity in that study, or due to differences in the residency of the populations at each range.

Stanistreet *et al.* (2022) used passive acoustic recordings during a multinational navy activity to assess marine mammal acoustic presence and behavioral response to especially long bouts of sonar lasting up to 13 consecutive hours, occurring repeatedly over 8 days (median and maximum SPL = 120 dB and 164 dB). Goose-beaked whales and sperm whales substantially reduced how often they produced clicks during sonar, indicating a decrease or cessation in foraging behavior. Few previous studies have shown sustained changes in foraging or displacement of sperm whales, but there was an absence of sperm whale clicks for 6 consecutive days of sonar activity. Sperm whales returned to baseline levels of clicks within days after the activity, but beaked whale detection rates remained

low even 7 days after the exercise. In addition, there were no detections from a Mesoplodon beaked whale species within the area during, and at least 7 days after, the sonar activity. Clicks from northern bottlenose whales and Sowerby's beaked whales were also detected but were not frequent enough at the recording site used to compare clicks between baseline and sonar conditions.

Goose-beaked whale behavioral responses (*i.e.,* deep and shallow dive durations, surface interval durations, inter-deep dive intervals) on the Southern California Anti-Submarine Warfare Range were modeled against predictor values that included helicopter dipping sonar, mid-power MFAS and hull-mounted, high-power MFAS along with other non-MFAS predictors (Falcone *et al.,* 2017). Falcone *et al.* (2017) found both shallow and deep dive durations increased as the proximity to both mid- and high-powered sources decreased and found that surface intervals and inter-deep dive intervals increased in the presence of both types of sonars (helicopter dipping and hull-mounted), although surface intervals shortened during periods without MFAS. Proximity of source and receiver were important considerations, as the responses to the mid-power MFAS at closer ranges were comparable to the responses to the higher source level vessel sonar, as was the context of the exposure. Helicopter dipping sonars are shorter duration and randomly located, therefore more difficult to predict or track by beaked whales and potentially more likely to elicit a response, especially at closer distances (6–25 km) (Falcone *et al.,* 2017).

Sea floor depths and quantity of light (*i.e.,* lunar cycle) are also important variables to consider in BRSs, as goose-beaked whale foraging dive depth increased with sea floor depth (maximum 2,000 m) and the amount of time spent at foraging depths (and likely foraging) was greater at night (likely avoiding predation by staying deeper during periods of bright lunar illumination), although they spent more time near the surface during the night, as well, particularly on dark nights with little moonlight (Barlow *et al.,* 2020). Sonar occurred during 10 percent of the dives studied and had little effect on the resulting dive metrics. Watwood *et al.* (2017) found that the longer the duration of a sonar event, the greater the reduction in detected goose-beaked whale group dives and, as helicopter dipping events occurred more frequently but with shorter durations than periods of hull-mounted sonar, when looking at the number of detected group dives there was a greater reduction during periods of hull-mounted sonar than during helicopter dipping sonar. DiMarzio *et al.* (2019) also found that group vocal periods (*i.e.,* clusters of foraging pulses), on average, decreased during sonar events on the Southern California Anti-Submarine Warfare Range, though the decline from before the event to during the event was significantly less for helicopter dipping events than hull-mounted events, and there was no difference in the magnitude of the decline between vessel-only events and events with both vessels and helicopters. Manzano-Roth *et al.* (2022) analyzed long-term PAM data from the PMRF in Kaua'i, Hawaii, and found beaked whales reduced group vocal periods during submarine command course events and remained low for a minimum of 3 days after the MFAS activity.

Harbor porpoise behavioral responses have been researched extensively using acoustic deterrent and acoustic harassment devices; however, BRSs using sonar are limited. Kastelein *et al.* (2018) found harbor porpoises did not respond to low-duty cycle MF sonar tones (3.5–4.1 kHz at 2.7 percent duty cycle; *e.g.,* one tone per minute) at any received level, but one individual did respond (*i.e.,* increased jumping, increased respiration rates) to high-duty cycle sonar tones (3.5–4.1 kHz at 96 percent duty cycle; *e.g.,* continuous tone for almost a minute).

Behavioral responses by odontocetes (other than beaked whales and harbor porpoises) to sonar and other transducers include horizontal avoidance, reduced breathing rates, changes in behavioral state, changes in vocal behavior, changes in dive behavior (Antunes *et al.,* 2014; Isojunno *et al.,* 2018; Isojunno *et al.,* 2017; Isojunno *et al.,* 2020; Miller, 2012; Miller *et al.,* 2011; Miller *et al.,* 2014; Samarra *et al.,* 2025; Southall *et al.,* 2024), and, in one study, separation of a killer whale calf from its group (Miller *et al.,* 2011). Some species of dolphin (*e.g.,* bottlenose, spotted, spinner, Clymene, Pacific white-sided, rough-toothed) are frequently documented bowriding with vessels and the drive to engage in bowriding, whether for pleasure or energetic savings (Fiori *et al.,* 2024) may supersede the impact of associated sonar noise (Würsig *et al.,* 1998).

In controlled exposure experiments on captive odontocetes, Houser *et al.* (2013a) recorded behavioral responses from bottlenose dolphins with 3 kHz sonar-like tones between 115–185 dB re 1 μPa, and individuals across 10 trials demonstrated a 50 percent probability of response at 172 dB re 1 μPa. Multiple studies have been conducted on bottlenose dolphins and beluga whales to measure TTS (Finneran *et al.,* 2003a; Finneran *et al.,* 2001; Finneran *et al.,* 2005; Finneran and Schlundt, 2004; Schlundt *et al.,* 2000). During these studies, when individuals were presented with 1-second tones up to 203 dB re 1 μPa, responses included changes in respiration rate, fluke slaps, and a refusal to participate or return to the location of the sound stimulus, including what appeared to be deliberate attempts by animals to avoid a sound exposure or to avoid the location of the exposure site during subsequent tests (Finneran *et al.,* 2002; Schlundt *et al.,* 2000). Bottlenose dolphins exposed to more intense 1-second tones exhibited short-term changes in behavior above received levels of 178–193 dB re 1 μPa, and beluga whales did so at received levels of 180–196 dB re 1 μPa and above.

While several opportunistic observations of odontocete (other than beaked whales and harbor porpoises) responses have been recorded during previous Navy activities and BRSs that employed sonar and sonar-like sources, it is difficult to definitively attribute responses of non-focal species to sonar exposure. Responses range from no response to potentially impactful responses, such as the separation of a killer whale calf from its group (Miller *et al.,* 2011). This may be due, in part, to the variety of species and sensitivities of the odontocete taxonomic group, as well as the breadth of study types conducted and field observations, leading to the assessment of both contextually driven and dose-based responses. The available data indicate exposures to sonar in close proximity and with multiple vessels approaching an animal likely lead to higher-level responses by most odontocete species, regardless of received level or behavioral state. However, when sources are further away and moving in variable directions, behavioral responses are likely driven by behavioral state, individual experience, or species-level sensitivities, as well as exposure duration and received level, with the likelihood of response increasing with increased received levels. As such, it is expected odontocete behavioral responses to sonar and other transducers will vary by species, populations, and individuals, and long-term consequences or population-level effects are likely dependent upon the frequency and

duration of the exposure and resulting behavioral response.

Responses Due to Impulsive Noise—

Impulsive signals have a rapid rise time and higher instantaneous peak pressure than other signal types, particularly at close range, which means they are more likely to cause startle or avoidance responses. At long distances, however, the rise time increases as the signal duration lengthens (similar to a ''ringing'' sound), making the impulsive signal more similar to a non-impulsive signal (Hastie *et al.,* 2019; Martin *et al.,* 2020). Behavioral responses from explosive sounds are likely to be similar to responses studied for other impulsive noise, such as those produced by air guns and impact pile driving. Data on behavioral responses to impulsive sound sources are limited across all marine mammal groups, with only a few studies available for mysticetes and odontocetes.

Mysticetes have varied responses to impulsive sound sources, including avoidance, aggressive directed movement towards the source, reduced surface intervals, altered swimming behavior, and changes in vocalization rates (Gordon *et al.,* 2003; McCauley *et al.,* 2000a; Richardson *et al.,* 1985; Southall *et al.,* 2007). Studies have been conducted on many baleen whale species, including gray, humpback, blue, fin, and bowhead whales; it is assumed that these responses are representative of all baleen whale species. The behavioral state of the whale seems to be an integral part of whether the animal responds and how they respond, as does the location and movement of the sound source, more than the received level of the sound.

If an individual is engaged in migratory behavior, it may be more likely to respond to impulsive noise, and some species may be more sensitive than others. Migrating gray whales showed avoidance responses to seismic vessels at received levels between 164 and 190 dB re 1 µPa (Malme *et al.,* 1986,; Malme *et al.,* 1988). In one study, McCauley *et al.* (1998) found that migrating humpback whales in Australia showed avoidance behavior at ranges of 5–8 km from a seismic array during observational studies and controlled exposure experiments, and another study found humpback whales in Australia decreased their dive times and reduced their swimming speeds (Dunlop *et al.,* 2015). However, when comparing received levels and behavioral responses between air gun ramp-up versus constant noise level of air guns, humpback whales did not change their dive behavior but did deviate from their predicted heading and decreased their swim speeds, deviating more during the constant noise source trials but reducing swim speeds more during ramp-up trials (Dunlop *et al.,* 2016). In both cases, there was no dose-response relationship with the received level of the air gun noise, and similar responses were observed in control trials without air guns (vessel movement remained constant across trials), so some responses may have been due to vessel presence and not received level from the air guns. Social interactions between males and mother-calf pairs were reduced in the presence of vessels towing seismic air gun arrays, regardless of whether the air guns were active or not, which indicates that it was likely the presence of vessels (rather than the impulsive noise generated from active air guns) that affected humpback whale behavior (Dunlop *et al.,* 2020).

Proximity of the impulsive source is another important factor to consider when assessing the potential for behavioral responses in marine mammals. Dunlop *et al.* (2017) found that groups of humpback whales were more likely to avoid a smaller air gun array at closer proximity than a larger air gun array, despite the same received level, showing the difference in response between arrays has more to do with the combined effects of received level and source proximity. In this study, responses were varied and generally small, with short-term course deviations of about 500 m. Studies on bowhead whales have shown they may be more sensitive than other species to impulsive noise, as individuals have shown clear changes in diving and breathing patterns up to 73 km from seismic vessels with received levels as low as 125 dB re 1 µPa (Malme *et al.,* 1988). Richardson *et al.* (1995a) documented bowhead whales exhibiting avoidance behaviors at a distance of more than 20 km from seismic vessels when received levels were as low as 120 dB re 1 µPa, although most did not show active avoidance until 8 km from the source. Although bowhead whales may avoid the area around seismic surveys, from 6 to 8 km (Koski and Johnson, 1987, as cited in Gordon *et al.,* 2003) out to 20 or 30 km (Richardson *et al.,* 1999), a study by Robertson *et al.* (2013) supports the idea that behavioral responses are contextually dependent, and that during seismic operations, bowhead whales may be less ''available'' for counting due to alterations in dive behavior but that they may not have completely vacated the area.

In contrast, noise from seismic surveys was not found to impact feeding behavior or exhalation rates in western gray whales while resting or diving off the coast of Russia (Gailey *et al.,* 2007; Yazvenko *et al.,* 2007); however, the increase in vessel traffic associated with surveys and the proximity of the vessels to the whales did affect the orientation of the whales relative to the vessels and shortened their dive-surface intervals (Gailey *et al.,* 2016). They also increased their speed and distance from the noise source and have been documented in one case study swimming towards shore to avoid an approaching seismic vessel (Gailey *et al.,* 2022). 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 closer to the noise source, possibly indicating a reduction in net detection associated with the noise through masking or TTS. Distributions of fin and minke whales were modeled with multiple environmental variables and with the occurrence or absence of seismic surveys, and no evidence of a decrease in sighting rates relative to seismic activity was found for either species (Vilela *et al.,* 2016). Their distributions were driven entirely by environmental variables, particularly those linked to prey, including warmer sea surface temperatures, higher chlorophyll-a values, and higher photosynthetically available radiation (a measure of primary productivity). Sighting rates based on over 8,000 hours of baleen and toothed whale survey data were compared on regular vessel surveys versus both active and passive periods of seismic surveys (Kavanagh *et al.,* 2019). Models of sighting numbers were developed, and it was determined that baleen whale sightings were reduced by 88 percent during active and 87 percent during inactive phases of seismic surveys compared to regular surveys. These results seemed to occur regardless of geographic location of the survey; however, when only comparing active versus inactive periods of seismic surveys, the geographic location did seem to affect the change in sighting rates.

Mysticetes seem to be the most behaviorally sensitive taxonomic group of marine mammals to impulsive sound sources, with possible avoidance responses occurring out to 30 km and vocal changes occurring in response to sounds over 100 km away. However, they are also the most studied taxonomic group, yielding a larger sample size and greater chance of

finding behavioral responses to impulsive noise. Also, their responses appear to be behavior-dependent, with most avoidance responses occurring during migration behavior and little observed response during feeding behavior. These response patterns are likely to hold true for impulsive sources used by the Action Proponents; however, their impulsive sources would largely be stationary (*e.g.,* explosives fired at a fixed target, small air guns) and short term (hours rather than days or weeks) compared with the activities in the aforementioned studies, so responses would likely occur in closer proximity to animals or not at all.

Odontocete responses to impulsive noise are not well studied and the majority of data have come from seismic (*i.e.,* air gun) surveys, pile driving, and construction activities, while only a few studies have been done to understand how explosive sounds impact odontocetes. What data are available show they may be less sensitive than mysticetes to impulsive sound and that responses occur at closer distances. This may be due to the predominance of low-frequency sound associated with impulsive sources that propagates across long distances and overlaps with the range of best hearing for mysticetes but is below that range for odontocetes. Even harbor porpoises—shown to be highly sensitive to most sound sources, avoiding both stationary (*e.g.,* pile driving) and moving (*e.g.,* seismic survey vessels) impulsive sound sources out to approximately 20 km (*e.g.,* Haelters *et al.,* 2014; Pirotta *et al.,* 2014)—have short-term responses, returning to an area within hours upon cessation of the impulsive noise.

Although odontocetes are generally considered less sensitive, impulsive noise does impact toothed whales in a variety of ways. In one study, dolphin detections were compared during 30-second periods before, during, and after underwater detonations near naval mine neutralization exercises in Virginia Capes Operating Area. Lammers *et al.* (2017) found that within 30 seconds after an explosion, the immediate response was an increase in whistles compared to the 30 seconds before an explosion, and that there was a reduction in dolphin acoustic activity during the day of and day after the exercise within 6 km. This held true only during daytime, as nighttime activity did not appear different than before the exercise, and 2 days after the explosion there seemed to be an increase in daytime acoustic activity, indicating dolphins may have returned to the area or resumed vocalizations (Lammers *et al.,* 2017). Weaver (2015) documented potential sex-based differences in behavioral responses to impulsive noise during construction (including blasting) of a bridge over a waterway commonly used by bottlenose dolphins, where females decreased area use and males continued using the area, perhaps indicating differential habitat uses.

When exposed to multiple impulses from a seismic air gun, Finneran *et al.* (2015) noted some captive dolphins turned their heads away from the source just before the impulse, indicating they could anticipate the timing of the impulses and may be able to behaviorally mediate the exposure to reduce their received level. Kavanagh *et al.* (2019) found sightings of odontocete whales decreased by 53 percent during active phases of seismic air gun surveys and 29 percent during inactive phases compared to control surveys. Heide-Jorgensen *et al.* (2021) found that narwhals exposed to air gun noise in an Arctic fjord were sensitive to seismic vessels over 11 km away, even though the small air gun source reached ambient noise levels around 3 km (source level of 231 dB re 1 μPa at 1 m) and large air gun source reached ambient noise levels around 10 km (source level 241 dB re 1 μPa at 1 m). Behavioral responses included changes in swimming speed and swimming direction away from the impulsive sound source and towards the shoreline. Changes in narwhal swimming speed was context-dependent and usually increased in the presence of vessels but decreased (a ''freeze'' response) in response to closely approaching air gun pulses (Heide-Jorgensen *et al.,* 2021). A cessation of feeding was also documented when the impulsive noise was less than 10 km away, although received SELs were less than 130 dB re 1 μPa^2s for either air gun at this distance. However, because of this study's research methods and criteria, the long-distance responses of narwhals may be conservatively estimating narwhals' range to behavioral response.

Similarly, harbor porpoises seem to have an avoidance response to seismic surveys by leaving the area and decreasing foraging activity within 5–10 km of the survey, as evidenced by both a decrease in vocalizations near the survey and an increase in vocalizations at a distance (Pirotta *et al.,* 2014; Thompson *et al.,* 2013). The response was short-term, as the porpoises returned to the area within 1 day upon cessation of the air gun operation. Sarnocińska *et al.* (2020) placed autonomous recording devices near oil and gas platforms and control sites to measure harbor porpoise acoustic activity during seismic air gun surveys. They noted a dose-response effect, with the lowest amount of porpoise activity closest to the seismic vessel ($SEL_{single\ shot}$ = 155 dB re 1 μPa^2s) and increasing porpoise activity out to 8–12 km, and that distance to the seismic vessel, rather than sound level, was a better model predictor of porpoise activity. Overall porpoise activity in the seismic survey area was similar to the control sites (approximately 15 km apart), which may indicate the harbor porpoises were moving around the area to avoid the seismic vessel without leaving the area entirely.

Pile driving, another activity that produces impulsive sound, elicited a similar response in harbor porpoises. Benhemma-Le Gall *et al.* (2021) examined changes in porpoise presence and foraging at two offshore windfarms between control (102–104 dB) and construction periods (155–161 dB) and found decreased presence (8–17 percent) and decreased foraging activity (41–62 percent) during construction periods. Porpoises were displaced up to 12 km away from pile driving and 4 km from construction vessels. Multiple studies have documented strong avoidance responses by harbor porpoises out to 20 km during pile driving activity; however, animals returned to the area after the activity stopped (Brandt *et al.,* 2011; Dähne *et al.,* 2014; Haelters *et al.,* 2014; Thompson *et al.,* 2010; Tougaard *et al.,* 2005; Tougaard *et al.,* 2009). When bubble curtains were deployed around pile driving, the avoidance distance appeared to be reduced by half to 12 km, and the animals returned to the area after approximately 5 hours rather than 1 day later (Dähne *et al.,* 2017). Further, Bergström *et al.* (2014) found that although there was a high likelihood of acoustic disturbance during wind farm construction (including pile driving), the impact was short-term, and Graham *et al.* (2019) found that the distance at which behavioral responses of harbor porpoises occurred likely decreased over the course of a construction project, suggesting habituation to impulsive pile-driving noise. Kastelein *et al.* (2013b) exposed captive harbor porpoises to impact pile driving noise and found that respiration rates increased above 136 dB re 1 μPa (zero-to-peak), and at higher sound levels individuals jumped more frequently. When a single harbor porpoise was exposed to playbacks of impact pile driving noise with different bandwidths, Kastelein *et al.* (2022) found the animal's behavioral response (*i.e.,* swim

speed, respiration rate, jumping) decreased with bandwidth.

Overall, odontocete behavioral responses to impulsive sound sources are likely species- and context-dependent. Responses might be expected close to a noise source, under specific behavioral conditions such as females with offspring, or for sensitive species such as harbor porpoises, while many other species demonstrate little to no behavioral response.

Responses Due to Vessel Noise—

Mysticetes have varied responses to vessel noise and presence, from having no response to approaching vessels to exhibiting an avoidance response by both horizontal (swimming away) and vertical (increased diving) movement (Baker *et al.,* 1983; Fiori *et al.,* 2019; Gende *et al.,* 2011). Avoidance responses include changing swim patterns, speed, or direction (Jahoda *et al.,* 2003), remaining submerged for longer periods of time (Au and Green, 2000), and performing shallower dives with more frequent surfacing. Behavioral responses to vessels range from smaller-scale changes, such as altered breathing patterns (*e.g.,* Baker *et al.,* 1983; Jahoda *et al.,* 2003), to larger-scale changes, such as a decrease in apparent presence (Anderwald *et al.,* 2013). Other common behavioral responses include changes in vocalizations, surface time, feeding and social behaviors (Au and Green, 2000; Dunlop, 2019; Fournet *et al.,* 2018; Machernis *et al.,* 2018; Richter *et al.,* 2003; Williams *et al.,* 2002). For example, North Atlantic right whales (NARWs) have been reported to increase the amplitude or frequency of their vocalizations or call at a lower rate in the presence of increased vessel noise (Parks *et al.,* 2007; Parks *et al.,* 2011) but generally demonstrate little to no response to vessels or sounds from approaching vessels and often continue to use habitats in high vessel traffic areas (Nowacek *et al.,* 2004). This lack of response may be due to habituation to the presence and associated noise of vessels in NARW habitat or may be due to propagation effects that may attenuate vessel noise near the surface (Nowacek *et al.,* 2004; Terhune and Verboom, 1999).

Similarly, sei whales have been observed ignoring the presence of vessels entirely and even pass close to vessels (Reeves *et al.,* 1998). Ramesh *et al.* (2021) found that fin whale calls in Ireland were less likely to be detected for every 1 dB re 1 μPa/minute increase in shipping noise levels. In the presence of tour boats in Chile, fin whales were changing their direction of movement more frequently, with less linear movement than occurred before the boats arrived; this behavior may represent evasion or avoidance of the boats (Santos-Carvallo *et al.,* 2021). The increase in travel swim speeds after the vessels departed may be related to the rapid speeds at which the vessels traveled, sometimes in front of fin whales, leading to additional avoidance behavior post-exposure.

Mysticete behavioral responses to vessels may also be affected by vessel behavior (Di Clemente *et al.,* 2018; Fiori *et al.,* 2019). Avoidance responses occurred most often after J-type vessel approaches (*i.e.,* traveling parallel to the whales' direction of travel, then overtaking the whales by turning in front of the group) compared to parallel or direct approaches. Mother humpbacks were particularly sensitive to direct and J-type approaches and spent significantly more time diving in response (Fiori *et al.,* 2019). The presence of a passing vessel did not change the behavior of resting humpback whale mother-calf pairs, but fast vessels with louder low-frequency weighted source levels (173 dB re 1 μPa, equating to weighted received levels of 133 dB re 1 μPa) at an average distance of 100 m resulted in a decreased resting behavior and increases in dives, swim speeds, and respiration rates (Sprogis *et al.,* 2020). Humpback whale responses to vessel disturbance were dependent on their behavioral state. Di Clemente *et al.* (2018) found that when vessels passed within 500 m of humpback whales, individuals would continue to feed if already engaged in feeding behavior but were more likely to start swimming if they were surface active when approached. In response to an approaching large commercial vessel in an area of high ambient noise levels (125–130 dB re 1 μPa), a tagged female blue whale turned around mid-ascent and descended perpendicular to the vessel's path (Szesciorka *et al.,* 2019). The whale did not respond until the vessel's closest point of approach (100 m distance, 135 dB re 1 μPa RMS), which was 10 dB above the ambient noise levels. After the vessel passed, the whale ascended to the surface again with a 3-minute delay.

Overall, mysticete responses to vessel noise and traffic are varied, and habituation or changes to vocalization are predominant long-term responses. When baleen whales do avoid vessels, they seem to do so by altering their swim and dive patterns to move away from the vessel. Although a lack of response in the presence of a vessel may minimize potential disturbance from passing vessels, it does increase the whales' vulnerability to vessel strike, which may be of greater concern for mysticetes than vessel noise.

Odontocete responses due to vessel noise are varied and context-dependent, and it is difficult to separate the impacts of vessel noise from the impacts of vessel presence. Vessel presence has been shown to interrupt feeding behavior in delphinids in some studies (Meissner *et al.,* 2015; Pirotta *et al.,* 2015b) while a recent study by Mills *et al.* (2023) found that, in an important foraging area, bottlenose dolphins may continue to forage and socialize even while constantly exposed to high vessel traffic. Ng and Leung (2003) found that the type of vessel, approach, and speed of approach can all affect the probability of a negative behavioral response and, similarly, Guerra *et al.* (2014) documented varied responses in group structure and vocal behavior.

While most odontocetes have documented neutral responses to vessels, avoidance (Bejder *et al.,* 2006a; Würsig *et al.,* 1998) and attraction (Norris and Prescott, 1961; Ritter, 2002; Shane *et al.,* 1986; Westdal *et al.,* 2023; Würsig *et al.,* 1998) behaviors have also been observed (Hewitt, 1985). Archer *et al.* (2010) compared the responses of dolphin populations far offshore that were often targeted by tuna fisheries to populations closer (less than 185.2 km) to shore and found the fisheries-associated populations (spotted, spinner, and common dolphins) showed evasive behavior when approached by vessels while those nearshore species not associated with offshore fisheries (coastal spotted and bottlenose dolphins) tended to be attracted to vessels.

Arranz *et al.* (2021) used different engine types to determine whether behavioral responses of short-finned pilot whales were attributable to vessel noise, vessel presence, or both. Mother-calf pairs were approached by the same vessel outfitted with either quiet electric engines or noisy traditional combustion engines, controlling for approach speed and distance. Arranz *et al.* (2021) found mother pilot whales rested less and calves nursed less in response to both types of engines compared to control conditions, but only the noisy engine caused significant impacts (29 percent and 81 percent, respectively).

Smaller vessels tend to generate more noise in higher frequency bands, are more likely to approach odontocetes directly, and spend more time near an animal. Carrera *et al.* (2008) found tour boat activity can cause short-term displacement of dolphins, and Haviland-Howell *et al.* (2007) documented longer term or repetitive

displacement of dolphins due to chronic vessel noise. Delphinid behavioral states also change in the presence of small tour vessels that often approach animals: travel and resting increases, foraging and social behavior decreases, and animals move closer together (Cecchetti *et al.,* 2017; Clarkson *et al.,* 2020; Kassamali-Fox *et al.,* 2020; Meissner *et al.,* 2015). Most studies on behavioral responses of bottlenose dolphins to vessel traffic show at least short-term changes in behavior, activities, or vocalization patterns when vessels are nearby (Acevedo, 1991; Arcangeli and Crosti, 2009; Berrow and Holmes, 1999; Fumagalli *et al.,* 2018; Gregory and Rowden, 2001; Janik and Thompson, 1996; Lusseau, 2004; Marega *et al.,* 2018; Mattson *et al.,* 2005; Perez-Ortega *et al.,* 2021; Puszka *et al.,* 2021; Scarpaci *et al.,* 2000).

Information is limited on beaked whale responses to vessel noise, but Würsig *et al.* (1998) noted that most beaked whales seem to exhibit avoidance behaviors when exposed to vessels and beaked whales may respond to all anthropogenic noise (*i.e.,* sonar, vessel) at similar sound levels (Aguilar de Soto *et al.,* 2006; Tyack *et al.,* 2011; Tyack, 2009). The information available includes a disruption of foraging by a vocalizing goose-beaked whale in the presence of a passing vessel (Aguilar de Soto *et al.,* 2006) and restriction of group movement, or possibly reduction in the number of individuals clicking within the group, after exposure to broadband (received level of 135 dB re 1 µPa) vessel noise up to at least 5.2 km away from the source, though no change in duration of Blainville's beaked whale foraging dives was observed (Pirotta *et al.,* 2012).

Porpoises and small delphinids are known to be sensitive to vessel noise, as well. Frankish *et al.* (2023) found harbor porpoises more likely to avoid large commercial vessels via horizontal movement during the day and vertical movement at night, which supports previous research that the species routinely avoids large, motorized vessels (Polacheck and Thorpe, 1990). Harbor porpoises have also been documented responding to vessels with increased changes in behavioral state and significantly decreased feeding (Akkaya Bas *et al.,* 2017), fewer clicks (Sairanen, 2014), and fewer prey capture attempts and have disrupted foraging when vessels pass closely and noise levels are higher (Wisniewska *et al.,* 2018). Habituation to vessel noise and presence was observed for a resident population of harbor porpoises that was in regular proximity to vessel traffic (10 m to 1 km away); the population had no response in 74 percent of interactions and an avoidance response in 26 percent of interactions. It should be noted that fewer responses in populations of odontocetes regularly subjected to high levels of vessel traffic could be a sign of habituation, or it could be that the more sensitive individuals in the population have abandoned that area of higher human activity.

Most avoidance responses were the result of fast-moving or steady plane-hulling motorized vessels and the vessel type and speed were considered to be more relevant than vessel presence, as few responses were observed to non-motorized or stationary vessels (Oakley *et al.,* 2017). Similarly, Akkaya Bas *et al.* (2017) found that when fast moving vessels were within 50 m of harbor porpoises, there was an 80 percent probability of change in swimming direction but only a 40 percent probability of change when vessels were beyond 400 m. Frankish *et al.* (2023) found that harbor porpoises were most likely to avoid vessels less than 300 m away but, 5–10 percent of the time, they would also respond to vessels more than 2 km away, signifying that they were not just attuning to vessel presence, but to vessel noise as well.

Although most vessel noise is constrained to frequencies below 1 kHz, at close ranges vessel noise can extend into mid- and high frequencies (into the tens of kHz) (Hermannsen *et al.,* 2014; Li *et al.,* 2015) and it is these frequencies that harbor porpoises are likely responding to; the mean M-weighted received SPL threshold for a response at these frequencies is 123 dB re 1 µPa (Dyndo *et al.,* 2015). M-weighting functions are generalized frequency weightings for various groups of marine mammals that were defined by Southall *et al.* (2007) based on known or estimated auditory sensitivity at different frequencies and are used to characterize auditory effects of strong sounds. Hermannsen *et al.* (2019) estimated that noise in the 16 kHz frequency band resulting from small recreational vessels could cause behavioral directions in harbor porpoises and could be elevated up to 124 dB re 1 µPa and raise ambient noise levels by a maximum of 51 dB. The higher noise levels were associated with vessel speed and range, which exceeded the threshold levels found by Dyndo *et al.* (2015) and Wisniewska *et al.* (2018) by 49–85 percent of events with high levels of vessel noise.

Lusseau and Bejder (2007) have reported some long-term consequences of vessel noise on odontocetes, but, overall, there is little information on the long-term and cumulative impacts of vessel noise (National Academies of Sciences Engineering and Medicine, 2017; NMFS, 2007). Many researchers speculate that long-term impacts may occur on odontocete populations that experience repeated interruption of foraging behaviors (Stockin *et al.,* 2008), and Southall *et al.* (2021) indicates that, in many contexts, the localized and coastal home ranges typical of many species make them less resilient to this chronic stressor than mysticetes.

Masking

Sound can disrupt behavior through masking, or interfering with, an animal's ability to produce, detect, recognize, interpret, or discriminate between acoustic signals of interest (*e.g.,* those used for intraspecific communication and social interactions, prey detection, predator avoidance, or navigation) (Clark *et al.,* 2009; Richardson *et al.,* 1995b; Erbe and Farmer, 2000; Tyack, 2000; Erbe *et al.,* 2016; Branstetter and Sills, 2022; Erbe *et al.,* 2025). Masking occurs when the production or 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 coincident 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 section 4.4 (Masking) of the Acoustic and Explosive Concepts Technical Report, 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/or the ability to produce a signal (communication masking), 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 in both signalers and receivers in an attempt to compensate for noise levels, including vocal changes (*e.g.,* Lombard effect, increasing amplitude, or changing frequency or timing of vocalizations), cessation of foraging, and leaving an area, (Erbe *et al.,* 2016).

Most research on auditory masking is focused on energetic masking, or the ability of the receiver (*i.e.,* listener) to detect a signal in noise. However, from a fitness perspective, both signal

detection and signal interpretation are necessary for success. This type of masking is called informational masking and occurs when a signal is detected by an animal but the meaning of that signal has been lost. Few data exist on informational masking in marine mammals, but studies have shown that some recognition of predator cues might be missed by species that are preyed upon by killer whales if killer whale vocalizations are masked (Curé *et al.,* 2016; Curé *et al.,* 2015; Deecke *et al.,* 2002; Isojunno *et al.,* 2016; Visser *et al.,* 2016). Von Benda-Beckman *et al.* (2021) modeled the effect of pulsed and continuous active sonars (CAS) on sperm whale echolocation and found that sonar sounds could reduce the ability of sperm whales to find prey under certain conditions.

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 (*i.e.,* masking) sound is man-made, it may be considered harassment when disrupting natural behavioral patterns to the point where the behavior is abandoned or significantly altered. 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 anthropogenic 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) of the animal (Finneran and Branstetter, 2013; Johnson *et al.,* 1989; Southall *et al.,* 2000) or the background noise level present. Masking is most likely to affect some species' ability to detect communication calls and natural sounds (surf noise, prey noise, *etc.*) (Richardson *et al.,* 1995b; Erbe *et al.,* 2025).

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; Erbe *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; Tennessen *et al.,* 2024). Masking can be reduced in situations where the signal and noise come from different directions (Richardson *et al.,* 1995b; Erbe *et al.,* 2025), through amplitude modulation of the signal, or through other compensatory behaviors (Houser and Moore, 2014; Erbe *et al.,* 2016; Branstetter and Sills, 2022). Masking can be tested directly in captive species, 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.,* Cholewiak *et al.,* 2018; Branstetter and Sills, 2022; Branstetter *et al.,* 2024; Tennessen *et al.,* 2024).

High-frequency sounds may mask the echolocation calls of toothed whales. Human data indicate low-frequency sounds 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). Odontocete hearing is highly directional at high frequencies, facilitating echolocation in masked conditions (Au and Moore, 1984). A study by Nachtigall *et al.* (2018) 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 (*i.e.,* 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 of 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 identify 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. The potential effects of masked predator acoustic cues depend 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 anthropogenic 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 vessel or industrial site. Directional hearing may significantly reduce the masking effects of these sounds by improving the effective signal-to-noise ratio (Erbe *et al.,* 2016).

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 some of the world's

ocean from pre-industrial periods, with most of the increase from distant commercial shipping (Hildebrand, 2009; Cholewiak *et al.,* 2018). All anthropogenic sound sources, but especially chronic, continuous, and lower-frequency signals (*e.g.,* from commercial vessel traffic), contribute to elevated ambient sound levels, thus intensifying masking for marine mammals.

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 Action Proponents' LFAS/MFAS/high-frequency active sonar (HFAS) training and the Navy's testing exercises. Additionally, almost all affected species' vocal repertoires span across the frequencies of these sonar sources used by the Action Proponents. Masking by LFAS or 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 and short durations of most sonars.

As described in additional detail in the 2026 MITT Draft SEIS/OEIS, high duty-cycle or CAS have more potential to mask vocalizations. These sonars transmit more frequently (greater than 80 percent duty cycle) than traditional sonars, but typically at lower source levels. HFAS, such as pingers that operate at higher repetition rates, 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 odontocetes. Continuous noise at the same frequency of communicative vocalizations may cause disruptions to communication, social interactions, and acoustically mediated cooperative behaviors (Sørensen *et al.,* 2023) such as foraging and mating. Similarly, because the high-duty cycle or CAS includes mid-frequency sources, there is also the potential for the MF sonar signals to mask important environmental cues (*e.g.,* predator or conspecific acoustic cues), possibly affecting survivorship for targeted animals. Spatial release from masking may occur with higher duty cycle or CAS.

While there are currently few 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 LF 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).

Von Benda-Beckmann *et al.* (2021) modeled the effect of pulsed and continuous 1 to 2 kHz active sonar on sperm whale echolocation clicks and found that the presence of upper harmonics in the sonar signal increased masking of clicks produced in the search phase of foraging compared to buzz clicks produced during prey capture. Different levels of sonar caused intermittent to continuous masking (120 to 160 dB re 1 μPa^2, respectively), but varied based on click level, whale orientation, and prey target strength. CAS resulted in a greater percentage of time that echolocation clicks were masked compared to pulsed active sonar. This means that sonar sounds could reduce the ability of sperm whales to find prey under certain conditions; however, echoes from prey are most likely spatially separated from the sonar source, and so spatial release from masking would be expected.

Masking Due to Impulsive Noise—

Impulsive sound sources, including explosions, are intense and short in duration. Since impulsive noise is intermittent, the length of the gap between sounds (*i.e.,* duty-cycle) and received level are relevant when considering the potential for masking. Impulsive sounds with lower duty cycles or lower received levels are less likely to result in masking than higher duty cycles or received levels. There are no direct observations of masking in marine mammals due to exposure to explosive sources. Potential masking from explosive sounds or weapon noise is likely similar to masking studied for other impulsive sounds, such as air guns.

Masking of mysticete calls could occur due to the overlap between their low-frequency vocalizations and the dominant frequencies of impulsive sources (Castellote *et al.,* 2012; Nieukirk *et al.,* 2012). For example, blue whale feeding/social calls increased when seismic exploration was underway (Di Lorio and Clark, 2010), indicative of a possible compensatory response to masking effects of the increased noise level. However, mysticetes that call at higher rates are less likely to be masked by impulsive noise with lower duty cycles (Clark *et al.,* 2009) because of the decreased likelihood that the noise would overlap with the calls, and because of dip listening. Field observations of masking effects such as vocal modifications are difficult to interpret because when recordings indicate that call rates decline, this could be caused by (1) animals calling less frequently (*i.e.,* actual noise-induced vocal modifications), (2) the calls being masked from the recording hydrophone due to the noise (*e.g.,* animals are not calling less frequently but are being detected less frequently), or (3) the animals moving away from the noise, or any combination of these causes (Blackwell *et al.,* 2013; Cerchio *et al.,* 2014).

Masking of pinniped communication sounds at 100 Hz center frequency is possible when vocalizations occur at the same time as an air gun pulse (Sills *et al.,* 2017). This might result in some percentage of vocalizations being masked if an activity such as a seismic survey is being conducted in the vicinity, even when the sender and receiver are near one another. Release from masking due to dip listening is likely in this scenario.

While a masking effect of impulsive noise can depend on the received level

(Blackwell *et al.,* 2015) and other characteristics of the noise, the vocal response of the affected animal to masking noise is an equally important consideration for inferring overall impacts to an animal. It is possible that the receiver would increase the rate and/or level of calls to compensate for masking or, conversely, cease calling.

In general, impulsive noise has the potential to mask sounds that are biologically important for marine mammals, reducing communication space or resulting in noise-induced vocal modifications that might impact marine mammals. Masking by close-range impulsive sound sources is most likely to impact marine mammal communication.

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, NARWs 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 NARWs, 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 Glacier Bay National 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 modeled 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 *et al.,* 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 (*e.g.,* Holt *et al.,* 2009; Holt *et al.,* 2011; Gervaise *et al.,* 2012; Williams *et al.,* 2014; Hermannsen *et al.,* 2014; Papale *et al.,* 2015; Liu *et al.,* 2017).

Other Physiological Response

Physiological stress is a natural and adaptive process that helps an animal survive changing conditions. When an animal perceives a potential threat, whether or not the stimulus actually poses a threat, a stress response is triggered (Selye, 1950; Moberg, 2000; Sapolsky, 2005). Once an animal's central nervous system perceives a threat, it mounts a biological response or defense that consists of a combination of behavioral responses, autonomic nervous system responses, neuroendocrine responses, or immune responses.

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. 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'' (Selye, 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.

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 classic fight or flight response, which includes the cardiovascular system, the gastrointestinal (commonly referred to as G.I.) 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 hypothalamus-pituitary-adrenal (HPA) 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.

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, social interactions with members of the same species, and molting (for pinnipeds) 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 (*e.g.,*

fishery interactions, pollution, tourism, ocean noise) (Fair *et al.,* 2014; Meissner *et al.,* 2015; Rolland *et al.,* 2012).

Relationships between these physiological mechanisms, animal behavior, and the costs of stress responses are well-studied through controlled experiments for both laboratory and free-ranging animals (*e.g.,* 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 Acoustic and Explosives Concepts Technical Report) that our understanding of the functions of various stress hormones (*e.g.,* 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. Relatively little information exists on the linkage between anthropogenic sound exposure and stress in marine mammals, and even less information exists on the ultimate consequences of sound-induced stress responses (either acute or chronic). Most studies to date have focused on acute responses to sound either by measuring catecholamines, a neurohormone, or heart rate as a proxy for an acute stress response.

The ability to make predictions from stress hormones about impacts on individuals and populations exposed to various forms of natural and anthropogenic stressors relies on understanding the linkages between changes in stress hormones and resulting physiological impacts. Currently, the sound characteristics that correlate with specific stress responses in marine mammals are poorly understood, as are the ultimate consequences of these changes. Several research efforts have improved the understanding of, and the ability to predict, how stressors ultimately affect marine mammal populations (*e.g.,* King *et al.,* 2015; New *et al.,* 2013a; Pirotta *et al.,* 2015a; Pirotta *et al.,* 2022b). This includes determining how and to what degree various types of anthropogenic sound cause stress in marine mammals and understanding what factors may mitigate those physiological stress responses. Factors potentially affecting an animal's response to a stressor include life history, sex, age, reproductive status, overall physiological and behavioral adaptability, 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). Because there are many unknowns regarding the occurrence of acoustically induced stress responses in marine mammals, any physiological response (*e.g.,* hearing loss or injury) or significant behavioral response is assumed to be associated with a stress response.

Non-impulsive sources of sound can cause direct physiological effects including noise-induced loss of hearing sensitivity (or ''threshold shift'') or other auditory injury, nitrogen decompression, acoustically-induced bubble growth, and injury due to sound-induced acoustic resonance. Separately, an animal's behavioral response to an acoustic exposure might lead to physiological effects that might ultimately lead to injury or death, which is discussed later in the *Stranding and Mortality* section.

Heart Rate Response—

Several experimental studies have measured the heart rate response of a variety of marine mammals. For example, Miksis *et al.* (2001) observed increases in heart rates of captive 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. However, it cannot be determined whether the increase in heart rate was due to stress or social factors, such as expectation of an encounter with a known conspecific. Similarly, a young captive beluga's heart rate increased 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 had potentially habituated 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 heart rate decrease was not impacted by the sonar exposure. Similarly, Thompson *et al.* (1998) observed a rapid, short-lived decrease in heart rates in wild harbor and grey seals exposed to seismic air guns (cited in Gordon *et al.,* 2003).

Two captive harbor porpoises showed significant bradycardia (reduced heart rate), below that which occurs with diving, when they were exposed to pinger-like sounds with frequencies between 100–140 kHz (Teilmann *et al.,* 2006). The bradycardia was found only in the early noise exposures and the porpoises acclimated quickly across successive noise exposures. Elmegaard *et al.* (2021) also found that initial exposures to sonar sweeps produced bradycardia but did not elicit a startle response in captive harbor porpoises. As with Teilmann *et al.* (2006), the cardiac response disappeared over several repeat exposures suggesting rapid acclimation to the noise. In the same animals, 40-kHz noise pulses induced startle responses but without a change in heart rate. Bakkeren *et al.* (2023) found no change in the heart rate of a harbor porpoise during exposure to masking noise (⅓ octave band noise, centered frequency of 125 kHz, maximum received level of 125 dB re 1 μPa) during an echolocation task but showed significant bradycardia while blindfolded for the same task. The authors attributed the change in heart rate to sensory deprivation, although no strong conclusions about acoustic masking could be made since the animal was still able to perform the echolocation task in the presence of the masking noise. Williams *et al.* (2022) observed periods of increased heart rate variability in narwhals during seismic air gun impulse exposure, but profound bradycardia was not noted. Conversely, Williams *et al.* (2017) found that a profound bradycardia persisted in narwhals, even though exercise effort increased dramatically as part of their escape response following release from capture and handling.

Limited evidence across several different species suggests that increased heart rate might occur as part of the acute stress response of marine mammals that are at the surface. However, the decreased heart rate typical of diving marine mammals can be enhanced in response to an acute stressor, suggesting that the context of the exposure is critical to understanding the cardiac response. Furthermore, in

instances where a cardiac response was noted, there appears to be rapid habituation when repeat exposures occur. Additional research is required to understand the interaction of dive bradycardia, noise-induced cardiac responses, and the role of habituation in marine mammals.

Stress Hormone and Immune Response—

What is known about the function of the various stress hormones is based largely upon observations of the stress response in terrestrial mammals. 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 (Atkinson *et al.,* 2015). For example, due to the necessity of breath-holding while diving and foraging at depth, the physiological role of epinephrine and norepinephrine (the catecholamines) might be different in marine versus other mammals.

Catecholamines increase during breath-hold diving in seals, co-occurring with a reduction in heart rate, peripheral vasoconstriction (*i.e.,* constriction of blood vessels), and an increased reliance on anaerobic metabolism during extended dives (Hance *et al.,* 1982; Hochachka *et al.,* 1995; Hurford *et al.,* 1996); the catecholamine increase is not associated with increased heart rate, glycemic release, and increased oxygen consumption typical of terrestrial mammals. Captive 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 captive bottlenose dolphin exposed to the same sounds did not demonstrate a catecholamine response but did demonstrate a statistically significant elevation in aldosterone (Romano *et al.,* 2004); however, the increase was within the normal daily variation observed in this species (St. Aubin *et al.,* 1996) and was likely of little biological significance. Aldosterone has been speculated to not only contribute to electrolyte balance, but possibly also the maintenance of blood pressure during periods of vasoconstriction (Houser *et al.,* 2011). In marine mammals, aldosterone is thought to play a role in mediating stress (St. Aubin and Geraci, 1989).

Yang *et al.* (2021) measured cortisol concentrations in two captive bottlenose dolphins and found significantly higher concentrations after exposure to 140 dB re 1 µPa impulsive noise playbacks. Two out of six tested indicators of immune system function underwent acoustic dose-dependent changes, suggesting that repeated exposures or sustained stress response to impulsive sounds may increase an affected individual's susceptibility to pathogens. Unfortunately, absolute values of cortisol were not provided, and it is not possible from the study to tell if cortisol rose to problematic levels (*e.g.,* see normal variation and changes due to handling in Houser *et al.* (2021) and Champagne *et al.* (2018)). Exposing dolphins to a different acoustic stressor yielded contrasting results. Houser *et al.* (2020) measured cortisol and epinephrine obtained from 30 captive bottlenose dolphins exposed to simulated Navy MFAS and found no correlation between SPL and stress hormone levels, even though sound exposures were as high as 185 dB re 1 µPa. In the same experiment (Houser *et al.,* 2013b), behavioral responses were shown to increase in severity with increasing received SPLs. These results suggest that behavioral responses to sonar signals are not necessarily indicative of a hormonal stress response.

Whereas a limited amount of work has addressed the potential for acute sound exposures to produce a stress response, almost nothing is known about how chronic exposure to acoustic stressors affects stress hormones in marine mammals, particularly as it relates to survival or reproduction. In what is probably the only study of chronic noise exposure in marine mammals associating changes in a stress hormone with changes in anthropogenic noise, Rolland *et al.* (2012) compared the levels of cortisol metabolites in NARW feces collected before and after September 11, 2001. Following the events of September 11, 2001, shipping was significantly reduced in the region where fecal collections were made, and regional ocean background noise declined. Fecal cortisol metabolites significantly decreased during the period of reduced ship traffic and ocean noise (Rolland *et al.,* 2012). Rolland *et al.* (2017) also compared acute (death by vessel strike) to chronic (entanglement or live stranding) stressors in NARW and found that whales subject to chronic stressors had higher levels of glucocorticoid stress hormones (cortisol and corticosterone) than either healthy whales or those killed by ships. It was presumed that whales subjected to acute stress may have died too quickly for increases in fecal glucocorticoids to be detected.

Considerably more work has been conducted in an attempt to determine the potential effect of vessel disturbance on smaller cetaceans, particularly killer whales (Bain, 2002; Erbe, 2002; Lusseau, 2006; Noren *et al.,* 2009; Pirotta *et al.,* 2015b; Read *et al.,* 2014; Rolland *et al.,* 2012; Williams *et al.,* 2006, 2009, 2014a, 2014b). Most of these efforts focused primarily on estimates of metabolic costs associated with altered behavior or inferred consequences of boat presence and noise but did not directly measure stress hormones. However, Ayres *et al.* (2012) investigated Southern Resident killer whale fecal thyroid hormone and cortisol metabolites to assess two potential threats to the species' recovery: lack of prey (salmon) and impacts from exposure to the physical presence of vessel traffic (but without measuring vessel traffic noise). Ayres *et al.* (2012) concluded from these stress hormone measures that the lack of prey overshadowed any population-level physiological impacts on Southern Resident killer whales due to vessel traffic. Lemos *et al.* (2022) investigated the potential for vessel traffic to affect gray whales. By assessing gray whale fecal cortisol metabolites across years in which vessel traffic was variable, Lemos *et al.* (2022) found a direct relationship between the presence/density of vessel traffic and fecal cortisol metabolite levels. Unfortunately, no direct noise exposure measurements were made on any individual making it impossible to tell if other natural and anthropogenic factors could also be related to the results. Collectively, these studies indicate the difficulty in determining which factors primarily influence the secretion of stress hormones, including the separate and additive effects of vessel presence and vessel noise. While vessel presence could contribute to the variation in fecal cortisol metabolites in NARWs and gray whales, there are other potential influences on fecal hormone metabolites, so it is difficult to establish a direct link between ocean noise and fecal hormone metabolites.

Non-Auditory Injury

Non-auditory injury, or direct injury, is considered less likely to occur in the context of the Action Proponents' activities than auditory injury, and the primary anticipated source of non-auditory injury for these activities is exposure to the pressure generated by explosive detonations, which is discussed in the *Potential Effects of Explosive Sources on Marine Mammals* section below. Here, we discuss less direct non-auditory injury impacts,

including acoustically induced bubble formation, injury from sonar-induced acoustic resonance, and behaviorally mediated injury.

One theoretical cause of injury to marine mammals is rectified diffusion (Crum and Mao, 1996), the process of increasing the size of a bubble by exposing it to a sound field. This process could be facilitated if the environment in which the ensonified bubbles exist is supersaturated with gas. Repetitive diving by marine mammals can cause the blood and some tissues to accumulate gas to a greater degree than is supported by the surrounding environmental pressure (Ridgway and Howard, 1979). The deeper and longer dives of some marine mammals (for example, beaked whales) are theoretically predicted to induce greater supersaturation (Houser *et al.,* 2001b). If rectified diffusion were possible in marine mammals exposed to high-level sound, conditions of tissue supersaturation could theoretically speed the rate and increase the size of bubble growth. Subsequent effects due to tissue trauma and emboli would presumably mirror those observed in humans suffering from decompression sickness. Acoustically induced (or mediated) bubble growth and other pressure-related physiological impacts are addressed below but are not expected to result from the Action Proponents' proposed activities.

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 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 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 (Fahlman *et al.,* 2009; Fahlman *et al.,* 2014; 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 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 (*i.e.,* decompression sickness) (Jepson *et al.,* 2003; Fernandez *et al.,* 2005). 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: ''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 predicted to cause in vivo bubble formation within diving cetaceans have not been evaluated (NOAA, 2002). Jepson *et al.* (2003, 2005) and Fernandez *et al.* (2004, 2005) 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 MFAS/HFAS 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 Behaviorally Mediated Injury section (4.7.1.2) of the Acoustic and Explosives Concepts Technical Report, 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, goose-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 goose-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 goose-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 goose-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 MFAS (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 N2 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, and goose-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 N2 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 goose-beaked whales) did not imply any significantly increased risk of decompression sickness due to high levels of N2. Therefore, further information is needed to understand the relationship between exposure to stimuli, behavioral response (discussed in more detail below), elevated N2 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 MFAS 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.

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 (NOAA, 2002). They modeled and evaluated the likelihood that Navy MFAS (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 MFAS or LFAS; 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 effect 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 MFAS 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 Action Proponents' proposed activity.

Potential Effects of Explosive Sources on Marine Mammals

Explosive detonations that occur in water 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, and the potential effects of an explosive injury to marine mammals would consist of primary blast injury, which refers to injuries resulting from the compression of a body exposed to a blast wave. Blast effects are greatest at the gas-liquid interface (Landsberg, 2000) and are usually observed as barotrauma of gas-containing structures (*e.g.,* lung, gastrointestinal tract) and structural damage to the auditory system (Goertner, 1982; Greaves *et al.,* 1943; Hill, 1978; Office of the Surgeon General, 1991; Richmond *et al.,* 1973; Yelverton *et al.,* 1973). 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.

The near instantaneous high magnitude pressure change near an explosion can injure an animal where tissue material properties significantly differ from the surrounding environment, such as around air-filled cavities in the lungs or gastrointestinal tract. Large pressure changes at tissue-air interfaces in the lungs and gastrointestinal tract may cause tissue rupture, resulting in a range of injuries depending on degree of exposure. The

lungs are typically the first site to show any damage, while the solid organs (*e.g.,* liver, spleen, and kidney) are more resistant to blast injury (Clark and Ward, 1943). Odontocetes can also incur hemorrhaging in the acoustic fats in the melon and jaw (Siebert *et al.,* 2022). Recoverable injuries would include slight lung injury, such as capillary interstitial bleeding, and contusions to the gastrointestinal tract. More severe injuries, such as tissue lacerations, major hemorrhage, organ rupture, or air in the chest cavity (pneumothorax), would significantly reduce fitness and likely cause death in the wild. Rupture of the lung may also introduce air into the vascular system, producing air emboli that can cause a stroke or heart attack by restricting oxygen delivery to critical organs.

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. 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 (*i.e.,* small red or purple spots caused by bleeding in the skin), and slight hemorrhaging (Yelverton *et al.,* 1973).

Relatively little is known about auditory system trauma in marine mammals resulting from explosive exposure, although it is assumed that auditory structures would be vulnerable to blast injuries because the ears are the most sensitive to pressure and, therefore, 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). Auditory trauma was found in two humpback whales that died after the detonation of an 5,000 kg explosive used off Newfoundland during demolition of an offshore oil rig platform (Ketten *et al.,* 1993), but the proximity of the whales to the detonation was unknown. Eardrum rupture was examined in submerged terrestrial mammals exposed to underwater explosions (Richmond *et al.,* 1973; Yelverton *et al.,* 1973); however, results may not be applicable to the anatomical adaptations for underwater hearing in marine mammals given differences in impedance (Wartzok and Ketten, 1999).

In general, models predict that an animal would be less susceptible to injury near the water surface because the pressure wave reflected from the water surface would interfere with the direct path pressure wave, reducing positive pressure exposure (Goertner, 1982; Yelverton and Richmond, 1981). This is shown in the records of humans exposed to blast while in the water, which show that the gastrointestinal tract was more likely to be injured than the lungs, likely due to the shallower exposure geometry of the lungs (*i.e.,* closer to the water surface) (Lance *et al.,* 2015). Susceptibility would increase with depth, until normal lung collapse (due to increasing hydrostatic pressure) and increasing ambient pressures again reduce susceptibility (Goertner, 1982). The only known occurrence of mortality or injury to a marine mammal due to a Navy training event involving explosives occurred in March 2011 in nearshore waters off San Diego, California, at the Silver Strand Training Complex (see Strandings Associated with Explosive Use section).

Controlled tests with a variety of lab animals (*i.e.,* mice, rats, dogs, pigs, sheep, and other species) are the best data sources on actual injury to mammals due to underwater exposure to explosions. In the early 1970s, the Lovelace Foundation for Medical Education and Research conducted a series of tests in an artificial pond at Kirtland Air Force Base, New Mexico, to determine the effects of underwater explosions on mammals, with the goal of determining safe ranges for human divers. The resulting data were summarized in two reports (Richmond *et al.,* 1973; Yelverton *et al.,* 1973). Specific physiological observations for each test animal are documented in Richmond *et al.* (1973). Gas-containing internal organs, such as lungs and intestines, were the principal damage sites in submerged terrestrial mammals; this is consistent with earlier studies of mammal exposures to underwater explosions in which lungs were consistently the first areas to show damage, with less consistent damage observed in the gastrointestinal tract (Clark and Ward, 1943; Greaves *et al.,* 1943).

In the Lovelace studies, the first positive acoustic impulse was found to be the metric most related to degree of injury, and size of an animal's gas-containing cavities was thought to play a role in blast injury susceptibility. For these shallow exposures of small terrestrial mammals (masses ranging from 3.4 to 50 kg) to underwater detonations, Richmond *et al.* (1973) reported that no blast injuries were observed when exposures were less than 6 pounds per square inch per millisecond (psi-ms) (40 pascal seconds (Pa-s)), no instances of slight lung hemorrhage occurred below 20 psi-ms (140 Pa-s), and instances of no lung damage were observed in some exposures at higher levels up to 40 psi-ms (280 Pa-s). An impulse of 34 psi-ms (230 Pa-s) resulted in about 50 percent incidence of slight lung hemorrhage. About half of the animals had gastrointestinal tract contusions (with slight ulceration, *i.e.,* some perforation of the mucosal layer) at exposures of 25–27 psi-ms (170–190 Pa-s). Lung injuries were found to be slightly more prevalent than gastrointestinal tract injuries for the same exposure. The anatomical differences between the terrestrial animals used in the Lovelace tests and marine mammals are summarized in Fetherston *et al.* (2019). Goertner (1982) examined how lung cavity size would affect susceptibility to blast injury by considering both marine mammal size and depth in a bubble oscillation model of the lung; however, the Goertner (1982) model did not consider how tissues surrounding the respiratory air spaces would reflect shock wave energy or constrain oscillation (Fetherston *et al.,* 2019).

Goertner (1982) suggested a peak overpressure gastrointestinal tract injury criterion because the size of gas bubbles in the gastrointestinal tract are variable, and their oscillation period could be short relative to primary blast wave exposure duration. The potential for gastrointestinal tract injury, therefore, may not be adequately modeled by the single oscillation bubble methodology used to estimate lung injury due to impulse. Like impulse, however, high instantaneous pressures may damage

many parts of the body, but damage to the gastrointestinal tract is used as an indicator of any peak pressure-induced injury due to its vulnerability.

Because gas-containing organs are more vulnerable to primary blast injury, adaptations for diving that allow for collapse of lung tissues with depth may make animals less vulnerable to lung injury with depth. Adaptations for diving include a flexible thoracic cavity, distensible veins that can fill space as air compresses, elastic lung tissue, and resilient tracheas with interlocking cartilaginous rings that provide strength and flexibility (Ridgway, 1972). Denk *et al.* (2020) found intra-species differences in the compliance of tracheobronchial structures of post-mortem cetaceans and pinnipeds under diving hydrostatic pressures, which would affect depth of alveolar collapse. Older literature suggested complete lung collapse depths at approximately 70 m for dolphins (Ridgway and Howard, 1979) and 20–50 m for phocid seals (Falke *et al.,* 1985; Kooyman *et al.,* 1972). Follow-on work by Kooyman and Sinnett (1982), in which pulmonary shunting was studied in harbor seals and sea lions, suggested that complete lung collapse for these species would be about 170 m and about 180 m, respectively. Evidence in sea lions suggests that complete collapse might not occur until depths as great as 225 m; although the depth of collapse and depth of the dive are related, sea lions can affect the depth of lung collapse by varying the amount of air inhaled on a dive (McDonald and Ponganis, 2012). This is an important consideration for all divers who can modulate lung volume and gas exchange prior to diving via the degree of inhalation and during diving via exhalation (Fahlman *et al.,* 2009); indeed, there are noted differences in pre-dive respiratory behavior, with some marine mammals exhibiting pre-dive exhalation to reduce the lung volume (*e.g.,* phocid seals) (Kooyman *et al.,* 1973).

Further Potential Effects of Behavioral Disturbance on Marine Mammal Fitness

The different ways in which 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. The long-term consequences of disturbance, hearing loss, chronic masking, and acute or chronic physiological stress are difficult to predict because of the different factors experienced by individual animals, such as context of stressor exposure, underlying health conditions, and other environmental or anthropogenic stressors. Linking these non-lethal effects on individuals to changes in population growth rates requires long-term data, which is lacking for many populations. We summarize several studies below, but 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; 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.

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 (*i.e.,* 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.

An important variable to consider is duration of disturbance. Severity scales used to assess behavioral responses of marine mammals to acute sound exposures are not appropriate to apply to sustained or chronic exposures, which requires considering the health of a population over time rather than a focus on immediate impacts to individuals (Southall *et al.,* 2021). For example, short-term costs experienced over the course of a week by an otherwise healthy individual may be recouped over time after exposure to the stressor ends. These short-term costs would be unlikely to result in long-term consequences to that individual or to that individual's population. Comparatively, long-term costs accumulated by otherwise healthy individuals over an entire season, year, or throughout a life stage (*e.g.,* pup, juvenile, adult) would be less easily recouped and more likely to result in long-term consequences to that individual or population.

Marine mammals exposed to frequent or intense anthropogenic activities may leave the area, habituate to the activity, or tolerate the disturbance and remain in the area (Wartzok *et al.,* 2003). Highly resident or localized populations may also stay in an area of disturbance because the cost of displacement is higher than the cost of remaining in the area (Forney *et al.,* 2017). As such, an apparent lack of response (*e.g.,* no displacement or avoidance of a sound source) does not necessarily indicate 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 the consequences of stress, masking, or hearing loss (Forney *et al.,* 2017).

Longer term displacement can lead to changes in abundance or distribution patterns of the species in the affected region (Bejder *et al.,* 2006b; Blackwell *et al.,* 2004; Teilmann *et al.,* 2006). For example, gray whales in Baja California, Mexico, abandoned a historical breeding lagoon in the mid-1960s due to an increase in dredging and commercial shipping operations, and only repopulated the lagoon after shipping activities had ceased for several years (Bryant *et al.,* 1984). Mysticetes in the northeast tended to adjust to vessel traffic over several years, trending towards more neutral behavioral responses to passing vessels, indicating that some animals may habituate to high levels of human activity. A study on bottlenose dolphin responses to vessel approaches found that lesser responses in populations of dolphins regularly subjected to high levels of vessel traffic could be a sign of habituation, or it could be that the more sensitive animals in this population previously abandoned the area of higher human activity (Bejder *et al.,* 2006a).

Population characteristics (*e.g.,* whether a population is open or closed to immigration and emigration) can influence sensitivity to disturbance as well; closed populations could not withstand a higher probability of disturbance compared to open populations with no limitation on food (New *et al.,* 2020). Predicting population trends or long-term displacement patterns due to anthropogenic disturbance is challenging due to limited information and survey data for many species over sufficient spatiotemporal scales, as well as a full understanding of how other factors, such as oceanographic oscillations, affect marine mammal presence (Moore and Barlow, 2013; Barlow, 2016; Moore and Barlow, 2017).

Population models are necessary to understand and link short-term effects to individuals from disturbance (anthropogenic impacts or environmental change) to long-term population consequences. Population models require inputs for the population size and changes in vital rates of the population (*e.g.,* the mean values for survival age, lifetime reproductive success, recruitment of new individuals into the population), to predict changes in population dynamics (*e.g.,* population growth rate). These efforts often rely on bioenergetic models, or energy budget models, which analyze energy intake from food and energy costs for life functions, such as maintenance, growth, and reproduction, either at the individual or population level (Pirotta, 2022), and model sensitivity analyses have identified the most consequential parameters, including prey characteristics, feeding processes, energy expenditure, body size, energy storage, and lactation capability (Pirotta, 2022). However, there is a high level of uncertainty around many parameters in these models (Hütt *et al.,* 2023).

The U.S. National Research Council (NRC) committee on Characterizing Biologically Significant Marine Mammal Behavior developed an initial conceptual model to link acoustic disturbance to population effects and inform data and research needs (NRC, 2005). This Population Consequences of Acoustic Disturbance, or PCAD, conceptual model linked the parameters of sound exposure, behavior change, life function immediately affected, vital rates, and population effects. In its report, the committee found that the relationships between vital rates and population effects were relatively well understood, but that the relationships between the other components of the model were not well-known or easily observed.

Following the PCAD framework (NRC, 2005), an ONR working group developed the Potential Consequences of Disturbance (PCoD), outlining an updated conceptual model of the relationships linking disturbance to changes in behavior and physiology, health, vital rates, and population dynamics. The PCoD model considers all types of disturbance, not solely anthropogenic or acoustic, and incorporates physiological changes, such as stress or injury, along with behavioral changes as a direct result of disturbance (National Academies of Sciences Engineering and Medicine, 2017). 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; Pirotta *et al.,* 2018a). 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, NARWs, *Ziphiidae* 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 models 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.* (2018a); California sea lion, McHuron *et al.* (2018b); and blue whale, Pirotta, *et al.* (2018b)).

The PCoD model identifies the types of data that would be needed to assess population-level impacts. These data are lacking for many marine mammal species (Booth *et al.,* 2020). Southall *et al.* (2021) states that future modeling and population simulation studies can help determine population-wide long-term consequences and impact analysis. However, the method to do so is still developing, as there are gaps in the literature, possible sampling biases, and results are rarely ground-truthed, with a few exceptions (Booth *et al.,* 2022; Schwarz *et al.,* 2022). Nowacek *et al.* (2016) reviewed technologies such as PAM, tagging, and the use of unmanned aerial vehicles which can improve scientists' abilities to study these model inputs and link behavioral changes to individual life functions and ultimately population-level effects. Relevant data needed for improving analyses of population-level consequences resulting from disturbances will continue to be collected during the 7-year period of the LOAs through projects funded by the Navy's Marine Species Monitoring Program. Multiple case studies across marine mammal taxonomic groups have been conducted following the PCoD framework. From these studies, Keen *et al.* (2021) identified themes and contextual factors relevant to assessing impacts to populations due to disturbance, which have been considered in the context of the impacts of the Action Proponents' activities.

A population's movement ecology determines the potential for spatiotemporal overlap with a disturbance. Resident populations or populations that rely on spatially limited habitats for critical life functions (*i.e.,* foraging, breeding) would be at greater risk of repeated or chronic exposure to disturbances than populations that are wide-ranging

relative to the footprint of a disturbance (Keen *et al.,* 2021). Even for the same species, differences in habitat use between populations can result in different potential for repeated exposure to individuals for a similar stressor (Costa *et al.,* 2016a). The location and radius of disturbance can impact how many animals are exposed and for how long (Costa *et al.,* 2016b). While some models have shown the advantages of populations with larger ranges, namely the decreased chance of being exposed (Costa *et al.,* 2016b), it is important to consider that for some species, the energetic cost of a longer migration could make a population more sensitive to energy lost through disturbance (Villegas-Amtmann *et al.,* 2017). In addition to ranging patterns, a species' activity budgets and lunging rates can cause variability in their predicted cost of disturbance as well (Pirotta *et al.,* 2021).

Bioenergetics frameworks that examine the impact of foraging disruption on body reserves of individual whales found that rates of daily foraging disruption can predict the number of days to terminal starvation for various life stages (Farmer *et al.,* 2018b). Similarly, when a population is displaced by a stressor, and only has access to areas of poor habitat quality (*i.e.,* low prey abundance) for relocation, bioenergetic models may be more likely to predict starvation, longer recovery times, or extinction (Hin *et al.,* 2023). There is some debate over the use of blubber thickness as a metric of cetacean energy stores and health, as marine mammals may not use their fat stores in a similar manner to terrestrial mammals (Derous *et al.,* 2020).

Resource limitation can impact marine mammal population growth rate regardless of additional anthropogenic disturbance. Stochastic Dynamic Programming models have been used to explore the impact declining prey species has on focal marine mammal predators (McHuron *et al.,* 2023a; McHuron *et al.,* 2023b). A Stochastic Dynamic Programming model determined that a decrease in walleye pollock (*Gadus chalcogrammus*) availability increased the time and distance northern fur seal mothers had to travel offshore, which negatively impacted pup growth rate and wean mass, despite attempts to compensate with longer recovery time on land (McHuron *et al.,* 2023b). Prey is an important factor in long-term consequence models for many species of marine mammals. In disturbance models that predict habitat displacement or otherwise reduced foraging opportunities, populations are being deprived of energy dense prey or high quality areas which can lead to long-term impacts on fecundity and survival (Czapanskiy *et al.,* 2021; Hin *et al.,* 2019; McHuron *et al.,* 2023a; New *et al.,* 2013b). Prey density limits the energy available for growth, reproduction, and survival. Some disturbance models indicate that the immediate decrease in a portion of the population (*e.g.,* young lactating mothers) is not necessarily detrimental to a population, since as a result, prey availability increases and the population's overall improved body condition reduces the age at first calf (Hin *et al.,* 2021). The timing of a disturbance with seasonally available resources is also important; if a disturbance occurs during periods of low resource availability, the population-level consequences are greater and occur faster than if the disturbance occurs during periods when resource levels are high (Hin *et al.,* 2019). Further, when resources are not evenly distributed, populations with cautious strategies and knowledge of resource variation have an advantage (Pirotta *et al.,* 2020).

Even when modeled alongside several anthropogenic sources of disturbance (*e.g.,* vessel strike, vessel noise, chemical contaminants, sonar), several species of marine mammals are most influenced by lack of prey (Czapanskiy *et al.,* 2021; Murray *et al.,* 2021). Some species like killer whales are especially sensitive to prey abundance due to their limited diet (Murray *et al.,* 2021). The short-term energetic cost of 11 species of cetaceans and mysticetes exposed to MFAS was influenced more by lost foraging opportunities than increased locomotor effort during avoidance (Czapanskiy *et al.,* 2021). Additionally, the model found that mysticetes incurred more energetic cost than odontocetes, even during mild behavioral responses to sonar. These results may be useful in the development of future Population Consequences of Multiple Stressors and PCoD models since they should seek to qualify cetacean health in a more ecologically relevant manner.

PCoD models have been used to assess the impacts of multiple and recurring stressors. A marine mammal population that is already subject to chronic stressors will likely be more vulnerable to acute disturbances. Models that have looked at populations of cetaceans who are exposed to multiple stressors over several years have found that even one major chronic stressor (*e.g.,* epizootic disease, oil spill) has severe impacts on population size. A layer of one or more stressor (*e.g.,* seismic surveys) in addition to a chronic stressor (*e.g.,* an oil spill) can yield devastating impacts on a population. These results may vary based on species and location, as one population may be more impacted by chronic shipping noise, while another population may not. However, just because a population does not appear to be impacted by one chronic stressor (*e.g.,* shipping noise), does not mean they are not affected by others (*e.g.,* disease) (Reed *et al.,* 2020). Recurring or chronic stressors can impact population abundance even when instances of disturbance are short and have minimal behavioral impact on an individual (Farmer *et al.,* 2018a; McHuron *et al.,* 2018b; Pirotta *et al.,* 2019). Some changes to response variables like pup recruitment (survival to age one) are not noticeable for several years, as the impacts on pup survival does not affect the population until those pups are mature but impacts to young animals will ultimately lead to population-wide declines. The severity of the repeated disturbance can also impact a population's long-term reproductive success. Scenarios with severe repeated disturbance (*e.g.,* 95 percent probability of exposure, with 95 percent reduction in feeding efficiency) can severely reduce fecundity and calf survival, while a weaker disturbance (25 percent probability of exposure, with 25 percent reduction in feeding efficiency) had no population-wide effect on vital rates (Pirotta *et al.,* 2019).

Farmer *et al.* (2018a) modeled how an oil spill led to chronic declines in a sperm whale population over 10 years, and if models included even one more stressor (*i.e.,* behavioral responses to air guns), the population declined even further. However, the amount of additional population decline due to acoustic disturbance depended on the way the dose-response of the noise levels were modeled. A single step-function led to higher impacts than a function with multiple steps and frequency weighting. In addition, the amount of impact from both disturbances was mediated when the metric in the model that described animal resilience was changed to increase resilience to disturbance (*e.g.,* able to make up reserves through increased foraging).

Not all stressors have the same impact for all species and all locations. Another model analyzed the effect of a number of chronic disturbances on two bottlenose dolphin populations in Australia over 5 years (Reed *et al.,* 2020). Results indicated that disturbance from fisheries interactions and shipping noise had little overall impact on population abundances in

either location, even in the most extreme impact scenarios modeled. At least in this area, other factors (*e.g.,* epizootic scenarios) had the largest impact on population size and fecundity.

Recurring stressors can impact population abundance even when individual instances of disturbance are short and have minimal behavioral impact on an individual. A model on California sea lions introduced a generalized disturbance at different times throughout the breeding cycle, with their behavior response being an increase in the duration of a foraging trip by the female (McHuron *et al.,* 2018a). Very short duration disturbances or responses led to little change, particularly if the disturbance was a single event, and changes in the timing of the event in the year had little effect. However, with even relatively short disturbances or mild responses, when a disturbance was modeled as recurring there were resulting reductions in population size and pup recruitment (survival to age one). Often, the effects were not noticeable for several years, as the impacts on pup survival did not affect the population until those pups were mature.

Stranding and Mortality

The definition for a stranding under title IV of the MMPA is an event in the wild in which (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 16 U.S.C. 1421h(6)). 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, vessel 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 (*e.g.,* Odell *et al.,* 1980), 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 2018).

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 Fair and Becker, 2000; 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 are 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.,* 2023; 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.,* 2016). 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 2006–2025, there were over 32,600 cetacean strandings (P. Onens, NMFS, *pers comm.,* August 2026). 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 can be found in the Acoustic and Explosives Concepts Technical Report and in the Navy's Technical Report on Marine Mammal Strandings Associated with U.S. Navy Sonar Activities (U.S. Department of the Navy, 2017a).

Worldwide, there have been several efforts to identify relationships between cetacean mass stranding events and military active sonar (Cox *et al.,* 2006; Hildebrand, 2004; Taylor *et al.,* 2004). 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 goose-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 goose-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 (Norman *et al.,* 2004; Wright *et al.,* 2013) and common dolphin (Jepson *et al.,* 2013).

Strandings Associated With Active Sonar

Over the past 21 years, there have been five stranding events coincident with naval MFAS 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. Department of the Navy, 2017a). These 5 mass strandings have resulted in about 40 known cetacean deaths consisting mostly of beaked whales and with close linkages to MFAS 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 exercises, between 150 and 200 usually pelagic melon-headed whales occupied the shallow waters of Hanalei Bay, Kaua'i, 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 (*i.e.,* 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 multibeam 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 MFAS use and a limited 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 goose-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 1 µPa, 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, 2005). 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, 2005). 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 goose-beaked whales in the Kyparissiakos Gulf (first one in historical records), the probability for the two events (the military exercises and the strandings) to coincide in time and location, while being independent of each other, was thought to be extremely low (Frantzis, 1998). However, because full necropsies had not been conducted, and no abnormalities were noted, the cause of the strandings could not be precisely determined (Cox *et al.,* 2006). A Bioacoustics Panel convened by NATO concluded that the evidence available did not allow them to accept or reject sonar exposures as a causal agent in these stranding events. The analysis of this stranding event provided support for, but no clear evidence for, the cause-and-effect relationship of tactical sonar training activities and beaked whale strandings (Cox *et al.,* 2006).

Bahamas (2000)—

NMFS and the Navy prepared a joint report addressing the multi-species stranding in the Bahamas in 2000, which took place within 24 hours of U.S. Navy ships using MFAS as they passed through the Northeast and Northwest Providence Channels on March 15–16, 2000. The ships, which operated both AN/SQS–53C and AN/SQS–56 sonar, moved through the channel while emitting pings approximately every 24 seconds. Of the 17 cetaceans that stranded over a 36-hour period (goose-beaked whales, Blainville's beaked whales, minke whales, and a spotted dolphin), 7 animals died on the beach (5 goose-beaked whales, 1 Blainville's beaked whale, and 1 spotted dolphin), while the other 10 were returned to the water alive (though their ultimate fate is unknown). As discussed in the Bahamas report (U.S. Department of Commerce and U.S. Department of the Navy, 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, vessel 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 fatty structure in the forehead of odontocetes).

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 did 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 goose-beaked whales were found 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 (Ketten, 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 postmortem (Ketten, 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 intracochlear 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, and the cranial sinuses and airways were found to be clear with little or no fluid deposition, which may indicate good preservation of tissues.

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.

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 1,000 m depth near a shoreline where there is a rapid change in bathymetry on the order of 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 65 km and at least 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 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 the Exploration of the Sea, 2005). 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 3 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 4 hours after the onset of MFAS activity (International Council for the Exploration of the Sea, 2005; Fernandez *et al.,* 2005).

Eight goose-beaked whales, one Blainville's beaked whale, and one Gervais' beaked whale were necropsied, six of them within 12 hours of stranding (Fernandez *et al.,* 2005). No pathogenic bacteria were isolated from the carcasses (Jepson *et al.,* 2003). The animals displayed severe vascular congestion and hemorrhage especially around the tissues in the jaw, ears, brain, and kidneys, displaying marked disseminated microvascular hemorrhages associated with widespread fat emboli (Jepson *et al.,* 2003; International Council for the Exploration of the Sea, 2005). 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, Kaua'i, Hawaii for over 28 hours.

Attendees of a canoe blessing observed the animals entering Hanalei 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 Hanalei Bay on the afternoon of July 4, 2004, and was found dead in Hanalei 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 Hanalei 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 (Southall *et al.,* 2006). 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 (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 Bay event was spatially and temporally correlated with the Rim of the Pacific Exercise (RIMPAC). Official sonar training and tracking exercises in the PMRF warning area did not commence until approximately 8 a.m. on July 3 and were thus ruled out as a possible trigger for the initial movement into the bay. However, six naval surface vessels transiting to the operational area on July 2 intermittently transmitted active sonar (for approximately 9 hours total from 1:15 p.m. to 12:30 a.m.) as they approached from the south. The potential for these transmissions to have triggered the whales' movement into Hanalei Bay was investigated. Analyses with the information available indicated that animals to the south and east of Kaua'i could have detected active sonar transmissions on July 2 and reached Hanalei Bay on or before 7 a.m. on July 3. However, data limitations regarding the position of the whales prior to their arrival in Hanalei 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 Hanalei Bay. If the animals responded negatively to these signals, it may have contributed to their continued presence in Hanalei 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 Hanalei 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 Kaua'i; (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 Hanalei 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, 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, though they later died. Two other whales were discovered during the day

on January 27 but had already died. The first three animals were located near the town of 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 93 km of the stranding site.

Veterinary pathologists necropsied the two male and two female goose-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 1,000 m depth near a shoreline where there is a rapid change in bathymetry on the order of 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).

Honaunau Bay (2022)—

On March 25, 2022, a beaked whale (species unknown) stranded in Honaunau Bay, Hawaii. The animal was observed swimming into shore and over rocks. Bystanders intervened to turn the animal off of the rocks, and it swam back out of Honaunau Bay on its own. Locals reported hearing a siren or alarm type of sound underwater on the same day, and a Navy vessel was observed from shore on the following day. The Navy confirmed it used CAS within 50 km and 48 hours of the time of stranding, though the stranding has not been definitively linked to the Navy's CAS use, and there is no evidence to determine whether the animal had any further short- or long-term effects.

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 *et al.,* 2006), may respond to active sonar by swimming into shallow waters to avoid further exposures and strand if they are 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.* (2006) found that slow ascent rates from deep dives and long periods of time spent within 50 m of the surface were typical for both goose-beaked 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 MFAS 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 (*e.g.,* 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 (*i.e.,* 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.* (2001b) 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 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 goose-beaked whale), perhaps as a consequence of an extended avoidance response 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) 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.,* 2010). 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.

Additional predictive modeling conducted to date has been performed with many unknowns about the respiratory physiology of deep-diving breath-hold animals. For example, Denk *et al.* (2020) found intra-species differences in the compliance of tracheobronchial structures of post-mortem cetaceans and pinnipeds under diving hydrostatic pressures, which would affect depth of alveolar collapse. Although, as hypothesized by Garcia Parraga *et al.* (2018) and reviewed in Fahlman *et al.* (2021), mechanisms may exist that allow marine mammals to create a pulmonary shunt without the need for hydrostatic pressure-induced lung collapse (*i.e.,* by varying perfusion to the lung independent of lung collapse and degree of ventilation). If such a mechanism exists, then assumptions in prior gas models require reconsideration, the degree of nitrogen gas accumulation associated with dive profiles needs to be re-evaluated, and behavioral responses potentially leading to a destabilization of the relationship between pulmonary ventilation and perfusion should be considered. Costidis and Rommel (2016) suggested that gas exchange may continue to occur across the tissues of air-filled sinuses in deep diving odontocetes below the depth of lung collapse if hydrostatic pressures are high enough to drive gas exchange across into non-capillary veins.

If marine mammals respond to an Action Proponent 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 Action Proponent vessels are approaching them directly, because a direct approach may convey detection and intent to capture (Burger and Gochfeld, 1981, 1990; Cooper, 1997; Cooper, 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 ringed seals (Born *et al.,* 1999), Pacific brant (*Branta bernicla 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 Non-Auditory 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 responses (*e.g.,* 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 Associated With Explosive Use

Silver Strand (2011)—

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 640.1-m exclusion zone around the explosive charge, monitored by personnel in a safety boat and participants in a dive boat. Approximately 5 minutes remained on a time-delay fuse connected to a single 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. The Navy recovered those animals and transferred them to the local stranding network for necropsy. 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. Upon necropsy, all four animals were found to have sustained typical mammalian primary blast injuries (Danil and St. Leger, 2011). 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 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 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 (2011)—

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.

Strandings in the Study Area

Although records of marine mammal strandings exist as far back as 1878 in Guam, reporting of marine mammal strandings across the Mariana Islands has likely only become consistent in recent years. A variety of marine mammals have historically stranded in the Study Area and have been documented by agencies such as the Department of Lands and Natural Resources Division of Fish and Wildlife and by the Department of Agriculture Division of Aquatic and Wildlife Resources. NMFS' National Marine Mammal Stranding Database documents the following identified stranded animals in the Study Area through 2025:

- Bottlenose dolphin: One (2013)
- Bryde's whale: One (2014)
- Dwarf sperm whale: Four (1970, 1971, 1974, 2002)
- False killer whale: Three (2007, 2019, 2020)
- Fraser's dolphin: One (2021)
- Melon-headed whale: Two (1980, 2015)
- Pantropical spotted dolphin: Two (2009, 2021)
- Pygmy sperm whale: Two (1989, 1989)
- Short-finned pilot whale: Two (1980, 2025)
- Sperm whale: Six (1993, 2011, 2011, 2012, 2013, 2020)
- Spinner dolphin: Six (1993, 1994, 2007, 2019, 2021, 2024)
- Striped dolphin: One (1985)
- Goose-beaked whales: Nine (2007, 2008, 2011, 2011, 2012, 2015, 2015, 2016, 2019). A review of Navy records indicated that sonar use occurred within 72 hours or 148.2 km of three of these stranding events (2011, 2015, 2016) (C. Johnson, Navy, *pers. comm.* 2019).

In February 2020, Simonis *et al.* (2020) published a study titled ''Co-occurrence of beaked whale strandings and naval sonar in the Mariana Islands, Western Pacific.'' The authors compiled publicly available information regarding Navy training exercises from 2006–2019 (from press releases, *etc.*) and PAM data indicating sonar use that they collected at two locations on high-frequency acoustic recording packages (HARPs) over a shorter period of time and compared it to the dates of beaked whale strandings. Using this data, they reported that 6 of the 10 goose-beaked whales, from 4 of 8 events, stranded during or within 6 days of a naval ASW exercise using sonar. In a note to the article, the authors acknowledged additional information provided by the Navy while Simonis *et al.* (2020) was in press that one of the strandings occurred 1 day prior to sonar transmissions and should not be considered coincident with sonar. The authors' analysis examined the probability that the remaining three of eight random days would fall during, or within 6 days after, a naval event (utilizing the Navy training events and sonar detections of which the authors were aware). Their results indicated that the probability that three of eight stranding events were randomly associated with naval sonar was 1 percent.

The authors did not have access to the Navy's classified data (in the Note added to the article, Simonis *et al.* (2020) stated the Navy was working with NMFS to make the broader classified dataset available for further statistical analysis). Later reporting by the Navy indicated there were more than three times as many sonar days in the Marianas during the designated time period than Simonis *et al.* (2020) reported. Primarily for this reason, the Navy tasked the Center for Naval Analysis (CNA) with repeating the statistical examination of Simonis *et al.* (2020) using the full classified sonar record, including vessel movement information to document the precise times and locations of Navy sonar use throughout the time period of consideration (2006–2019).

CNA re-evaluated the relationship between the strandings and sonar activities using the entire classified data set in two ways. First, from their sonar database, CNA tabulated the number of sonar days for use in their analysis. The total number of sonar days from the classified database was 923 (approximately 19.5 percent of all days in the study timeframe). In comparison, Simonis *et al.* (2020) assumed only 293 days of sonar (approximately 6.1 percent of all days in the study timeframe). CNA conducted re-constructions for each stranding event to determine/confirm if Navy sonar use coincided in time and space with each stranding location. The Navy extended the analysis through the entire year of 2019 to capture both sonar use and stranding events. As a result, the CNA analysis included consideration of the November 2019 stranding of a single beaked whale on Rota, which was not addressed in Simonis *et al.* (2020).

NMFS uses a distance of 148.2 km in ITRs for military readiness activities to evaluate strandings in the context of MTEs although, of note, none of the Marianas stranding events occurred during an MTE. All strandings reported to have been coincident with sonar use in Simonis *et al.* (2020), as well as the additional stranding that occurred while Simonis *et al.* was in press, were confirmed to be coincident by CNA analysis (*i.e.,* within 148.2 km) and, for the first analysis, CNA examined the four strandings in relation to the total sonar days throughout the Study Area recorded in the classified data set. Based on the calculations conducted by CNA, when the analysis is conducted consistent with the Simonis *et al.* (2020) assumptions (*i.e.,* without considering proximity of sonar to strandings in counting sonar days), but with consideration of the accurate number of sonar days from the classified record and the additional stranding at Rota, the analysis suggests that the probability that four of nine stranding events were randomly associated with naval events is 10 percent, which the Navy interpreted as insufficient evidence, at $p<0.10$ threshold level, to claim a

relationship between sonar use and stranding in the Mariana Islands.

For the second CNA analysis, the same four coincident strandings were considered, but only sonar use within 148.2 km from a stranding location would be considered as possibly influencing a potential stranding event and, therefore, included in the sonar days for this analysis. This analysis resulted in the calculations being performed separately for Guam, Rota, and Saipan.

When the analysis was conducted specifically for Guam including only those sonar days within 148.2 km, the results suggested that the probability that the strandings were randomly associated with sonar was notably higher, at 26 percent (p=0.26). This is notable because this location had the highest number of overall stranding events (n=7), coincident stranding events (n=2), and sonar days (n=681) of all the locations within the Mariana Islands. The probability values for Saipan and Rota (p=0.06 and 0.14, respectively) should be viewed with caution given that statistical analyses considering single data points (*i.e.,* one stranding each) have low power and high uncertainty and, similarly, the Navy reported insufficient evidence to claim a relationship (p<0.05 and 0.10, respectively) between sonar use and strandings. NMFS has evaluated the Navy's analysis and results along with the analysis and results of Simonis *et al.* (2020) and has determined that both analyses are appropriate to consider in NMFS' assessment of whether beaked whale mortality is reasonably likely to occur as a result of the Navy's activities described in this 7-year rule.

Standard statistical significance thresholds of 0.05 and 0.1 are often used in the interpretation of the results of statistical tests, and the Navy stated that their results show that the data showing the relationship between sonar and stranding are not statistically significant and do not allow one to rule out a null hypothesis that there is no relationship. NMFS consulted guidance from the American Statistical Association, which cautions against strict interpretations of *p*-values and notes that ''researchers should bring many contextual factors into play to derive scientific inferences, including the design of a study, the quality of the measurements, the external evidence for the phenomenon under study, and the validity of assumptions that underlie the data analysis. Pragmatic considerations often require binary, 'yes-no' decisions, but this does not mean that *p*-values alone can ensure that a decision is correct or incorrect.'' Separately, we also note that the Navy strove to use identical methods as Simonis *et al.* (2020) to conduct their analysis. A miscommunication resulted in the Navy initially using a Poisson distribution, while Simonis *et al.* (2020) used a permutation test; however, additional tests were run to ensure an appropriate comparison. The tests were consistent and the results are reflected in the discussion above. Last, we note that correlation does not equate to causation.

In addition to examining the correlation (or lack thereof) of activities with strandings, necropsies of stranded animals can provide insight into the potential cause of death. The number of strandings that can be thoroughly investigated through necropsy, sample collection, and advanced diagnostics is limited to animals that are not returned to the sea and those that are found and accessible prior to extensive decomposition. In the case of beaked whale strandings that occurred in the Study Area during this time period, necropsy examinations were performed and high quality tissue samples were collected from three live-stranded or fresh dead individuals: (1) one of the whales from the August 2011 Saipan stranding; (2) the single whale from the March 2015 Guam stranding; and (3) the single whale from the January 2019 Guam stranding. Of these, only the 2011 and 2015 events were coincident with the use of Navy sonar.

None of the three beaked whales from the Mariana Islands had evidence of gas bubble formation in the organs examined grossly and histologically. Stranding response staff from the University of Hawaii conducted the examinations and compared the results to the diagnostic features of gas and fat embolic syndrome described by Bernaldo de Quiros *et al.* (2019). Bernaldo de Quiros *et al.* (2019) established that, to date, strandings which have a confirmed association with naval exercise have exhibited all seven of the following diagnostic features:

1. Individual or multiple animals stranded within hours or a few days of an exercise in good body condition;

2. Food remnants in the first gastric compartment ranging from undigested food to squid beaks;

3. Abundant gas bubbles widely distributed in veins (subcutaneous, mesenteric, portal, coronary, subarachnoid veins, *etc.*) composed primarily of nitrogen (N2) in fresh carcasses;

4. Gross subarachnoid and/or acoustic fat hemorrhages;

5. Microscopic multi-organ gas and fat emboli associated with bronchopulmonary shock;

6. Diffuse, mild to moderate, acute, monophasic myonecrosis (hyaline degeneration) with ''disintegration'' of the interstitial connective tissue and related structures, including fat deposits, and their replacement by amorphous hyaline material (degraded material) in fresh and well preserved carcasses; and

7. Multi-organ microscopic hemorrhages of varying severity in lipid-rich tissues such as the central nervous system, spinal cord, and the coronary and kidney fat when present.

Results from the necropsies for the 2011 and 2015 stranded animals indicate that they only exhibited one to three of the diagnostic features, but not all seven. Additionally, the necropsy results from both animals indicated severe parasite infestations. The 2015 specimen also had indication of myocardial fibrosis which could have impacted cardiac function. Results for the January 2019 Guam animal, which was a stranding that was not coincident with sonar, indicated that it exhibited up to three [2] of the seven diagnostic features. Overall, the results of these necropsies appear to align with evidence from single beaked whale strandings in the Canary Islands between 2002 and 2015 (n=45) which stranded with no known correlation in space or time with active sonar. These individuals had one or more diagnostic features of gas and fat embolic syndrome for beaked whales stranded in association with MFAS exercises, but not all seven (Bernaldo de Quiros *et al.,* 2019). NMFS acknowledges that situations could potentially occur in which beaked whales might strand as a result of sonar exposure and not exhibit all seven of the features of gas and fat embolic syndrome described above; however, taken as a whole, these necropsy and histopathology results do not support a conclusion that the 2011 and 2015 strandings resulted from exposure to naval sonar. Furthermore, the role of natural stressors or other non-Navy factors as they affect beaked

[2] One of the diagnostic features is ''individual or multiple animals stranded within hours or a few days of an exercise in good body condition,'' however, Bernaldo de Quiros *et al.* (2019) does not specify if the stranding had to occur after an exercise in which sonar use occurred though, presumably, it does since it investigated sonar's ability to cause strandings. The 2019 animal stranded close in time to the outset of a Navy training event; however, sonar use did not occur until the day after the stranding. Therefore, this event is not considered coincident, but due to the ambiguity in the description of this diagnostic factor, the 2019 stranding is conservatively assumed to be positive for this factor.

whale strandings is not understood. The majority of strandings in the Study Area occurred without the presence of Navy sonar.

NMFS has acknowledged it is possible for naval activities using hull-mounted tactical sonar to contribute to the death of marine mammals in certain circumstances via strandings resulting from behaviorally mediated physiological impacts or other gas-related injuries. Above, NMFS discussed these potential causes and outlined the few cases where active naval sonar (in the United States or, largely, elsewhere) had either potentially contributed to or (as with the Bahamas example) been more definitively causally linked with marine mammal mass strandings (more than two animals). There have been no documented mass strandings of beaked whales in the Marianas since stranding data was collected, and the first beaked whale stranding was documented in 2007, while the Navy has been using sonar in the Marianas since the 1960s. As also noted previously, there are a suite of factors that have been associated with the specific cases of strandings directly causally associated with sonar (steep bathymetry, multiple hull-mounted platforms using sonar simultaneously, constricted channels, strong surface ducts, *etc.*) that are not present together in the Study Area and during the specified activities (and which the Navy takes care across the world not to operate under without additional monitoring).

While the results of Simonis *et al.* (2020) and the fuller CNA analysis both suggest (the latter to a notably lesser degree) that it is more probable than not that there was some form of non-random relationship between sonar days and strandings in the Marianas during this period of time, the results of the Navy analysis (using the full dataset) allow, statistically, that the strandings and sonar use may not be related. Given the uncertainties and assumptions inherent in these correlation analyses, the small sample size (in terms of the strandings), and the fact that correlation does not equate to causation, these results, alone, do not indicate a reasonable likelihood that the Navy's proposed activities will result in serious injury or mortality of beaked whales. Further, the necropsies of the two animals stranded in the Study Area in 2011 and 2015 do not support a conclusion that these strandings resulted from exposure to naval sonar. NMFS considered this information in combination with the absence of mass beaked whale strandings in the Study Area and the absence of beaked whale strandings coinciding with any MTEs, despite Navy sonar training activity in the area since the 1960s, and NMFS has preliminarily concluded that serious injury or mortality of beaked whales is unlikely to result from the Navy activities covered under this 7-year rule.

Further, a growing body of research describes the emergence of new pathogens within Pacific Island odontocetes, including beaked whales (Clifton *et al.,* 2023; Silva-Krott *et al.,* 2025; West *et al.,* 2013; West *et al.,* 2021). Infectious disease has been reported as a significant pathological finding in 62 percent of cetaceans necropsied in the Pacific Islands between 2006 and 2024 (West *et al.,* in press). Beaked whale morbillivirus (BWMV) was first identified from a stranded Longman's beaked whale in Hawaii (West *et al.,* 2013) and, since that time, BWMV has been identified from archived Hawaiian stranding samples (Jacob *et al.,* 2016; West *et al.,* 2015; West *et al.,* 2024).

On a global scale, the first cetacean circovirus was identified in a stranded Hawaiian whale (Landrau-Giovannetti *et al.,* 2020) and Navy-funded research has since detected circovirus in archival tissues from 10 additional species previously stranded in Hawaii, Saipan, and American Samoa (Clifton *et al.,* 2023). Additionally, novel cetacean herpes virus from this region has been identified (West *et al.,* 2013; Waltzek, unpublished data). This research has included reports of other pathogens that threaten Pacific Islands cetaceans, including the fungal disease *Cryptococcus gatti* in a spinner dolphin (Rotstein *et al.,* 2010) and the discovery of lobomycosis-like disease for the first time in the central Pacific (West *et al.,* in press). Brucella cases include a neonate sperm whale co-infected with morbillivirus (West *et al.,* 2015) and the identification of a high susceptibility to Brucella among pygmy killer whales and striped dolphins (Silva-Krott *et al.,* 2025). Fatally disseminated toxoplasmosis has caused the death of a bottlenose dolphin and three stranded spinner dolphins that researchers project to represent at least 60 spinner dolphin deaths (Landrau-Giovannetti *et al.,* 2022; West *et al.,* in press).

While we have preliminarily found that serious injury or mortality are not likely to result from the activities covered by this rule, we note the number of beaked whale strandings in the Study Area (acknowledging the comparatively lower carcass recovery rate for offshore species), the paucity of beaked whale data in the region, and the Simonis *et al.* (2020) and Navy analysis results, all of which highlight the need for additional data-gathering and future analysis. Accordingly, as part of the monitoring and adaptive management requirements of the 2020 MITT final rule, the Navy funded and co-organized with NMFS an expert panel to provide recommendations addressing scientific data gaps and uncertainties to further inform consideration of future protective measures to minimize the impact of Navy training and testing activities on beaked whales in the Mariana Islands (U.S. Department of the Navy, 2025a), in addition to continuing to fund stranding investigations in the Marianas and other monitoring measures. The Navy's ''Beaked Whale Occurrence, Distribution, and Behavior in the Mariana Islands Training and Testing (MITT) Study Area: Summary of Current Knowledge'' report (hereafter referred to as the MITT Beaked Whale Report) summarizes the available information about beaked whales in the Study Area, including occurrence, distribution, abundance, stranding events, and behavioral responses to anthropogenic disturbance. It also discusses regional oceanographic and bathymetric conditions known to be potential contributing factors to beaked whale strandings. The Navy conducted an extensive literature search, yielding over 2,300 sources, and conducted an email data call to 69 research scientists requesting unpublished data or information not available to the general public, which resulted in 30 responses. As outlined in the MITT Beaked Whale Report, Blainville's, goose-beaked, Longman's, and the Cross Seamount (hypothesized to be the ginkgo-toothed) beaked whale have been documented in the Study Area. Acoustic data indicate beaked whale habitat preference is concentrated on the Mariana Ridge and the Mariana Trough in waters between 1,800 and 2,300 m deep, with more beaked whales occurring in the northern part of the archipelago, where oceanographic data suggest a richer food niche may exist. The report describes recently derived passive acoustic monitoring (PAM)-based abundance and density estimates (*e.g.,* Klinck *et al.,* 2020, 2024; Hill *et al.,* 2020c; Barlow *et al.,* 2021; McCullough *et al.,* 2021; Yano *et al.,* 2022; Badger *et al.,* 2024). The report also discusses beaked whale stranding events globally and within the Study Area and assesses whether there is a link in time and space to Navy activities that may have included the use of MFAS, as well as new diagnostic techniques to improve mortality diagnoses. As stated in the report, ''both NMFS and the Navy acknowledge the need for more information about where

beaked whales occur, how they occupy their habitat spatially and temporally, how they respond to anthropogenic impacts, including MFAS, what the causes of natural mortality are, and what factors contribute to the likelihood of a stranding occurrence, and continue to fund research in this area.'' The full report and a GeoPDF showing environmental factors in the Mariana Islands generally associated with an increased likelihood of strandings during Navy training events is available on the Navy's website at *https://www.navymarinespeciesmonitoring.us/reading-room/technical-reports/pacific/*.

Marine Mammal Habitat

The 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 2026 MITT Draft SEIS/OEIS (see section C.7.7 (Secondary Stressors) of appendix C (Acoustic and Non-Acoustic Effects Supporting Information) and was determined not to have adverse effects on marine mammal habitat. Based on the information below and the supporting information included in the 2026 MITT Draft SEIS/OEIS, NMFS has determined that the proposed training and testing 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, fishes, 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.

Fishes use 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, impulsive sounds (such as impact pile driving or seismic air guns) can cause overt or subtle changes in fish behavior and local distribution (*e.g.,* van der Knapp *et al.,* 2021; van der Knaap *et al.,* 2022; Jarriel *et al.,* 2025). The response 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 from exposure to underwater noise may include behavioral responses, hearing damage, barotrauma (*i.e.,* pressure-related injuries), and, in some cases, mortality. While it is clear that the behavioral responses of individual prey, such as displacement or other changes in distribution, can have direct impacts on the foraging success of marine mammals, the effects on marine mammals of individual prey that experience hearing damage, barotrauma, or mortality is less clear, though obviously population scale impacts that meaningfully reduce the amount of prey available could have more serious impacts.

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; Popper *et al.,* 2022), while 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; Popper *et al.,* 2022).

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; Popper *et al.,* 2022). 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); fishes with a swim bladder not involved in hearing (*e.g.,* salmon, cod, pollock); fishes with a swim bladder involved in hearing (*e.g.,* sardines, anchovy, herring); 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 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 fishes from exposure to LF and MF sonar and other sounds (Cox *et al.,* 2018; Halvorsen *et al.,* 2012b; Jørgensen *et al.,* 2005; 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 higher frequency military sonar, or for those species that could perceive sonar-like signals, any TTS experienced would be recoverable (Halvorsen *et al.,* 2012b; 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.,* 2012b; Mann *et al.,* 2005; Mann, 2016; Popper *et al.,* 2014) would have the potential to receive TTS or exhibit behavioral responses from exposure to MF sonar. In addition, any sonar-induced TTS to fishes whose hearing range could perceive sonar would only occur in the narrow spectrum of the mid-frequency source (*e.g.,* 3.5 kHz) compared to the species' total hearing range (*e.g.,* 0.01 kHz to 5 kHz). Overall, military sonar sources are much narrower in terms of source frequency compared to a given fish species full hearing range (Halvorsen *et al.,* 2012b; Jørgensen *et al.,* 2005; Juanes *et al.,* 2017; Kane *et al.,* 2010; Kvadsheim and 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 fishes, 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 MFAS. Doksaeter *et al.* (2009, 2012) reported no behavioral responses to MF naval sonar by Atlantic herring; specifically, no escape responses (vertically or horizontally) were observed in free swimming herring exposed to MF sonar transmissions. Based on these results (Doksaeter *et al.,* 2009, 2012; Sivle *et al.,* 2012), Sivle *et al.* (2015a) 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 fishes exposed to any short-term noise within their hearing range might initially startle but would quickly return to normal behavior.

Occasional behavioral responses 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. Several studies have demonstrated that air gun sounds might affect the distribution and behavior of some fishes, potentially impacting foraging opportunities or increasing energetic costs (*e.g.,* Fewtrell and McCauley, 2012; Pearson *et al.,* 1992; Skalski *et al.,* 1992; Santulli *et al.,* 1999; Paxton *et al.,* 2017).

For fishes exposed to military 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 exposure, 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 MF sonar. Training and testing exercises involving explosions are dispersed in space and time; therefore, repeated exposure of individual fishes is 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 Study Area, would not be expected.

Vessels and in-water devices do not normally collide with adult fishes, particularly those that are common marine mammal prey, most of which can detect and avoid them. Exposure of fishes to vessel strike stressors is limited to those fish groups that are large, slow-moving, and may occur near the surface, such as ocean sunfish, whale sharks, basking sharks, and manta rays. These species are distributed widely in offshore portions of the Study Area. Any isolated cases of a military 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 responses 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 fishes, 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 (Aguilar de Soto, 2016; Solé *et al.,* 2017; Solé *et al.,* 2023). 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). Solé *et al.* (2017) 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 μPa^2s). However, the sources Solé *et al.* (2017) and Fewtrell and McCauley (2012) used are not similar and were much lower than typical Navy sources within the Study Area. These studies do not address the issue of individual displacement outside of a zone of impact when exposed to sound. Jones *et al.* (2020) found that when squid (*Doryteuthis* (*Amerigo*) *pealeii*) were exposed to impulse pile driving noise, body pattern changes, inking, jetting, and startle responses were observed and nearly all squid exhibited at least one response. However, these responses occurred primarily during the first eight impulses and diminished quickly, indicating potential rapid, short-term habituation.

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; Leedham *et al.,* 2026). 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; Solé *et al.,* 2023). Squids, like most fishes species, are likely more sensitive to low frequency sounds (Mooney *et al.,* 2010), 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 fishes, are not likely to be significant, and explosive impacts would be short-term and localized.

Explosions would likely 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 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 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 air gun 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 (*i.e.,* species that produce a large number of offspring and contribute few resources to each individual offspring) such as plankton, the spatial or temporal scale of impact must be large in comparison with the ecosystem concerned (McCauley *et al.,* 2017).

Notably, a recently described study produced results inconsistent with those of McCauley *et al.* (2017). Researchers conducted a field and laboratory study to assess if exposure to air gun noise affects mortality, predator escape response, or gene expression of the copepod *Calanus finmarchicus* (Fields *et al.,* 2019). Immediate mortality of copepods was significantly higher, relative to controls, at distances of 5 m or less from the air guns. Mortality 1 week after the air gun blast was significantly higher in the copepods placed 10 m from the air gun but was not significantly different from the controls at a distance of 20 m from the air gun. The increase in mortality, relative to controls, did not exceed 30 percent at any distance from the air gun. Moreover, the authors caution that even this higher mortality in the immediate vicinity of the air guns may be more pronounced than what would be observed in free-swimming animals due to increased flow speed of fluid inside bags containing the experimental animals. There were no sublethal effects on the escape performance or the sensory threshold needed to initiate an escape response at any of the distances from the air gun that were tested. Whereas McCauley *et al.* (2017) reported an SEL of 156 dB at a range of 509–658 m, with zooplankton mortality observed at that range, Fields *et al.* (2019) reported an SEL of 186 dB at a range of 25 m, with no reported mortality at that distance. 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 (Fields *et al.,* 2019; Hawkins *et al.,* 2014; McCauley *et al.,* 2017). The most likely impacts for most prey species in a given area would be temporary avoidance of the area. Surveys using towed air gun arrays move through an area relatively quickly, limiting exposure to multiple impulsive sounds. In all cases, sound levels would return to ambient once a survey ends and the noise source is shut down and, when exposure to sound ends, behavioral and/or physiological responses are expected to end relatively quickly (McCauley *et al.,* 2000b). The duration of fish avoidance of a given area after survey effort stops is unknown, but a rapid return to normal recruitment, distribution, and behavior is anticipated. While the potential for disruption of spawning aggregations or schools of important prey species can be meaningful on a local scale, the mobile and temporary nature of most surveys and the likelihood of temporary avoidance behavior suggest that impacts would be minor. Long-term consequences to marine invertebrate populations would not be expected as a result of exposure to sounds or vessels in the Study Area.

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 (*e.g.,* communication during feeding, mating, and other social activities), other animals (*e.g.,* finding prey or avoiding predators), and the physical environment (*e.g.,* 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 (*e.g.,* the use of air gun arrays) or for military training and testing purposes (*e.g.,* the use of sonar and explosives and other acoustic sources). Anthropogenic noise varies widely in its frequency, content, duration, and SPL, and these characteristics greatly influence the potential habitat-mediated effects to marine mammals (please also see the previous discussion in the Masking section), 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; Lillis *et al.,* 2015.

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.,* 2015; 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 Study Area is temporary and transitory. Any anthropogenic noise attributed to training and testing activities in the 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 constituents into the water column. Based on the analysis of the 2026 MITT Draft SEIS/OEIS (see Section 3.1 (Sediments and Water Quality)), 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 0.15–0.3 m away from degrading ordnance, the concentrations of these compounds were not statistically distinguishable from background beyond 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 (0.3–2 m).

Equipment used by the Action Proponents within the 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, Coast Guard, Army, Air Force, 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 number of take that NMFS anticipates is reasonably likely to occur. NMFS coordinated closely with the Action Proponents in the development of their incidental take application and preliminarily agrees that the methods the Action Proponents have put forth described herein to estimate take (including the model, thresholds, and density estimates) and the resulting numbers are based on the best available science and appropriate for authorization.

Takes would be in the form of harassment only. For this military readiness activity, the MMPA defines ''harassment'' as (1) 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 (2) 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 the behavioral patterns are abandoned or significantly altered (Level B harassment) (16 U.S.C. 1362(18)(B)).

Proposed authorized takes would primarily be in the form of Level B harassment, as use of the acoustic (*e.g.,* active sonar) and explosive sources are most likely to result in 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 disturbance) for marine mammals, either via direct behavioral disturbance or TTS. There is also the potential for Level A harassment, in the form of auditory and non-auditory injury to result from exposure to the sound sources and explosives utilized in military readiness activities.

Generally speaking, for acoustic impacts NMFS estimates the amount and type of harassment by considering: (1) acoustic thresholds above which NMFS believes the best available science indicates marine mammals would experience behavioral disturbance or incur some degree of temporary or permanent hearing impairment; (2) the area or volume of water that would 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 directly incur a disruption in behavior patterns to a point where they are abandoned or significantly altered (equated to onset of Level B harassment), or to incur TTS onset (equated to Level B harassment via the indirect disruptions of behavioral patterns), or AUD INJ onset (equated to Level A harassment). Thresholds have also been developed to identify the pressure and impulse levels above which animals may incur non-auditory injury or mortality from exposure to explosive detonation.

Hearing Impairment (TTS/AUD INJ), Non-Auditory Injury, and Mortality

NMFS' 2024 Technical Guidance (NMFS, 2024) identifies dual criteria to assess AUD INJ (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 Updated Technical Guidance also identifies criteria to predict TTS, which is not considered injury and falls into the Level B harassment category. The Action Proponents' specified activities include the use of non-impulsive (*i.e.,* sonar) and impulsive (*i.e.,* explosives) sources.

For the consideration of impacts on hearing in Phase IV, marine mammals were divided into nine groups for analysis: VLF, LF, HF, VHF, SI, PCW and PCA, and OCW and OCA. For each group, a frequency-dependent weighting function and numeric thresholds for the onset of TTS and the onset of AUD INJ were estimated. The onset of TTS is defined as a TTS of 6 dB measured approximately 2–5 minutes after exposure. A TTS of 40 dB is used as a proxy for the onset of AUD INJ (*i.e.,* it is assumed that exposures beyond those capable of causing 40 dB of TTS have the potential to result in PTS or other auditory injury (*e.g.,* loss of cochlear neuron synapses)). Exposures just sufficient to cause TTS or AUD INJ are denoted as ''TTS onset'' or ''AUD INJ onset'' exposures. Onset levels are treated as step functions or all-or-nothing thresholds: exposures above the TTS or AUD INJ onset level are assumed to always result in TTS or AUD INJ, while exposures below the TTS or AUD INJ onset level are assumed to not cause TTS or AUD INJ. For non-impulsive exposures, onset levels are specified in frequency-weighted cumulative SEL; for impulsive exposures, dual metrics of weighted SEL and unweighted peak SPL are used.

To compare Phase IV weighting functions and TTS/AUD INJ SEL thresholds to those used in Phase III, both the weighting function shape and the weighted threshold values were considered; the weighted thresholds by themselves only indicate the TTS/AUD INJ threshold at the most susceptible frequency (based on the relevant weighting function). In contrast, the TTS/AUD INJ exposure functions incorporate both the shape of the weighting function and the weighted threshold value and provide the best means of comparing the frequency-dependent TTS/AUD INJ thresholds for Phase III and Phase IV.

The most significant differences between the Phase III and Phase IV functions and thresholds are the following:

- Mysticetes were divided into two groups (VLF and LF cetaceans), with the upper hearing limit for the LF cetacean group increasing from Phase III to match recent hearing measurements in minke whales (Houser *et al.,* 2024);
- Group names were changed from Phase III to be consistent with Southall *et al.* (2019c). Specifically, the Phase III MF cetacean group is now designated as the HF cetacean group, and the group previously designated as HF cetaceans is now the VHF cetacean group;
- For the HF group, Phase IV onset TTS/AUD INJ thresholds are lower

compared to Phase III at frequencies below approximately 10 kHz. This is a result of new TTS onset data for dolphins at low frequencies (Finneran *et al.,* 2023);

- For the PCW group, new TTS data for harbor seals (Kastelein *et al.,* 2020a, 2020b) resulted in slightly lower TTS/AUD INJ thresholds at high frequencies compared to Phase III; and
- For group OCW, new TTS data for California sea lions (Kastelein *et al.,* 2021b, 2022a, 2022b) resulted in significantly lower TTS/AUD INJ thresholds compared to Phase III.

Of note, the thresholds and weighting function for the LF cetacean hearing group in NMFS' 2024 Technical Guidance (NMFS, 2024) match the Navy's VLF cetacean hearing group; however, the weighting function for those hearing groups differs between the two documents (*i.e.,* the Navy's LF cetacean group has a different weighting function from NMFS) due to the Houser *et al.* (2024) minke whale data incorporated into Navy 2024 but not NMFS (2024). While NMFS' 2024 Technical Guidance differs from the criteria that the Action Proponents used to assess AUD INJ and TTS for LF cetaceans, NMFS concurs that the criteria the Action Proponents applied are appropriate for assessing the impacts of their proposed action. The criteria used by the Action Proponents are conservative in that those criteria show greater sensitivity at higher frequencies (*i.e.,* application of those criteria result in a higher amount of estimated take by higher frequency sonars than would result from application of NMFS' 2024 Technical Guidance), which is where more of the take is expected.

These thresholds (table 9 and table 10) were developed by compiling and synthesizing the best available science and soliciting input multiple times from both public and peer reviewers. The references, analysis, and methodology used in the development of the thresholds are described in Updated Technical Guidance, which may be accessed at: *https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-acoustic-technical-guidance.*

Table 9 -- Acoustic Thresholds Identifying the Onset of TTS and AUD INJ for Non-Impulsive Sound Sources by Functional Hearing Group

Group	TTS threshold SEL (weighted)	AUD INJ threshold SEL (weighted)
Very low-frequency (VLF)	177	197
Low-frequency (LF)	177	197
High-frequency (HF)	181	201
Very high-frequency (VHF)	161	181

Note: SEL thresholds in dB re 1 μPa^2 s underwater and dB re 20 μPa^2 s in air.

Based on the best available science, the Action Proponents (in coordination with NMFS) used the acoustic and pressure thresholds indicated in table 10 to predict the onset of behavioral harassment, AUD INJ, TTS, tissue damage, and mortality due to explosive sources.

For explosive activities using single detonations (*i.e.,* no more than one detonation within a day), NMFS uses TTS onset thresholds to assess the likelihood of behavioral harassment, rather than the Level B harassment threshold for multiple detonations indicated in table 10. While marine mammals may also respond to single explosive detonations, these responses are expected to more typically be in the form of startle response, rather than a more meaningful disruption of a behavioral pattern. On the rare occasion that a single detonation might result in a behavioral response that qualifies as Level B harassment, it would be expected to be in response to a comparatively higher received level. Accordingly, NMFS considers the potential for these responses to be quantitatively accounted for through the application of the TTS criteria, which, as noted above, is 5 dB higher than the behavioral harassment threshold for multiple explosives.

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Table 10 -- Explosive Thresholds for Marine Mammals for AUD INJ, TTS, and Behavior (Multiple Detonations)

Hearing Group	AUD INJ Impulsive Threshold*	TTS Impulsive Threshold*	Behavioral Threshold (multiple detonations)
Low-Frequency (LF) Cetaceans	$L_{p,0\text{-}pk,flat}$: 222 dB $L_{E,p,LF,24h}$: 183 dB	$L_{p,0\text{-}pk,flat}$: 216 dB $L_{E,LF,24h}$: 168 dB	$L_{E,LF,24h}$: 163 dB
High-Frequency (HF) Cetaceans	$L_{p,0\text{-}pk,flat}$: 230 dB $L_{E,p,HF,24h}$: 193 dB	$L_{p,0\text{-}pk,flat}$: 224 dB $L_{E,HF,24h}$: 178 dB	$L_{E,HF,24h}$: 173 dB
Very High-Frequency (VHF) Cetaceans	$L_{p,0\text{-}pk,flat}$: 202 dB $L_{E,p,VHF,24h}$: 159 dB	$L_{p,0\text{-}pk,flat}$: 196 dB $L_{E,VHF,24h}$: 144 dB	$L_{E,VHF,24h}$: 139 dB
Phocid Pinnipeds (PW) (Underwater)	$L_{p,0\text{-}pk,flat}$: 223 dB $L_{E,p,PW,24h}$: 183 dB	$L_{p,0\text{-}pk,flat}$: 217 dB $L_{E,PW,24h}$: 168 dB	$L_{E,PW,24h}$: 163 dB
Otariid Pinnipeds (OW) (Underwater)	$L_{p,0\text{-}pk,flat}$: 230 dB $L_{E,p,OW,24h}$: 185 dB	$L_{p,0\text{-}pk,flat}$: 224 dB $L_{E,OW,24h}$: 170 dB	$L_{E,OW,24h}$: 165 dB
Phocid Pinnipeds (PA) (In-Air)	$L_{p,0\text{-}pk,flat}$: 162 dB $L_{E,p,PA,24h}$: 140 dB	$L_{p,0\text{-}pk,flat}$: 156 dB $L_{E,PA,24h}$: 125 dB	N/A
Otariid Pinnipeds (OA) (In-Air)	$L_{p,0\text{-}pk,flat}$: *177 dB* $L_{E,p,OA,24h}$: *163 dB*	$L_{p,0\text{-}pk,flat}$: *171 dB* $L_{E,OA,24h}$: *148 dB*	N/A

Note: N/A = Not Applicable. Peak sound pressure level ($L_{p,0\text{-}pk}$) has a reference value of 1 µPa, and weighted cumulative sound exposure level ($L_{E,p}$) has a reference value of 1 μPa^2s. In this table, criteria are abbreviated to be more reflective of International Organization for Standardization standards (ISO, 2017; ISO, 2020). The subscript "flat" is being included to indicate peak sound pressure are flat weighted or unweighted within the generalized hearing range of marine mammals underwater (*i.e.*, 7 Hz to 165 kHz) or in air (*i.e.*, 42 Hz to 52 kHz). The subscript associated with cumulative sound exposure level criteria indicates the designated marine mammal auditory weighting function (LF, HF, and VHF cetaceans, and PW and OW pinnipeds) and that the recommended accumulation period is 24 hours. The weighted cumulative sound exposure level criteria could be exceeded in a multitude of ways (*i.e.*, varying exposure levels and durations, duty cycle). When possible, it is valuable for action proponents to indicate the conditions under which these criteria will be exceeded.

*Dual metric criteria for impulsive sounds: Use whichever criteria results in the larger isopleth for calculating AUD INJ onset. If a non-impulsive sound has the potential of exceeding the peak sound pressure level criteria associated with impulsive sounds, the PK SPL criteria are recommended for consideration for non-impulsive sources.

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The criterion for mortality is based on severe lung injury observed in terrestrial mammals exposed to underwater explosions as recorded in Goertner (1982). The criteria for non-auditory injury are based on slight lung injury or gastrointestinal tract injury observed in the same data set. Mortality and slight lung injury impacts to marine mammals are estimated using impulse thresholds based on both calf/pup/juvenile and adult masses (see the Criteria and Thresholds Technical Report). The peak pressure threshold applies to all species and age classes. Unlike the prior analysis (Phase III), this analysis relies on the onset rather than the mean estimated threshold for these effects. This revision results in a small increase in the predicted non-auditory injuries and mortalities for the same event versus prior analyses. Thresholds are provided in table 11 for use in non-auditory injury assessment for marine mammals exposed to underwater explosives.

Table 11 -- Non-Auditory Injury Thresholds for Underwater Explosives

Hearing Group	Mortality–Impulse*	Injury–Impulse*	Injury–Peak Pressure
All Marine Mammals	$103M^{1/3}(1 + D/10.1)^{1/6}$ Pa-s	$47.5M^{1/3}(1 + D/10.1)^{1/6}$Pa-s	$L_{p0\text{-}pk,flat}$: 237 dB

Note: Peak sound pressure (L_{pk}) has a reference value of 1 µPa. In this table, thresholds are abbreviated to reflect American National Standards Institute (ANSI). However, ANSI defines peak sound pressure as incorporating frequency weighting, which is not the intent for this Technical Guidance. Hence, the subscript "flat" is being included to indicate peak sound pressure should be flat weighted or unweighted within the overall marine mammal generalized hearing range.
* Lung injury (severe and slight) thresholds are dependent on animal mass (Recommendation: table C.9 from U.S. Department of the Navy (2017a) based on adult and/or calf/pup mass by species).

M animal (adult and/or calf/pup) mass (kg) (table C.9 in DoN 2017)
D animal depth (meters)

Level B Harassment by Behavioral Disturbance

Though significantly driven by received level and distance, the onset of Level B harassment by behavioral disturbance from anthropogenic noise exposure is also informed to varying degrees by other factors and can be difficult to predict (Southall *et al.,* 2007; Ellison *et al.,* 2012). As discussed in the Potential Effects of Specified Activities on Marine Mammals and Their Habitat section, marine mammal responses to sound (some of which are considered disturbances that qualify as take under the MMPA) are highly variable and context specific (*i.e.,* they are affected by differences in acoustic conditions; differences between species and populations; differences in sex, age, reproductive status, or social behavior; and other prior experience of the individuals). This means there is support for considering alternative approaches for estimating Level B behavioral harassment.

Despite the rapidly 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 criteria that identify Level B harassment by behavioral disturbance (referred to as ''behavioral 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 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 behavioral 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 harassment criteria are the most appropriate method for predicting Level B harassment by behavioral disturbance given the best available science and the associated uncertainty.

Sonar—

In its analysis of impacts associated with sonar acoustic sources, which was coordinated with NMFS, the Action Proponents used an updated approach, as described below. Many of the behavioral responses identified using the Action Proponents' quantitative analysis are most likely to be of moderate severity as described in the Southall *et al.* (2021) 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 Action Proponents' quantitative analysis, many responses are predicted from exposure to sound that may exceed an animal's Level B behavioral harassment threshold for only a single exposure (lasting 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 a significant alteration or abandonment of natural behavioral patterns (*i.e.,* the estimated number of takes by Level B harassment due to behavioral disturbance and response is likely somewhat of an overestimate).

As noted above, the Action Proponents coordinated with NMFS to develop behavioral harassment thresholds specific to their military readiness activities utilizing active sonar that identify at what received level and distance Level B harassment by behavioral disturbance would be expected to result. These behavioral harassment thresholds consist of behavioral response functions (BRFs) and associated distance cut-off conditions and are also referred to, together, as ''the criteria.'' These criteria are used to estimate the number of animals that may exhibit a behavioral response that qualifies as take under the MMPA when exposed to sonar and other transducers. The way the criteria were derived is discussed in detail in the Criteria and Thresholds Technical Report. Developing these behavioral harassment 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. Marine mammals were divided into four groups for analysis: (1) mysticetes (all baleen whales); (2) odontocetes (most toothed whales, dolphins, and porpoises); (3) sensitive species (beaked whales and harbor porpoise); and (4) pinnipeds and other marine carnivores (true seals, sea lions, walruses, sea otters, polar bears). These groups are like the groups used in the behavioral response analysis (Phase III), with the exception of combining beaked whales and harbor porpoise into a single curve. For each group, a biphasic BRF was developed using the best available data and Bayesian dose response models

developed at the University of St. Andrews. The BRF base probability of response on the highest RMS SPL received level.

The analysis of BRFs differs from the previous phase (Phase III) due to the addition of new data and the separation of some species groups. Figure 10 in the Criteria and Thresholds Technical Report indicates the changes in BRFs from Phase III to Phase IV. The sensitive species BRF is more sensitive at lower received levels but less sensitive at higher received levels than the prior beaked whale and harbor porpoise functions. The odontocete BRF is less sensitive overall due to additional behavioral response research, which will result in a lower number of behavioral responses than in the prior analysis for the same event, but also reduces the avoidance of auditory effects. The pinnipeds (in-water) BRF is more sensitive due to the inclusion of additional captive pinniped data (only three behavioral studies using captive pinnipeds were available for the derivation of the BRF). Behavioral studies of captive animals can be difficult to extrapolate to wild animals due to several factors (*e.g.,* use of trained subjects). This means the pinniped BRF likely overestimates effects compared to observed responses of wild pinnipeds to sound and anthropogenic activity. The mysticete BRF is less sensitive across most received levels due to including additional behavioral response research. This will result in a lower number of behavioral responses than in the prior analysis for the same event but also reduces the avoidance of auditory effects.

The BRFs only relate the highest received level of sound to the probability that an animal will have a behavioral response. The BRFs do not account for the duration or pattern of use of any individual sound source or of the activity as a whole, the number of sound sources that may be operating simultaneously, or how loud the animal may perceive the sonar signal to be based on the frequency of the sonar versus the animal's hearing range.

Criteria for assessing marine mammal behavioral responses to sonars use the metric of highest received sound pressure level (RMS SPL) to evaluate the risk of immediate responses by exposed animals. Currently, there are limited data to develop criteria that include the context of an exposure, characteristics of individual animals, behavioral state, duration of an exposure, sound source duty cycle, and the number of individual sources in an activity (although these factors certainly influence the severity of a behavioral response) and, further, even where certain contextual factors may be predictive where known, it is difficult to reliably predict when such factors will be present.

The BRFs also do not account for distance. At moderate to low received levels the correlation between probability of response and received level is very poor and it appears that other variables such as the distance between the animal and the sound source mediate behavioral responses (*e.g.,* Ellison *et al.,* 2012). For this analysis, distance between the animal and the sound source (*i.e.,* range) was initially included; however, range was too confounded with received level and, therefore, did not provide additional information about the possibility of response.

Data suggest that beyond a certain distance, significant behavioral responses are unlikely. At shorter ranges (less than 10 km), some behavioral responses have been observed at received levels below 140 dB re 1 µPa. Thus, proximity may mediate behavioral responses at lower received levels. Since most data used to derive the BRFs are within 10 km of the source, probability of response at farther ranges is not well-represented. Therefore, the source-receiver range must be considered separately to estimate likely significant behavioral responses.

This analysis applies behavioral cut-off conditions to responses predicted using the BRFs. Animals within a specified distance and above a minimum probability of response are assumed to have a significant behavioral response. The cut-off distance is based on the farthest source-animal distance across all known studies where animals exhibited a significant behavioral response. Animals beyond the cut-off distance but with received levels above the SPL associated with a probability of response of 0.5 on the BRF are also assumed to have a significant behavioral response. The actual likelihood of significant behavioral responses occurring beyond the distance cut-off is unknown. Significant behavioral responses beyond 100 km are unlikely based on source-animal distance and attenuated received levels. The behavioral cut-off conditions and additional information on the derivation of the cut-off conditions can be found in table 2.2–3 of the Criteria and Thresholds Technical Report.

The Action Proponents used cutoff distances beyond which the potential of significant behavioral responses (and therefore Level B harassment) is considered to be unlikely (see table 12). These distances were determined by examining all available published field observations of behavioral responses to sonar or sonar-like signals that included the distance between the sound source and the marine mammal. Behavioral effects calculations are based on the maximum SPL to which a modeled marine mammal is exposed. There is empirical evidence to suggest that animals are more likely to exhibit significant behavioral responses to moderate levels sounds that are closer and less likely to exhibit behavioral responses when exposed to moderate levels of sound from a source that is far away. To account for this, the Action Proponents have implemented behavioral cutoffs that consider both received sound level and distance from the source. These updated cutoffs conditions are unique to each behavioral hearing group and are outlined in table 12.

Table 12 -- Behavioral Cut-off Conditions for each Behavioral Hearing Group

Behavioral group	Received level associated with p(0.50) on the behavioral response function	Cut-off range
Sensitive Species	133 dB RMS SPL	40 km
Odontocetes	168 dB RMS SPL	15 km
Mysticetes	185 dB RMS SPL	10 km
Pinnipeds	156 dB RMS SPL	5 km
Note: Sensitive Species includes beaked whales and harbor porpoises.		

The Action Proponents and NMFS have used the best available science to address the challenging differentiation between significant and non-significant behavioral responses (*i.e.,* whether the behavior has been abandoned or significantly altered such that it qualifies as harassment). Where uncertainty exists, the Action Proponents and NMFS have made decisions that likely result in some degree of overestimation of Level B harassment by behavioral disturbance (*e.g.,* counting lower duration responses as take). We consider application of these behavioral harassment thresholds, 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). NMFS has carefully reviewed the criteria (*i.e.,* BRFs and 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 military sonar and other transducers and for calculating take and to support the proposed determinations in this proposed rule. 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.

Explosives—

Based on best available science and the practical need to use a threshold based on a factor that is both predictable and measurable for most activities, NMFS uses generalized acoustic thresholds based on received level to estimate the onset of behavioral harassment for sources other than active sonar. NMFS predicts that marine mammals are likely to be behaviorally harassed in a manner we consider Level B harassment when exposed to underwater anthropogenic noise above received levels of 120 dB re 1 µPa (RMS) for continuous (*e.g.,* vibratory pile-driving, drilling) and above 160 dB re 1 µPa (RMS) for non-explosive impulsive (*e.g.,* seismic air guns) or intermittent (*e.g.,* scientific sonar) sources. For the Action Proponents' activities, to estimate behavioral effects from explosives, the TTS onset threshold is used (table 13). The explosive behavioral threshold has shifted since the prior analysis (Phase III), corresponding to changes in the TTS thresholds (table 11).

Table 13 -- Behavioral Response Thresholds for Explosives

Sound source	Behavioral threshold
Single explosion (underwater)	TTS onset threshold (weighted SEL)
Multiple explosions (underwater)	5 dB less than the TTS onset threshold (weighted SEL)

While the best available science for assessing behavioral responses of marine mammals to impulsive sounds relies on data from seismic and pile driving sources, it is likely that these predicted responses using a threshold based on seismic and pile driving represent a more prolonged temporal scenario compared to behavioral responses to explosives used in military readiness activities, which would typically consist of single impulses or a cluster of impulses rather than long-duration, repeated impulses (*e.g.,* large-scale air gun arrays).

For single explosions at received sound levels below hearing loss thresholds, the most likely behavioral response is a brief alerting or orienting response. Since no further sounds follow the initial brief impulses, significant behavioral responses would not be expected to occur. If a significant response were to occur, the Action Proponents' analysis assumes it would be as a result of an exposure at levels within the range of auditory impacts (TTS and AUD INJ). Because of this approach, the number of auditory impacts is higher than the number of behavioral impacts in the quantified results for some stocks.

If more than one explosive event occurs within any given 24-hour period during a military readiness activity, behavioral disturbance is considered more likely to occur and specific criteria are applied to predict the number of animals that may have a behavioral response. For events with multiple explosions, the behavioral threshold used in this analysis is 5 dB less than the TTS onset threshold. This value is derived from observed onsets of behavioral response by test subjects (bottlenose dolphins) during non-impulse TTS testing (Schlundt *et al.,* 2000).

Navy Acoustic Effects Model

NAEMO is their standard model for assessing acoustic effects on marine mammals. NAEMO calculates sound energy propagation from sonar and other transducers and explosives during military readiness activities and the sound received by animat dosimeters (animats). Animats are virtual representations of marine mammals distributed in the area around the modeled activity, and each dosimeter records its individual sound dose. The model bases the distribution of animats over the Study Area on the density values in the Navy Marine Species Density Database (NMSDD) 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 NAEMO intentionally err on the side of overestimation when there are unknowns. The specified activities are modeled as though they would occur regardless of proximity to marine mammals, meaning that the implementation of power downs or shutdowns are not modeled or, thereby, considered in the take estimates. For more information on this process, see the discussion in the Estimated Take from Acoustic Stressors section 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 acoustic impacts caused by sonars and other transducers and explosives during individual military readiness activities. 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 NAEMO is provided in the Acoustic Impacts Technical Report and a summary of changes to the modeling of acoustic effects due to sonars is detailed in the Acoustic and Explosives Concepts Technical Report.

As NAEMO interrogates the simulation data in the Animat Processor, exposures that are both outside the distance cutoff and below the received level cutoff are omitted when determining the maximum SPL for each animat. This differs from Phase III, in which only distance cutoffs were applied, meaning that all exposures outside the distance cutoffs were omitted, with no consideration of received level.

The presence of the two cutoff criteria in Phase IV provides a more accurate and conservative estimation of behavioral effects because louder exposures that would have been omitted previously, when only a distance cutoff was applied, are considered in Phase IV, while the estimation of behavioral effects still omits exposures at distances and received levels that would be unlikely to produce a significant behavioral response. NAEMO retains the capability of calculating behavioral effects without the cutoffs applied, depending on user preference.

The impulsive behavioral criteria are not based on the probability of a behavioral response but rather on a single SPL metric. For consideration of impulsive behavioral effects, the cutoff conditions in table 12 are not applied.

Range to Effects

This section provides range (distance) to effects for sonar and other active acoustic sources as well as explosives to specific acoustic thresholds determined using NAEMO. Ranges are determined by modeling the distance that noise from a source will need to propagate to reach exposure level thresholds specific to a hearing group that will cause behavioral response, TTS, AUD INJ, non-auditory injury, and mortality. Ranges to effects (table 14 through table 22) are utilized to help predict impacts from acoustic and explosive sources and assess the benefit of mitigation zones. 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

Ranges to effects for sonar were determined by modeling the distance that sound would need to propagate to reach exposure level thresholds specific to a hearing group that would cause behavioral response, TTS, and AUD INJ, as described in the Criteria and Thresholds Technical Report. The ranges do not account for an animal avoiding a source nor for the movement of the platform, both of which would influence the actual range to onset of auditory effects during an actual exposure.

Table 14 through table 17 below provide the ranges to TTS and AUD INJ for marine mammals from exposure durations of 1, 30, 60, and 120 seconds (s) for six sonar systems proposed for use (see also ''Acoustic and Explosive Effects Analysis for Marine Species in the Mariana Islands Training and Testing Study Area (Phase IV) Technical Report (U.S. Department of the Navy, 2026a) (hereafter referred to as the MITT Acoustic and Explosive Effects Analysis Technical Report). Due to the lower acoustic thresholds for TTS versus AUD INJ, ranges to TTS are larger. Successive pings can be expected to add together, further increasing the range to the onset of TTS and AUD INJ.

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Table 14 -- Very Low-Frequency Cetacean Ranges to Effects for Sonar

Sonar Type	Water Depth	Duration	Range to TTS (SD)	Range to AUD INJ (SD)
Dipping Sonar	>200 m	1 s	120 m (19 m)	0 m (0 m)
Dipping Sonar	>200 m	30 s	260 m (37 m)	6 m (8 m)
Dipping Sonar	>200 m	60 s	360 m (52 m)	23 m (9 m)
Dipping Sonar	>200 m	120 s	525 m (74 m)	35 m (14 m)
MF1 Ship Sonar	≤200 m	1 s	749 m (120 m)	90 m (1 m)
MF1 Ship Sonar	≤200 m	30 s	749 m (120 m)	90 m (1 m)
MF1 Ship Sonar	≤200 m	60 s	849 m (122 m)	140 m (2 m)
MF1 Ship Sonar	≤200 m	120 s	881 m (145 m)	176 m (5 m)
MF1 Ship Sonar	>200 m	1 s	1,000 m (42 m)	85 m (2 m)
MF1 Ship Sonar	>200 m	30 s	1,000 m (42 m)	85 m (2 m)
MF1 Ship Sonar	>200 m	60 s	1,750 m (162 m)	140 m (5 m)
MF1 Ship Sonar	>200 m	120 s	2,264 m (675 m)	170 m (5 m)
MF1C Ship Sonar	>200 m	1 s	1,000 m (44 m)	85 m (2 m)
MF1C Ship Sonar	>200 m	30 s	2,271 m (684 m)	170 m (5 m)
MF1C Ship Sonar	>200 m	60 s	5,250 m (800 m)	250 m (6 m)
MF1C Ship Sonar	>200 m	120 s	7,486 m (1,231 m)	370 m (6 m)
MF1K Ship Sonar	≤200 m	1 s	190 m (3 m)	13 m (0 m)
MF1K Ship Sonar	<200 m	30 s	341 m (30 m)	24 m (0 m)
MF1K Ship Sonar	≤200 m	60 s	422 m (51 m)	30 m (0 m)
MF1K Ship Sonar	≤200 m	120 s	529 m (89 m)	45 m (0 m)
MF1K Ship Sonar	>200 m	1 s	190 m (5 m)	6 m (6 m)
MF1K Ship Sonar	>200 m	30 s	330 m (7 m)	12 m (12 m)
MF1K Ship Sonar	>200 m	60 s	430 m (7 m)	28 m (3 m)
MF1K Ship Sonar	>200 m	120 s	625 m (15 m)	40 m (2 m)
Mine-Hunting Sonar	≤200 m	1 s	2 m (2 m)	0 m (0 m)
Mine-Hunting Sonar	≤200 m	30 s	6 m (1 m)	0 m (0 m)
Mine-Hunting Sonar	≤200 m	60 s	9 m (1 m)	0 m (0 m)
Mine-Hunting Sonar	≤200 m	120 s	14 m (2 m)	0 m (1 m)
Mine-Hunting Sonar	>200 m	1 s	0 m (0 m)	0 m (0 m)
Mine-Hunting Sonar	>200 m	30 s	2 m (3 m)	0 m (0 m)
Mine-Hunting Sonar	>200 m	60 s	4 m (4 m)	0 m (0 m)
Mine-Hunting Sonar	>200 m	120 s	12 m (1 m)	0 m (0 m)
Sonobuoy Sonar	>200 m	1 s	0 m (7 m)	0 m (0 m)
Sonobuoy Sonar	>200 m	30 s	23 m (11 m)	0 m (0 m)

Sonobuoy Sonar	>200 m	60 s	35 m (12 m)	0 m (0 m)
Sonobuoy Sonar	>200 m	120 s	50 m (6 m)	0 m (0 m)

Note: Median ranges are shown with standard deviation (SD) in parentheses. The Action Proponents split the LF functional hearing group into LF and VLF based on Houser *et al.* (2024). NMFS updated acoustic technical guidance (NMFS, 2024) does not include these data but we have included the VLF group here for reference. TTS = Temporary Threshold Shift, AUD INJ = Auditory Injury, MF1 = hull-mounted surface ship sonar, MF1C = >80 percent duty cycle, MF1K = kingfisher mode

Table 15 -- Low-Frequency Cetacean Ranges to Effects for Sonar

Sonar Type	Water Depth	Duration	Range to TTS (SD)	Range to AUD INJ (SD)
Dipping Sonar	>200 m	1 s	120 m (73 m)	0 m (6 m)
Dipping Sonar	>200 m	30 s	270 m (82 m)	0 m (10 m)
Dipping Sonar	>200 m	60 s	360 m (107 m)	23 m (12 m)
Dipping Sonar	>200 m	120 s	525 m (84 m)	35 m (17 m)
MF1 Ship Sonar	≤200 m	1 s	749 m (117 m)	92 m (3 m)
MF1 Ship Sonar	≤200 m	30 s	749 m (117 m)	92 m (3 m)
MF1 Ship Sonar	≤200 m	60 s	858 m (127 m)	140 m (5 m)
MF1 Ship Sonar	≤200 m	120 s	881 m (173 m)	180 m (2 m)
MF1 Ship Sonar	>200 m	1 s	1,000 m (98 m)	90 m (3 m)
MF1 Ship Sonar	>200 m	30 s	1,000 m (98 m)	90 m (3 m)
MF1 Ship Sonar	>200 m	60 s	1,944 m (267 m)	140 m (1 m)
MF1 Ship Sonar	>200 m	120 s	3,083 m (849 m)	180 m (1 m)
MF1C Ship Sonar	>200 m	1 s	1,000 m (102 m)	90 m (3 m)
MF1C Ship Sonar	>200 m	30 s	3,083 m (863 m)	180 m (1 m)
MF1C Ship Sonar	>200 m	60 s	5,694 m (881 m)	260 m (4 m)
MF1C Ship Sonar	>200 m	120 s	8,167 m (1,369 m)	380 m (7 m)
MF1K Ship Sonar	≤200 m	1 s	200 m (6 m)	14 m (0 m)
MF1K Ship Sonar	≤200 m	30 s	350 m (32 m)	25 m (0 m)
MF1K Ship Sonar	≤200 m	60 s	432 m (53 m)	30 m (0 m)
MF1K Ship Sonar	≤200 m	120 s	538 m (92 m)	45 m (0 m)
MF1K Ship Sonar	>200 m	1 s	190 m (5 m)	12 m (1 m)
MF1K Ship Sonar	>200 m	30 s	350 m (6 m)	24 m (0 m)
MF1K Ship Sonar	>200 m	60 s	450 m (10 m)	30 m (0 m)
MF1K Ship Sonar	>200 m	120 s	625 m (21 m)	45 m (0 m)
Mine-Hunting Sonar	≤200 m	1 s	0 m (4 m)	0 m (0 m)
Mine-Hunting Sonar	≤200 m	30 s	0 m (7 m)	0 m (0 m)
Mine-Hunting Sonar	≤200 m	60 s	19 m (3 m)	0 m (0 m)

Mine-Hunting Sonar	≤200 m	120 s	33 m (3 m)	0 m (0 m)
Mine-Hunting Sonar	>200 m	1 s	0 m (3 m)	0 m (0 m)
Mine-Hunting Sonar	>200 m	30 s	0 m (8 m)	0 m (0 m)
Mine-Hunting Sonar	>200 m	60 s	0 m (12 m)	0 m (0 m)
Mine-Hunting Sonar	>200 m	120 s	23 m (5 m)	0 m (0 m)
Sonobuoy Sonar	>200 m	1 s	0 m (8 m)	0 m (0 m)
Sonobuoy Sonar	>200 m	30 s	25 m (13 m)	0 m (1 m)
Sonobuoy Sonar	>200 m	60 s	35 m (20 m)	0 m (1 m)
Sonobuoy Sonar	>200 m	120 s	55 m (28 m)	0 m (2 m)

Note: Median ranges are shown with standard deviation (SD) in parentheses. The Action Proponents split the LF functional hearing group into LF and VLF based on Houser *et al.* (2024). NMFS updated acoustic technical guidance (NMFS, 2024) does not include these data but we have included the VLF group here for reference. TTS = Temporary Threshold Shift, AUD INJ = Auditory Injury, MF1 = hull-mounted surface ship sonar, MF1C = >80 percent duty cycle, MF1K = kingfisher mode

Table 16 -- High-Frequency Cetacean Ranges to Effects for Sonar

Sonar Type	Water Depth	Duration	Range to TTS (SD)	Range to AUD INJ (SD)
Dipping Sonar	>200 m	1 s	50 m (27 m)	0 m (2 m)
Dipping Sonar	>200 m	30 s	95 m (51 m)	0 m (4 m)
Dipping Sonar	>200 m	60 s	120 m (70 m)	0 m (5 m)
Dipping Sonar	>200 m	120 s	200 m (100 m)	0 m (8 m)
MF1 Ship Sonar	≤200 m	1 s	525 m (107 m)	45 m (8 m)
MF1 Ship Sonar	≤200 m	30 s	525 m (107 m)	45 m (8 m)
MF1 Ship Sonar	≤200 m	60 s	661 m (143 m)	65 m (12 m)
MF1 Ship Sonar	≤200 m	120 s	714 m (151 m)	85 m (16 m)
MF1 Ship Sonar	>200 m	1 s	600 m (93 m)	42 m (14 m)
MF1 Ship Sonar	>200 m	30 s	600 m (93 m)	42 m (14 m)
MF1 Ship Sonar	>200 m	60 s	875 m (138 m)	65 m (20 m)
MF1 Ship Sonar	>200 m	120 s	1,000 m (152 m)	85 m (20 m)
MF1C Ship Sonar	>200 m	1 s	600 m (93 m)	42 m (14 m)
MF1C Ship Sonar	>200 m	30 s	1,000 m (153 m)	85 m (20 m)
MF1C Ship Sonar	>200 m	60 s	1,500 m (329 m)	130 m (24 m)
MF1C Ship Sonar	>200 m	120 s	3,250 m (1,160 m)	200 m (34 m)
MF1K Ship Sonar	≤200 m	1 s	100 m (17 m)	7 m (3 m)
MF1K Ship Sonar	≤200 m	30 s	182 m (31 m)	13 m (2 m)
MF1K Ship Sonar	≤200 m	60 s	241 m (38 m)	17 m (3 m)
MF1K Ship Sonar	≤200 m	120 s	349 m (58 m)	25 m (4 m)

MF1K Ship Sonar	>200 m	1 s	100 m (30 m)	0 m (3 m)
MF1K Ship Sonar	>200 m	30 s	180 m (32 m)	10 m (6 m)
MF1K Ship Sonar	>200 m	60 s	240 m (40 m)	16 m (8 m)
MF1K Ship Sonar	>200 m	120 s	350 m (56 m)	24 m (11 m)
Mine-Hunting Sonar	≤200 m	1 s	9 m (5 m)	0 m (0 m)
Mine-Hunting Sonar	≤200 m	30 s	18 m (9 m)	1 m (0 m)
Mine-Hunting Sonar	≤200 m	60 s	25 m (13 m)	1 m (1 m)
Mine-Hunting Sonar	≤200 m	120 s	35 m (17 m)	2 m (1 m)
Mine-Hunting Sonar	>200 m	1 s	7 m (4 m)	0 m (0 m)
Mine-Hunting Sonar	>200 m	30 s	15 m (7 m)	0 m (0 m)
Mine-Hunting Sonar	>200 m	60 s	21 m (10 m)	0 m (0 m)
Mine-Hunting Sonar	>200 m	120 s	25 m (9 m)	0 m (1 m)
Sonobuoy Sonar	>200 m	1 s	0 m (4 m)	0 m (0 m)
Sonobuoy Sonar	>200 m	30 s	0 m (9 m)	0 m (0 m)
Sonobuoy Sonar	>200 m	60 s	0 m (13 m)	0 m (0 m)
Sonobuoy Sonar	>200 m	120 s	30 m (17 m)	0 m (1 m)

Note: Median ranges are shown with standard deviation (SD) in parentheses. TTS = Temporary Threshold Shift, AUD INJ = Auditory Injury, MF1 = hull-mounted surface ship sonar, MF1C = >80 percent duty cycle, MF1K = kingfisher mode

Table 17 -- Very High-Frequency Cetacean Ranges to Effects for Sonar

Sonar Type	Water Depth	Duration	Range to TTS (SD)	Range to AUD INJ (SD)
Dipping Sonar	>200 m	1 s	85 m (47 m)	0 m (0 m)
Dipping Sonar	>200 m	30 s	150 m (90 m)	0 m (1 m)
Dipping Sonar	>200 m	60 s	230 m (122 m)	14 m (7 m)
Dipping Sonar	>200 m	120 s	350 m (65 m)	24 m (12 m)
MF1 Ship Sonar	≤200 m	1 s	863 m (136 m)	150 m (3 m)
MF1 Ship Sonar	≤200 m	30 s	863 m (136 m)	150 m (3 m)
MF1 Ship Sonar	≤200 m	60 s	885 m (238 m)	220 m (8 m)
MF1 Ship Sonar	≤200 m	120 s	894 m (254 m)	271 m (18 m)
MF1 Ship Sonar	>200 m	1 s	1,785 m (400 m)	150 m (5 m)
MF1 Ship Sonar	>200 m	30 s	1,785 m (400 m)	150 m (5 m)
MF1 Ship Sonar	>200 m	60 s	4,451 m (830 m)	220 m (2 m)
MF1 Ship Sonar	>200 m	120 s	5,500 m (831 m)	270 m (2 m)
MF1C Ship Sonar	>200 m	1 s	1,778 m (407 m)	145 m (5 m)
MF1C Ship Sonar	>200 m	30 s	5,569 m (823 m)	270 m (2 m)
MF1C Ship Sonar	>200 m	60 s	8,028 m (1,355 m)	390 m (4 m)
MF1C Ship Sonar	>200 m	120 s	11,660 m (2,028 m)	550 m (7 m)
MF1K Ship Sonar	≤200 m	1 s	301 m (23 m)	20 m (0 m)
MF1K Ship Sonar	<200 m	30 s	478 m (68 m)	35 m (0 m)
MF1K Ship Sonar	≤200 m	60 s	557 m (99 m)	50 m (1 m)
MF1K Ship Sonar	≤200 m	120 s	673 m (140 m)	85 m (0 m)
MF1K Ship Sonar	>200 m	1 s	300 m (2 m)	16 m (0 m)
MF1K Ship Sonar	>200 m	30 s	525 m (6 m)	35 m (0 m)
MF1K Ship Sonar	>200 m	60 s	675 m (14 m)	50 m (3 m)
MF1K Ship Sonar	>200 m	120 s	975 m (19 m)	85 m (2 m)
Mine-Hunting Sonar	≤200 m	1 s	115 m (2 m)	10 m (0 m)
Mine-Hunting Sonar	≤200 m	30 s	281 m (4 m)	19 m (0 m)
Mine-Hunting Sonar	≤200 m	60 s	450 m (3 m)	25 m (0 m)
Mine-Hunting Sonar	≤200 m	120 s	606 m (3 m)	40 m (0 m)
Mine-Hunting Sonar	>200 m	1 s	80 m (0 m)	7 m (0 m)
Mine-Hunting Sonar	>200 m	30 s	140 m (0 m)	15 m (0 m)
Mine-Hunting Sonar	>200 m	60 s	210 m (1 m)	22 m (0 m)
Mine-Hunting Sonar	>200 m	120 s	300 m (5 m)	30 m (0 m)
Sonobuoy Sonar	>200 m	1 s	65 m (33 m)	0 m (2 m)
Sonobuoy Sonar	>200 m	30 s	110 m (61 m)	0 m (5 m)

Sonobuoy Sonar	>200 m	60 s	170 m (83 m)	10 m (7 m)
Sonobuoy Sonar	>200 m	120 s	280 m (50 m)	21 m (11 m)

Note: Median ranges are shown with standard deviation (SD) in parentheses. TTS = Temporary Threshold Shift, AUD INJ = Auditory Injury, MF1 = hull-mounted surface ship sonar, MF1C = >80 percent duty cycle, MF1K = kingfisher mode

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Explosives

This section provides the range (*i.e.,* distance) over which specific physiological or behavioral effects are expected to occur based on the explosive criteria (see section 6.2.1 (Impacts from Explosives) of the application and the Criteria and Thresholds Technical Report and the explosive propagation calculations from NAEMO. The range to effects are shown for a range of explosive bins from E1 (0.1–0.25 lb (0.045–0.113 kg) NEW) to E12 (>675–1,000 lb (306–454 kg) NEW) (table 18 through table 21). 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, and AUD INJ. NMFS has reviewed the range distance to effect data provided by the Action Proponents 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 appropriate mitigation ranges to avoid higher level effects, especially injury to marine mammals. For additional information on how ranges to impacts from explosions were estimated, see the Acoustic Impacts Technical Report.

Table 18 through table 21 show the minimum, average, and maximum ranges to onset of auditory and likely behavioral effects that qualify as Level B harassment for all functional hearing groups based on the developed thresholds. Ranges are provided for a representative source depth and cluster size (*i.e.,* the number of rounds fired, or buoys dropped, within a very short duration) for each bin. Ranges for behavioral response are only provided if more than one explosive cluster occurs. As noted previously, single explosions at received sound levels below TTS and AUD INJ thresholds are most likely to result in a brief alerting or orienting response. 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. Modeled ranges to TTS and AUD INJ based on peak pressure for a single explosion generally exceed the modeled ranges based on SEL even when accumulated for multiple explosions. Peak pressure-based ranges are estimated using the best available science; however, data on peak pressure at far distances from explosions are very limited. The explosive ranges to effects for TTS and AUD INJ that are in the tables are based on the metric (*i.e.,* SEL or SPL) that produced larger ranges.

Table 22 shows ranges to non-auditory injury and mortality as a function of animal mass and explosive bin. For non-auditory injury, the larger of the ranges to slight lung injury or gastrointestinal tract injury was used as a conservative estimate, and the boxplots in the MITT Acoustic and Explosive Effects Analysis Technical Report present ranges for both metrics for comparison. For the non-auditory metric, ranges are only available for a cluster size of one. Animals within water volumes encompassing the estimated range to non-auditory injury 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.

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Table 18 -- Very Low-Frequency Cetacean Ranges to Effects for Explosives

Bin	Source Depth	Cluster Size	Range to behavioral disturbance (SD)	Range to TTS (SD)	Range to AUD INJ (SD)
E1	Near surface	1	NA	215 m (0 m)	100 m (0 m)
E2	Below surface	1	NA	420 m (1 m)	132 m (3 m)
E3	Near surface	1	NA	445 m (11 m)	222 m (2 m)
E3	Near surface	7	1,000 m (306 m)	775 m (109 m)	250 m (8 m)
E3	Near surface	15	1,000 m (251 m)	925 m (97 m)	340 m (11 m)
E4	Near surface	1	NA	526 m (3 m)	282 m (1 m)
E4	Below surface	1	NA	1,000 m (12 m)	282 m (1 m)
E5	Near surface	1	NA	601 m (24 m)	350 m (1 m)
E5	Near surface	5	1,000 m (377 m)	925 m (134 m)	350 m (1 m)
E5	Below surface	1	NA	1,688 m (108 m)	351 m (1 m)
E6	Near surface	1	NA	740 m (119 m)	436 m (4 m)
E6	Below surface	1	NA	854 m (162 m)	438 m (6 m)
E7	Near surface	1	NA	2,669 m (233 m)	528 m (14 m)
E7	Below surface	1	NA	2,844 m (309 m)	523 m (15 m)
E8	Near surface	1	NA	1,098 m (76 m)	649 m (21 m)
E9	Near surface	1	NA	1,271 m (428 m)	763 m (30 m)
E10	Near surface	1	NA	1,125 m (186 m)	847 m (36 m)
E11	Below surface	1	NA	40,882 m (6,708 m)	1,861 m (65 m)
E12	Near surface	1	NA	1,625 m (340 m)	951 m (38 m)

Note: N/A = Not Applicable. Behavioral response criteria are applied to explosive clusters >1. The values listed for TTS and AUD INJ are the greater of the respective SPL and SEL ranges. Median ranges are shown with standard deviation (SD) in parentheses. The Action Proponents split the LF functional hearing group into LF and VLF based on Houser *et al.* (2024). NMFS updated acoustic technical guidance (NMFS, 2024) does not include these data but we have included the VLF group here for reference. BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AUD INJ = Auditory Injury, NA = not applicable, near surface explosives occur at or above the surface and are modeled at a depth of 0.1 meter. E1 (0.1-0.25 lb (0.045-0.113 kg)), E2 (>0.25-0.5 lb (0.113-0.23 kg)), E3 (>0.5-2.5 lb (0.23-1.13 kg)), E4 (>2.5-5 lb (1.13-2.27 kg)), E5 (>5-10 lb (2.27-4.54 kg)), E6 (>10-20 lb (4.54-9.07 kg)), E7 (>20-60 lb (9.07-27.2 kg)), E8 (>60-100 lb (27.2-45.4 kg)), E9 (>100-250 lb (45.4-113 kg)), E10 (>250-500 lb (113-227 kg)), E11 (>500-675 lb (227-306 kg)), E12 (>675-1,000 lb (306-454 kg)).

Table 19 -- Low-Frequency Cetacean Ranges to Effects for Explosives

Bin	Source Depth	Cluster Size	Range to behavioral disturbance (SD)	Range to TTS (SD)	Range to AUD INJ (SD)
E1	Near surface	1	NA	246 m (15 m)	100 m (8 m)
E2	Below surface	1	NA	437 m (7 m)	130 m (2 m)
E3	Near surface	1	NA	500 m (74 m)	166 m (17 m)
E3	Near surface	7	1,000 m (375 m)	890 m (161 m)	270 m (23 m)
E3	Near surface	15	1,250 m (391 m)	1,000 m (172 m)	380 m (47 m)
E4	Near surface	1	NA	509 m (8 m)	274 m (4 m)
E4	Below surface	1	NA	1,000 m (0 m)	275 m (3 m)
E5	Near surface	1	NA	700 m (114 m)	320 m (35 m)
E5	Near surface	5	1,250 m (505 m)	1,000 m (224 m)	370 m (46 m)
E5	Below surface	1	NA	1,597 m (190 m)	330 m (0 m)
E6	Near surface	1	NA	819 m (195 m)	413 m (56 m)
E6	Below surface	1	NA	861 m (207 m)	414 m (58 m)
E7	Near surface	1	NA	2,419 m (296 m)	530 m (85 m)
E7	Below surface	1	NA	2,600 m (354 m)	520 m (83 m)
E8	Near surface	1	NA	1,083 m (117 m)	660 m (115 m)
E9	Near surface	1	NA	1,250 m (231 m)	782 m (143 m)
E10	Near surface	1	NA	1,250 m (162 m)	862 m (170 m)
E11	Below surface	1	NA	16,847 m (3,681 m)	1,660 m (70 m)
E12	Near surface	1	NA	1,708 m (283 m)	962 m (177 m)

Note: N/A = Not Applicable. Behavioral response criteria are applied to explosive clusters >1. The values listed for TTS and AUD INJ are the greater of the respective SPL and SEL ranges. Median ranges are shown with standard deviation (SD) in parentheses. The Action Proponents split the LF functional hearing group into LF and VLF based on Houser *et al.* (2024). NMFS updated acoustic technical guidance (NMFS, 2024) does not include these data but we have included the VLF group here for reference. BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AUD INJ = Auditory Injury, NA = not applicable, near surface explosives occur at or above the surface and are modeled at a depth of 0.1 meter. E1 (0.1-0.25 lb (0.045-0.113 kg)), E2 (>0.25-0.5 lb (0.113-0.23 kg)), E3 (>0.5-2.5 lb (0.23-1.13 kg)), E4 (>2.5-5 lb (1.13-2.27 kg)), E5 (>5-10 lb (2.27-4.54 kg)), E6 (>10-20 lb (4.54-9.07 kg)), E7 (>20-60 lb (9.07-27.2 kg)), E8 (>60-100 lb (27.2-45.4 kg)), E9 (>100-250 lb (45.4-113 kg)), E10 (>250-500 lb (113-227 kg)), E11 (>500-675 lb (227-306 kg)), E12 (>675-1,000 lb (306-454 kg)).

Table 20 -- High-Frequency Cetacean Ranges to Effects for Explosives

Bin	Source Depth	Cluster Size	Range to behavioral disturbance (SD)	Range to TTS (SD)	Range to AUD INJ (SD)
E1	Near surface	1	NA	92 m (28 m)	44 m (4 m)
E2	Below surface	1	NA	129 m (39 m)	58 m (2 m)
E3	Near surface	1	NA	180 m (56 m)	98 m (5 m)
E3	Near surface	7	597 m (253 m)	380 m (145 m)	98 m (5 m)
E3	Near surface	15	794 m (368 m)	518 m (203 m)	140 m (40 m)
E4	Near surface	1	NA	228 m (3 m)	120 m (1 m)
E4	Below surface	1	NA	250 m (72 m)	121 m (1 m)
E5	Near surface	1	NA	270 m (85 m)	150 m (12 m)
E5	Near surface	5	824 m (356 m)	515 m (190 m)	150 m (12 m)
E5	Below surface	1	NA	363 m (100 m)	150 m (13 m)
E6	Near surface	1	NA	348 m (112 m)	176 m (13 m)
E6	Below surface	1	NA	341 m (114 m)	180 m (13 m)
E7	Near surface	1	NA	304 m (241 m)	157 m (107 m)
E7	Below surface	1	NA	303 m (228 m)	156 m (115 m)
E8	Near surface	1	NA	499 m (202 m)	279 m (39 m)
E9	Near surface	1	NA	637 m (278 m)	368 m (72 m)
E10	Near surface	1	NA	750 m (367 m)	434 m (109 m)
E11	Below surface	1	NA	1,653 m (871 m)	755 m (42 m)

Note: N/A = Not Applicable. Behavioral response criteria are applied to explosive clusters >1. The values listed for TTS and AUD INJ are the greater of the respective SPL and SEL ranges. Median ranges are shown with standard deviation (SD) in parentheses. BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AUD INJ = Auditory Injury, NA = not applicable, near surface explosives occur at or above the surface and are modeled at a depth of 0.1 meter. E1 (0.1-0.25 lb (0.045-0.113 kg)), E2 (>0.25-0.5 lb (0.113-0.23 kg)), E3 (>0.5-2.5 lb (0.23-1.13 kg)), E4 (>2.5-5 lb (1.13-2.27 kg)), E5 (>5-10 lb (2.27-4.54 kg)), E6 (>10-20 lb (4.54-9.07 kg)), E7 (>20-60 lb (9.07-27.2 kg)), E8 (>60-100 lb (27.2-45.4 kg)), E9 (>100-250 lb (45.4-113 kg)), E10 (>250-500 lb (113-227 kg)), E11 (>500-675 lb (227-306 kg)), E12 (>675-1,000 lb (306-454 kg)).

Table 21 -- Very High-Frequency Cetacean Ranges to Effects for Explosives

Bin	Source Depth	Cluster Size	Range to behavioral disturbance (SD)	Range to TTS (SD)	Range to AUD INJ (SD)
E1	Near surface	1	NA	1,375 m (21 m)	697 m (2 m)
E2	Below surface	1	NA	3,076 m (268 m)	1,000 m (0 m)
E3	Near surface	1	NA	2,000 m (57 m)	1,250 m (0 m)
E3	Near surface	7	5,764 m (2,284 m)	3,611 m (1,773 m)	1,500 m (123 m)
E3	Near surface	15	6,889 m (1,601 m)	3,806 m (1,268 m)	1,750 m (33 m)
E4	Near surface	1	NA	3,714 m (248 m)	1,853 m (30 m)
E4	Below surface	1	NA	3,757 m (368 m)	1,875 m (20 m)
E5	Near surface	1	NA	2,250 m (241 m)	1,528 m (214 m)
E5	Near surface	5	6,382 m (1,710 m)	3,681 m (1,179 m)	1,750 m (95 m)
E5	Below surface	1	NA	6,604 m (281 m)	1,514 m (16 m)
E6	Near surface	1	NA	2,944 m (396 m)	1,819 m (222 m)
E6	Below surface	1	NA	3,663 m (509 m)	2,108 m (333 m)
E7	Near surface	1	NA	5,236 m (290 m)	3,888 m (203 m)
E7	Below surface	1	NA	5,326 m (501 m)	4,056 m (297 m)
E8	Near surface	1	NA	4,264 m (297 m)	2,396 m (94 m)
E9	Near surface	1	NA	5,704 m (574 m)	2,611 m (234 m)
E10	Near surface	1	NA	6,444 m (587 m)	2,583 m (349 m)
E11	Below surface	1	NA	48,069 m (4,745 m)	18,590 m (2,562 m)
E12	Near surface	1	NA	8,035 m (917 m)	3,375 m (573 m)

Note: N/A = Not Applicable. Behavioral response criteria are applied to explosive clusters >1. The values listed for TTS and AUD INJ are the greater of the respective SPL and SEL ranges. Median ranges are shown with standard deviation (SD) in parentheses. BEH = Significant Behavioral Response, TTS = Temporary Threshold Shift, AUD INJ = Auditory Injury, NA = not applicable, near surface explosives occur at or above the surface and are modeled at a depth of 0.1 meter. E1 (0.1-0.25 lb (0.045-0.113 kg)), 10 lb (2.27-4.54 kg)), E6 (>10-20 lb (4.54-9.07 kg)), E7 (>20-60 lb (9.07-27.2 kg)), E8 (>60-100 lb (27.2-45.4 kg)), E9 (>100-250 lb (45.4-113 kg)), E10 (>250-500 lb (113-227 kg)), E11 (>500-675 lb (227-306 kg)), E12 (>675-1,000 lb (306-454 kg)).

Table 22 -- Explosive Ranges to Non-Auditory Injury and Mortality for all Marine Mammal Hearing Groups as a Function of Animal Mass

Bin	Effect	10 kg (SD)	250 kg (SD)	1,000 kg (SD)	5,000 kg (SD)	25,000 kg (SD)	72,000 kg (SD)
E1	Non-auditory injury	22 m (0 m)	20 m (3 m)	20 m (3 m)	22 m (4 m)	22 m (2 m)	20 m (2 m)
E1	Mortality	3 m (0 m)	1 m (1 m)	0 m (0 m)	0 m (0 m)	0 m (0 m)	0 m (0 m)
E2	Non-auditory injury	28 m (0 m)	28 m (1 m)	25 m (1 m)	25 m (1 m)	25 m (1 m)	25 m (0 m)
E2	Mortality	8 m (0 m)	3 m (2 m)	0 m (1 m)	0 m (0 m)	0 m (0 m)	0 m (0 m)
E3	Non-auditory injury	48 m (0 m)	45 m (3 m)	45 m (2 m)	45 m (4 m)	48 m (2 m)	45 m (0 m)
E3	Mortality	8 m (0 m)	3 m (2 m)	2 m (1 m)	1 m (0 m)	0 m (0 m)	0 m (0 m)
E4	Non-auditory injury	60 m (2 m)	60 m (2 m)	60 m (1 m)	60 m (0 m)	60 m (2 m)	60 m (0 m)
E4	Mortality	18 m (3 m)	8 m (4 m)	3 m (1 m)	0 m (0 m)	0 m (0 m)	0 m (0 m)
E5	Non-auditory injury	78 m (1 m)	78 m (4 m)	78 m (3 m)	77 m (3 m)	78 m (4 m)	78 m (0 m)
E5	Mortality	14 m (1 m)	6 m (3 m)	3 m (2 m)	2 m (1 m)	0 m (0 m)	0 m (0 m)
E6	Non-auditory injury	96 m (4 m)	98 m (5 m)	98 m (6 m)	98 m (2 m)	98 m (8 m)	98 m (0 m)
E6	Mortality	17 m (2 m)	8 m (3 m)	4 m (2 m)	2 m (1 m)	1 m (0 m)	0 m (0 m)
E7	Non-auditory injury	27 m (14 m)	31 m (41 m)	45 m (51 m)	31 m (43 m)	29 m (47 m)	29 m (15 m)
E7	Mortality	5 m (3 m)	3 m (2 m)	1 m (1 m)	1 m (1 m)	0 m (0 m)	0 m (0 m)
E8	Non-auditory injury	151 m (14 m)	156 m (11 m)	156 m (15 m)	165 m (4 m)	140 m (12 m)	165 m (1 m)
E8	Mortality	28 m (0 m)	15 m (5 m)	8 m (1 m)	5 m (2 m)	3 m (1 m)	1 m (1 m)
E9	Non-auditory injury	190 m (15 m)	190 m (16 m)	191 m (25 m)	225 m (10 m)	171 m (13 m)	225 m (0 m)
E9	Mortality	57 m (8 m)	21 m (10 m)	12 m (1 m)	8 m (2 m)	4 m (1 m)	2 m (1 m)
E10	Non-auditory injury	225 m (21 m)	230 m (25 m)	240 m (29 m)	275 m (21 m)	240 m (25 m)	282 m (3 m)
E10	Mortality	48 m (1 m)	25 m (6 m)	14 m (1 m)	10 m (2 m)	5 m (1 m)	3 m (0 m)
E11	Non-auditory injury	624 m (19 m)	345 m (17 m)	337 m (16 m)	349 m (20 m)	351 m (15 m)	335 m (16 m)
E11	Mortality	306 m (7 m)	166 m (41 m)	92 m (6 m)	65 m (5 m)	35 m (2 m)	26 m (4 m)
E12	Non-auditory injury	255 m (21 m)	305 m (41 m)	321 m (37 m)	345 m (39 m)	320 m (33 m)	353 m (1 m)
E12	Mortality	67 m (25 m)	38 m (17 m)	18 m (1 m)	12 m (1 m)	7 m (1 m)	5 m (0 m)

Note: Median ranges with standard deviation (SD) in parentheses. For non-auditory injury ranges, the greater of the respective ranges for 1 percent chance of gastro-intestinal tract injury and 1 percent chance of injury. E1 (0.1-0.25 lb (0.045-0.113 kg)), E2 (>0.25-0.5 lb (0.113-0.23 kg)), E3 (>0.5-2.5 lb (0.23-1.13 kg)), E4 (>2.5-5 lb (1.13-2.27 kg)), E5 (>5-10 lb (2.27-4.54 kg)), E6 (>10-20 lb (4.54-9.07 kg)), E7 (>20-60 lb (9.07-27.2 kg)), E8 (>60-100 lb (27.2-45.4 kg)), E9 (>100-250 lb (45.4-113 kg)), E10 (>250-500 lb (113-227 kg)), E11 (>500-675 lb (227-306 kg)), E12 (>675-1,000 lb (306-454 kg)).

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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; Bradford *et al.,* 2021; Calambokidis *et al.,* 2008). This is the general approach applied in estimating cetacean abundance in NMFS SARs. Although the single value provides a good average estimate of abundance (*i.e.,* 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 has been used to estimate cetacean densities (*e.g.,* Becker *et al.,* 2022a, Becker *et al.,* 2022b, Becker *et al.,* 2021, Becker *et al.,* 2020a; Becker *et al.,* 2020b). These models estimate cetacean density as a continuous function of habitat variables (*e.g.,* sea surface temperature, seafloor depth) 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 specified activities on marine species. However, in many places, vessel 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 the marine species density for large oceanic regions, the Action Proponents review, critically assess, and prioritize 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 NMSDD, which includes seasonal density values for every marine mammal species and stock present within the Study Area. This database is described in the ''U.S. Navy Marine Species Density Database Phase IV for the Mariana Islands Training and Testing Study Area'' technical report (U.S. Department of the Navy, 2024c) (hereafter referred to as the Density Technical Report). NMFS reviewed all marine mammal densities provided by the Action Proponents prior to use in their acoustic analysis for the current rulemaking process.

A variety of density data and density models are needed to develop a density database that encompasses the entirety of the Study Area. Because these data are collected using different methods with varying amounts of accuracy and uncertainty, the Action Proponents have developed a hierarchy to ensure the most accurate data are used when available. The ''U.S. Navy Marine Species Density Database Phase IV for the Hawaii California Training and Testing Study Area'' technical report (U.S. Department of the Navy, 2024b) describes these models in detail and provides detailed explanations of the best available density estimate for each species. The list below describes possible sources of density data in order of preference:

1. Density spatial models are preferred and used when available because they provide spatially-explicit density estimates (typically at 10 km by 10 km spatial resolution) throughout the study area with the least amount of uncertainty. These models (see Becker *et al.,* 2019, 2021, 2020a, 2020b, 2022a, 2022b; Forney *et al.,* 2015) predict spatial variability of animal density based on habitat variables (*e.g.,* sea surface temperature, seafloor depth). Density spatial models are developed for areas, species, and, when available, specific timeframes (*e.g.,* months or seasons) with sufficient survey data; therefore, these models 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 (*i.e.,* stratified) into sub-regions, and a density is derived for each sub-region (see Barlow, 2016; Barlow and Forney, 2007; Bradford *et al.,* 2021). 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 collected from ship or aerial surveys designed to cover a specific geographic area (see Carretta *et al.,* 2024a). 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.

When interpreting the results of the quantitative analysis, as described in the Density Technical Report for the Phase III Atlantic Fleet Training and Testing Study Area (U.S. Department of the Navy, 2017b), ''it is important to consider that even the best estimate of marine species density is really a model representation of the values of concentration where these animals might occur. Each model is limited to the variables and assumptions considered by the original data source provider. No mathematical model representation of any biological population is perfect and with regards to marine species biodiversity, any single model method will not completely explain the actual distribution and abundance of marine

mammal species. It is expected that there would be anomalies in the results that need to be evaluated, with independent information for each case, to support if we might accept or reject a model or portions of the model.''

When calculating the proportion of a population affected by takes (*e.g.,* the number of takes divided by population abundance), which can also be helpful in estimating the number of days over which some individuals may be taken, it is important to choose an appropriate population estimate against which to make the comparison. The SARs, where available, provide the official population estimate for a given species or stock in U.S. waters in a given year (and are typically based solely on the most recent survey data). When the stock is known to range well outside of U.S. EEZ boundaries, population estimates based on surveys conducted only within the U.S. EEZ are known to be underestimates. For marine mammal populations in the Study Area, there have been no specific stocks assigned to those populations and there are no associated SARs, with the exception of the Western North Pacific stock of humpback whale and the Central North Pacific stock of blue whale. There is also no information on trends for any of these species. The information used to estimate take includes the best available survey abundance data to model density layers. Accordingly, in calculating the percentage of takes versus abundance for each species in order to assist in understanding both the percentage of the species affected, as well as how many days across a year individuals could be taken, we use the data most appropriate for the situation: the survey data used to estimate abundance in the Density Technical Report. Models may predict different population abundances for many reasons. The models may be based on different data sets or different temporal predictions may be made. For example, the SARs are often based on single years of NMFS surveys, whereas the models used by the Navy generally include multiple years of survey data from NMFS, the Navy, and other sources. To present a single, best estimate, the SARs often use a single season survey where they have the best spatial coverage (generally summer). Navy models often use predictions for multiple seasons, where appropriate for the species, even when survey coverage in non-Summer seasons is limited, to characterize impacts over multiple seasons as Navy activities may occur in any season. Predictions may be made for different spatial extents. Many different, but equally valid, habitat and density modeling techniques exist, and these can also be the cause of differences in population predictions.

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 species and 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.

Estimated Take From Acoustic Stressors

The 2026 MITT Draft SEIS/OEIS considered all military readiness activities proposed to occur in the Study Area that have the potential to result in the MMPA defined take of marine mammals. The Action Proponents determined that the two stressors below could result in the incidental taking of marine mammals. NMFS has reviewed the Action Proponents' 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 specified activities:

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

Acoustic and explosive sources are likely to result in incidental takes of marine mammals by harassment.

The quantitative analysis process used for the 2026 MITT Draft SEIS/OEIS and the application to estimate potential exposures of marine mammals resulting from acoustic and explosive stressors is detailed in the Acoustic Impacts Technical Report.

Regarding how avoidance of loud sources is considered in the take estimation, NAEMO does not simulate horizontal animat (*i.e.,* a virtual animal) movement during an event. However, NAEMO approximates marine mammal avoidance of high sound levels due to exposure to sonars in a one-dimensional calculation that scales how far an animat would be from a sound source based on sensitivity to disturbance, swim speed, and avoidance duration. This process reduces the SEL, defined as the accumulation for a given animat, by reducing the received SPL of individual exposures based on a spherical spreading calculation from sources on each unique platform in an event. The onset of avoidance was based on the BRFs. Avoidance speeds and durations were informed by a review of available exposure and baseline data. This method captures a more accurate representation of avoidance by using the received sound levels, distance to platform, and species-specific criteria to calculate potential avoidance for each animat than the approach used in Phase III. However, this method may underestimate avoidance of long-duration sources with lower sound levels because it triggers avoidance calculations based on the highest modeled SPL received level exceeding p(0.5) on the BRF, rather than on cumulative exposure. Please see section 4.4.2.2 of the Acoustic Impacts Technical Report.

Regarding the consideration of mitigation effectiveness in the take estimation, during military readiness 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, unlike in previous phases of MITT, this quantitative analysis does not reduce model-estimated impacts to account for activity-based mitigation. While the activity-based mitigation is not quantitatively included in the take estimates (which, of note, would result in a reduction in the number of takes), table 2.3–1 of the MITT Acoustic and Explosive Effects Analysis Technical Report indicates the percentage of the instances of take where an animal's closest point of approach was within a mitigation zone and, therefore, AUD INJ could potentially be mitigated. Note that these percentages do not account for other factors, such as the sightability of a given species or viewing conditions.

While mitigation areas are not quantitatively included in the take estimates, the extent to which the mitigation areas reduce impacts on the affected species is addressed in the Preliminary Analysis and Negligible Impact Determination section.

For additional information on the quantitative analysis process, refer to the Acoustic Impacts Technical Report and sections 6 and 11 of the 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 marine mammals. There are multiple pieces of the Navy's 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 Action Proponents' 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, NAEMO is the result of a NMFS-led Center for Independent Experts review of the components used in earlier models. The acoustic propagation component of NAEMO (titled CASS/GRAB) is accredited by the Oceanographic and Atmospheric Master Library (OAML), and many of the environmental variables used in NAEMO come from approved OAML databases and are based on in-situ data collection. The animal density components of NAEMO 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, habitat-based density model results for species off Hawaii and California) have been published in several peer-reviewed journals (Becker *et al.,* 2020b, 2021, 2022a, 2022b). Additionally, NAEMO simulation components underwent quality assurance and quality control (commonly referred to as QA/QC) review and validation for model parts (*e.g.,* scenario builder, acoustic builder, scenario simulator), conducted by qualified statisticians and modelers to ensure accuracy. Other models and methodologies have gone through similar review processes.

In summary, we conclude the Action Proponents' methods, including the method for incorporating avoidance, are the most appropriate methods for predicting AUD INJ, non-auditory injury, TTS, and behavioral disturbance. Even with the consideration of 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 AUD INJ, non-auditory injury, TTS, or behavioral disturbance.

Based on the methods discussed in the previous sections and NAEMO, the Action Proponents provided their take estimates and request for authorization of takes incidental to the use of acoustic and explosive sources for military readiness activities annually (based on the maximum number of activities that could occur per 12-month period) and over the 7-year period covered by the application. NMFS has reviewed the Action Proponents' 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.

Table 23 and table 24 summarize the maximum annual and 7-year total amount and type of Level A harassment and Level B harassment that NMFS concurs is reasonably expected to occur by species and stock for training activities and testing activities, respectively.

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Table 23 -- Incidental Take Estimate by Species and Stock due to Acoustic and Explosive Sources during Training Activities

Species	Stock	Maximum annual Level B harassment	Maximum annual Level A harassment	7-year total Level B harassment	7-year total Level A harassment
Blue Whale	Central North Pacific	40	1	264	3
Bryde's Whale	NSD	66	1	441	5
Fin Whale	NSD	33	1	223	1
Humpback Whale	Western North Pacific	1,491	21	10,364	136
Minke Whale	NSD	23	1	151	2
Omura's Whale	NSD	50	1	331	2
Sei Whale	NSD	35	1	236	2
Sperm Whale	NSD	212	0	1,461	0
Dwarf Sperm Whale	NSD	17,859	306	123,632	2,089
Pygmy Sperm Whale	NSD	20,083	353	139,007	2,402
Blainville's Beaked Whale	NSD	2,973	0	20,517	0
Deraniyagala Beaked Whale	NSD	4735	1	32,543	3
Ginkgo-toothed Beaked Whale	NSD	5,632	0	38,642	0
Goose-Beaked Whale	NSD	2,476	0	17,042	0
Longman's Beaked Whale	NSD	964	0	6,600	0
False Killer Whale	NSD	217	0	1,506	0
Killer Whale	NSD	50	0	349	0
Melon-Headed Whale	NSD	453	1	3,142	1
Pygmy Killer Whale	NSD	844	1	5,852	1
Short-Finned Pilot Whale	NSD	216	0	1,493	0
Bottlenose Dolphin	NSD	339	1	2,339	1
Fraser's Dolphin	NSD	10,912	5	75,612	22
Pantropical Spotted Dolphin	NSD	4,354	3	30,094	11
Risso's Dolphin	NSD	1,701	2	11,799	4
Rough-Toothed Dolphin	NSD	1,897	1	13,164	6
Spinner Dolphin	NSD	3,935	2	26,307	9
Striped Dolphin	NSD	1,497	1	10,391	3

Note: Mortality is neither anticipated nor proposed for authorization.

Table 24 -- Incidental Take Estimate by Species and Stock due to Acoustic and Explosive Sources during Testing Activities

Species	Stock	Maximum annual Level B harassment	Maximum annual Level A harassment	7-year total Level B harassment	7-year total Level A harassment
Blue Whale	Central North Pacific	2	0	5	0
Bryde's Whale	NSD	2	0	8	0
Fin Whale	NSD	2	0	6	0
Humpback Whale	Western North Pacific	26	0	170	0
Minke Whale	NSD	2	0	3	0
Omura's Whale	NSD	2	0	5	0
Sei Whale	NSD	2	0	5	0
Sperm Whale	NSD	13	0	80	0
Dwarf Sperm Whale	NSD	857	17	5,946	67
Pygmy Sperm Whale	NSD	909	21	6,322	82
Blainville's Beaked Whale	NSD	147	0	1,018	0
Deraniyagala Beaked Whale	NSD	238	0	1,648	0
Ginkgo-toothed Beaked Whale	NSD	297	0	2,078	0
Goose-Beaked Whale	NSD	142	0	993	0
Longman's Beaked Whale	NSD	51	0	357	0
False Killer Whale	NSD	11	0	70	0
Killer Whale	NSD	4	0	17	0
Melon-Headed Whale	NSD	22	0	148	0
Pygmy Killer Whale	NSD	41	0	280	0
Short-Finned Pilot Whale	NSD	12	0	74	0
Bottlenose Dolphin	NSD	17	0	115	0
Fraser's Dolphin	NSD	513	1	3,567	1
Pantropical Spotted Dolphin	NSD	201	0	1,399	0
Risso's Dolphin	NSD	80	0	555	0
Rough-Toothed Dolphin	NSD	87	0	599	0
Spinner Dolphin	NSD	156	0	1,068	0
Striped Dolphin	NSD	66	0	451	0

Note: Mortality is neither anticipated nor proposed for authorization.

Estimated Take From Sonar and Other Transducers—

Table 25 and table 26 provide estimated effects from sonar and other transducers, including the comparative amounts of TTS and behavioral disturbance for each species and stock annually, noting that if a modeled marine mammal was taken through exposure to both TTS and behavioral disturbance in the model, it was recorded as a TTS.

The updated HF cetacean criteria reflect greater susceptibility to auditory effects at low and mid-frequencies than previously analyzed. Consequently, the predicted auditory effects due to sources under 10 kHz, including but not limited to MF1 hull-mounted sonar and other ASW sonars, are substantially greater for this auditory group than in prior analyses of the same activities. Thus, for activities with sonars, some modeled exposures that would previously have been categorized as significant behavioral responses may now instead be counted as auditory effects (TTS and AUD INJ). Similarly, the updated HF cetacean criteria reflect greater susceptibility to auditory effects at low and mid-frequencies in impulsive sounds. For VHF cetaceans, susceptibility to auditory effects has not changed substantially since the prior analysis.

Table 25 -- Annual and 7-Year Estimated Take of Marine Mammal Species and Stocks from Sonar and Other Active Transducers during Training Activities

Species	Stock	Maximum annual behavioral	Maximum annual TTS	Maximum annual ΛUD INJ	Maximum annual non-auditory injury	Maximum 7-year behavioral	Maximum 7-year TTS	Maximum 7-year ΛUD INJ	Maximum 7-year non-auditory injury
Blue Whale	Central North Pacific	2	36	(1)	-	10	252	3	-
Bryde's Whale	NSD	2	62	1	-	11	428	5	-
Fin Whale	NSD	2	30	(1)	-	12	210	1	-
Humpback Whale	Western North Pacific	27	1,453	20	-	178	10,128	135	-
Minke Whale	NSD	(1)	21	(1)	-	3	147	2	-
Omura's Whale	NSD	2	46	(1)	-	10	318	2	-
Sei Whale	NSD	1	33	(1)	-	6	229	2	-
Sperm Whale	NSD	111	99	0	-	769	689	0	-
Dwarf Sperm Whale	NSD	936	16,328	247	-	6,269	113,665	1,720	-
Pygmy Sperm Whale	NSD	1,064	18,327	285	-	7,128	127,574	1,980	-
Blainville's Beaked Whale	NSD	2,948	23	-	-	20,354	160	-	-
Deraniyagala Beaked Whale	NSD	4,727	1	-	-	32,496	5	-	-
Ginkgo-toothed Beaked Whale	NSD	5,577	53	-	-	38,266	371	-	-
Goose-Beaked Whale	NSD	2,455	19	-	-	16,911	129	-	-
Longman's Beaked Whale	NSD	951	11	-	-	6,527	71	-	-
False Killer Whale	NSD	60	157	0	-	414	1,092	0	-
Killer Whale	NSD	11	39	0	-	76	273	0	-
Melon-Headed Whale	NSD	150	302	(1)	-	1,034	2,107	1	-

Pygmy Killer Whale	NSD	230	612	(1)	-	1,578	4,272	1	-
Short-Finned Pilot Whale	NSD	69	146	0	-	476	1,016	0	-
Bottlenose Dolphin	NSD	100	237	(1)	-	683	1,654	1	-
Fraser's Dolphin	NSD	3,728	7,169	3	-	25,525	49,998	18	-
Pantropical Spotted Dolphin	NSD	1,181	3,170	2	-	7,998	22,078	9	-
Risso's Dolphin	NSD	477	13	-	-	3,260	8,535	3	-
Rough-Toothed Dolphin	NSD	422	1,473	1	-	2,886	10,273	6	-
Spinner Dolphin	NSD	2,133	1,798	1	-	13,873	12,408	4	-
Striped Dolphin	NSD	370	1,125	(1)	-	2,540	7,847	3	-
Note: Mortality is neither anticipated nor proposed for authorization. Zero (0) impacts indicate total less than 0.5 and a dash (-) is a true zero. In some cases where the estimated take within a cell is equal to 1, that value has been rounded up from a value that is less than 0.5 to avoid underestimating potential impacts to a species or stock based on the 7-year rounding rules discussed in the MITT Acoustic and Explosive Effects Analysis Technical Report.									

Table 26 -- Annual and 7-Year Estimated Take of Marine Mammal Stocks from Sonar and Other Active Transducers During Testing Activities

Species	Stock	Maximum annual behavioral	Maximum annual TTS	Maximum annual AUD INJ	Maximum annual non-auditory injury	Maximum 7-year behavioral	Maximum 7-year TTS	Maximum 7-year AUD INJ	Maximum 7-year non-auditory injury
Blue Whale	Central North Pacific	1	(1)	-	-	4	1	-	-
Bryde's Whale	NSD	1	(1)	-	-	5	3	-	-
Fin Whale	NSD	1	(1)	-	-	5	1	-	-
Humpback Whale	Western North Pacific	15	10	0	-	104	65		-
Minke Whale	NSD	(1)	(1)	-	-	2	1	-	-
Omura's Whale	NSD	1	(1)	-	-	4	1	-	-
Sei Whale	NSD	(1)	(1)	0	-	3	2		
Sperm Whale	NSD	12	(1)	-	-	79	1	-	-
Dwarf Sperm Whale	NSD	150	686	7	-	1,044	4,796	48	-
Pygmy Sperm Whale	NSD	158	728	9	-	1,102	5,096	559	-
Blainville's Beaked Whale	NSD	146	(1)	-	-	1,017	1	-	-
Deraniyagala Beaked Whale	NSD	236	(1)	-	-	1,646	1	-	-
Ginkgo-toothed Beaked Whale	NSD	297	0	-	-	2,078	0	-	-
Goose-Beaked Whale	NSD	142	0	-	-	993	0	-	-
Longman's Beaked Whale	NSD	51	0	-	-	357	0	-	-

False Killer Whale	NSD	10	(1)	-	-	68	2	-	-
Killer Whale	NSD	3	(1)	-	-	16	1	-	-
Melon-Headed Whale	NSD	21	1	-	-	142	6	-	-
Pygmy Killer Whale	NSD	39	2	0	-	270	10	0	-
Short-Finned Pilot Whale	NSD	11	(1)	-	-	72	2	-	-
Bottlenose Dolphin	NSD	16	1	-	-	111	4	-	-
Fraser's Dolphin	NSD	499	12	-	-	3,487	78	-	-
Pantropical Spotted Dolphin	NSD	190	11	0	-	1,328	71	0	-
Risso's Dolphin	NSD	77	3	0	-	535	20	-	-
Rough-Toothed Dolphin	NSD	83	4	0	-	577	22	0	-
Spinner Dolphin	NSD	113	41	0	-	785	281	0	-
Striped Dolphin	NSD	63	3	-	-	435	16	-	-

Note: Mortality is neither anticipated nor proposed for authorization. Zero (0) impacts indicate total less than 0.5 and a dash (-) is a true zero. In some cases where the estimated take within a cell is equal to 1, that value has been rounded up from a value that is less than 0.5 to avoid underestimating potential impacts to a species or stock based on the 7-year rounding rules discussed in the MITT Acoustic and Explosive Effects Analysis Technical Report.

Estimated Take From Explosives

Table 27 and table 28 provide estimated effects from explosives during training and testing activities, respectively.

Table 27 -- Annual and 7-Year Estimated Take of Marine Mammal Species and Stocks from Explosives during Training Activities

Species	Stock	Maximum annual behavioral	Maximum annual TTS	Maximum annual AUD INJ	Maximum annual non-auditory injury	Maximum annual mortality	Maximum 7-year behavioral	Maximum 7-year TTS	Maximum 7-year AUD INJ	Maximum 7-year non-auditory injury	Maximum 7-year mortality
Blue Whale	Central North Pacific	(1)	(1)	-	-	-	1	1	-	-	-
Bryde's Whale	NSD	(1)	(1)	0	-	-	1	1	0	-	-
Fin Whale	NSD	(1)	0	0	-	-	1	0	0	-	-
Humpback Whale	Western North Pacific	7	4	(1)	-	-	37	21	1	-	-
Minke Whale	NSD	(1)	0	-	-	-	1	0	-	-	-
Omura's Whale	NSD	(1)	(1)	-	-	-	1	2	-	-	-
Sei Whale	NSD	(1)	0	0	-	-	1	0	0	-	-
Sperm Whale	NSD	(1)	(1)	0	-	-	2	1	0	-	-
Dwarf Sperm Whale	NSD	302	293	59	0	0	1,855	1,843	369	0	0
Pygmy Sperm Whale	NSD	343	349	68	0	0	2,115	2,190	424	0	0
Blainville's Beaked Whale	NSD	(1)	(1)	0	0	-	2	1	0	0	-
Deraniyagala Beaked Whale	NSD	4	3	(1)	-	-	23	19	3	-	-
Ginkgo-toothed Beaked Whale	NSD	(1)	1	0	0	-	2	3	0	0	-
Goose-Beaked Whale	NSD	(1)	(1)	0	0	-	1	1	0	0	-
Longman's Beaked Whale	NSD	(1)	(1)	0	0	-	1	1	0	0	-

False Killer Whale	NSD	0	0	0	0	-	0	0	0	0	-
Killer Whale	NSD	-	-	-	-	-	-	-	-	-	
Melon-Headed Whale	NSD	(1)	0	0	0	-	1	0	0	0	-
Pygmy Killer Whale	NSD	(1)	(1)	0	0	0	1	1	0	0	0
Short-Finned Pilot Whale	NSD	(1)	0	0	0	0	1	0	0	0	0
Bottlenose Dolphin	NSD	(1)	(1)	0	0	0	1	1	0	0	0
Fraser's Dolphin	NSD	9	6	(1)	(1)	0	54	35	3	1	0
Pantropical Spotted Dolphin	NSD	2	1	(1)	0	0	11	7	2	0	0
Risso's Dolphin	NSD	1	0	0	(1)	-	4	0	0	1	-
Rough-Toothed Dolphin	NSD	1	(1)	0	0	0	3	2	0	0	0
Spinner Dolphin	NSD	1	3	1	0	-	5	21	5	0	-
Striped Dolphin	NSD	(1)	(1)	0	0	-	2	2	0	0	-

Note: Mortality is neither anticipated nor proposed for authorization. Zero (0) impacts indicate total less than 0.5 and a dash (-) is a true zero. In some cases where the estimated take within a cell is equal to 1, that value has been rounded up from a value that is less than 0.5 to avoid underestimating potential impacts to a species or stock based on the 7-year rounding rules discussed in the MITT Acoustic and Explosive Effects Analysis Technical Report.

Table 28 -- Annual and 7-Year Estimated Take of Marine Mammal Stocks from Explosives During Testing Activities

Species	Stock	Maximum annual behavioral	Maximum annual TTS	Maximum annual AUD INJ	Maximum annual non-auditory injury	Maximum annual mortality	Maximum 7-year behavioral	Maximum 7-year TTS	Maximum 7-year AUD INJ	Maximum 7-year non-auditory injury	Maximum 7-year mortality
Blue Whale	Central North Pacific	-	-	-	-	-	-	-	-	-	-
Bryde's Whale	NSD	0	0	0	-	-	0	0	0	-	-
Fin Whale	NSD	-	0	-	-	-	-	0	-	-	-
Humpback Whale	Western North Pacific	0	(1)	-	-	-	0	1	-	-	-
Minke Whale	NSD	-	0	-	-	-	-	0	-	-	-
Omura's Whale	NSD	-	0	-	-	-	-	0	-	-	-
Sei Whale	NSD	-	0	-	-	-	-	0	-	-	-
Sperm Whale	NSD	0	0	0	-	-	0	0	0	-	-
Dwarf Sperm Whale	NSD	7	14	10	0	0	44	62	19	0	0
Pygmy Sperm Whale	NSD	7	16	12	-	-	45	79	23	-	-
Blainville's Beaked Whale	NSD	0	0	0	-	-	0	0	0	-	-
Deraniyagala Beaked Whale	NSD	0	(1)	-	-	-	0	1	-	-	-
Ginkgo-toothed Beaked Whale	NSD	0	-	-	-	-	0	-	-	-	-
Goose-Beaked Whale	NSD	0	0	0	-	-	0	0	0	-	-
Longman's Beaked Whale	NSD	0	0	0	-	-	0	0	0	-	-

False Killer Whale	NSD	-	0	0	-	-	-	0	0	-	-
Killer Whale	NSD	-	-	-	-	-	-	-	-	-	-
Melon-Headed Whale	NSD	0	0	-	-	-	0	0	-	-	-
Pygmy Killer Whale	NSD	0	0	0	0	0	0	0	0	0	0
Short-Finned Pilot Whale	NSD	0	0	-	-	-	0	0	-	-	-
Bottlenose Dolphin	NSD	0	0	0	0	-	0	0	0	0	-
Fraser's Dolphin	NSD	(1)	(1)	(1)	-	-	1	1	1	-	-
Pantropical Spotted Dolphin	NSD	0	0	0	0	-	0	0	0	0	-
Risso's Dolphin	NSD	0	-	0	-	-	0	-	0	-	-
Rough-Toothed Dolphin	NSD	0	0	0	0	0	0	0	0	0	0
Spinner Dolphin	NSD	(1)	(1)	0	-	-	1	1	0	-	-
Striped Dolphin	NSD	0	0	0	0	-	0	0	0	0	-

Note: Mortality is neither anticipated nor proposed for authorization. Zero (0) impacts indicate total less than 0.5 and a dash (-) is a true zero. In some cases where the estimated take within a cell is equal to 1, that value has been rounded up from a value that is less than 0.5 to avoid underestimating potential impacts to a species or stock based on the 7-year rounding rules discussed in the MITT Acoustic and Explosive Effects Analysis Technical Report.

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Summary of Requested Take From Military Readiness Activities

Table 29 and table 30 summarize the take requested by the Action Proponents and proposed for authorization by NMFS by harassment type and effect type, respectively.

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Table 29 -- Total Annual and 7-year Incidental Take Proposed for Authorization by Species and Stock During all Activities by Harassment Type

Species	Stock	Maximum annual Level B harassment	Maximum annual Level A harassment	7-year total Level B harassment	7-year total Level A harassment
Blue Whale	Central North Pacific	42	1	269	3
Bryde's Whale	NSD	68	1	449	5
Fin Whale	NSD	35	1	229	1
Humpback Whale	Western North Pacific	1,517	21	10,534	136
Minke Whale	NSD	25	1	154	2
Omura's Whale	NSD	52	1	336	2
Sei Whale	NSD	37	1	241	2
Sperm Whale	NSD	225	0	1,541	0
Dwarf Sperm Whale	NSD	18,716	323	129,578	2,156
Pygmy Sperm Whale	NSD	20,992	374	145,329	2,486
Blainville's Beaked Whale	NSD	3,120	0	21,535	0
Deraniyagala Beaked Whale	NSD	4,973	1	34,191	3
Ginkgo-toothed Beaked Whale	NSD	5,929	0	40,720	0
Goose-Beaked Whale	NSD	2,618	0	18,035	0
Longman's Beaked Whale	NSD	1,015	0	6,957	0
False Killer Whale	NSD	228	0	1,576	0
Killer Whale	NSD	54	0	366	0
Melon-Headed Whale	NSD	475	1	3,290	1
Pygmy Killer Whale	NSD	885	1	6,132	1
Short-Finned Pilot Whale	NSD	228	0	1,567	0
Bottlenose Dolphin	NSD	356	1	2,454	1
Fraser's Dolphin	NSD	11,425	6	79,179	23
Pantropical Spotted Dolphin	NSD	4,555	3	31,493	11
Risso's Dolphin	NSD	1,781	2	12,354	4
Rough-Toothed Dolphin	NSD	1,984	1	13,763	6
Spinner Dolphin	NSD	4,091	2	27,375	9
Striped Dolphin	NSD	1,563	1	10,842	3

Note: Mortality is neither anticipated nor proposed for authorization.

Table 30 -- Total Annual and 7-year Incidental Take Proposed by Species and Stock during all Activities by Effect Type

Species	Stock	Maximum annual behavioral	Maximum annual TTS	Maximum annual AUD INJ	Maximum annual non-auditory injury	Maximum annual mortality	Maximum 7-year behavioral	Maximum 7-year TTS	Maximum 7-year AUD INJ	Maximum 7-year non-auditory injury	Maximum 7-year mortality
Blue Whale	Central North Pacific	4	38	1	-	-	15	254	3	-	-
Bryde's Whale	NSD	4	64	1	-	-	17	432	5	-	-
Fin Whale	NSD	4	31	1	-	-	18	211	1	-	-
Humpback Whale	Western North Pacific	49	1,468	21	-	-	319	10,215	136	-	-
Minke Whale	NSD	3	22	1	-	-	6	148	2	-	-
Omura's Whale	NSD	4	48	1	-	-	15	321	2	-	-
Sei Whale	NSD	3	34	1	-	-	10	231	2	-	-
Sperm Whale	NSD	124	101	0	-	-	850	691	0	-	-
Dwarf Sperm Whale	NSD	1,395	17,321	323	0	0	9,212	120,366	2,156	0	0
Pygmy Sperm Whale	NSD	1,572	19,420	374	0	0	10,390	134,939	2,486	0	0
Blainville's Beaked Whale	NSD	3,095	25	0	0	-	21,373	162	0	0	-
Deraniyagala Beaked Whale	NSD	4,967	6	1	-	-	34,165	26	3	-	-
Ginkgo-toothed Beaked Whale	NSD	5,875	54	0	0	-	40,346	374	0	0	-
Goose-Beaked Whale	NSD	2,598	20	0	0	-	17,905	130	0	0	-
Longman's Beaked Whale	NSD	1,003	12	0	0	-	6,885	72	0	0	-
False Killer Whale	NSD	70	158	0	0	-	482	1,094	0	0	0
Killer Whale	NSD	14	40	0	-	-	92	274	0	-	-

Melon-Headed Whale	NSD	172	303	1	0	-	1,177	2,113	1	0	-
Pygmy Killer Whale	NSD	270	615	1	0	0	1,849	4,283	1	0	0
Short-Finned Pilot Whale	NSD	81	147	0	0	0	549	1,018	0	0	0
Bottlenose Dolphin	NSD	117	239	1	0	0	795	1,659	1	0	0
Fraser's Dolphin	NSD	4,237	7,188	5	1	0	29,067	50,112	22	1	-
Pantropical Spotted Dolphin	NSD	1,373	3,182	3	0	0	9,337	22,156	11	0	0
Risso's Dolphin	NSD	555	1,226	1	1	-	3,799	8,555	3	1	-
Rough-Toothed Dolphin	NSD	506	1,478	1	0	0	3,466	10,297	6	0	0
Spinner Dolphin	NSD	2,248	1,843	2	0	-	14,664	12,711	9	0	-
Striped Dolphin	NSD	434	1,129	1	0	-	2,977	7,865	3	0	-

Note: Mortality is neither anticipated nor proposed for authorization. Zero (0) impacts indicate total less than 0.5 and a dash (-) is a true zero. In some cases where the estimated take within a cell is equal to 1, that value has been rounded up from a value that is less than 0.5 to avoid underestimating potential impacts to a species or stock based on the 7-year rounding rules discussed in the MITT Acoustic and Explosive Effects Analysis Technical Report.

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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 ITA 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. For additional discussion of NMFS' interpretation of the least practicable adverse impact standard, see the Mitigation Measures section of the Gulf of Alaska Study Area final rule (88 FR 604, January 4, 2023).

Implementation of Least Practicable Adverse Impact Standard

Here, we discuss 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 the Action Proponents' 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, or their availability for subsistence uses (where relevant). This analysis considers such things as the nature of the potential adverse impact (*e.g.,* likelihood, scope, and range), the likelihood that the measure will be effective if implemented, and the likelihood of successful implementation.

2. The practicability of the measure(s) 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 more 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 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 (*i.e.,* 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.

Reduction of Adverse Impacts to Marine Mammal Species or Stocks and Their Habitat

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: (1) avoiding or minimizing injury or mortality; (2) limiting interruption of known feeding, breeding, mother/young, or resting behaviors; (3) minimizing the abandonment of important habitat (temporally and spatially); (4) minimizing the number of individuals subjected to these types of disruptions; and (5) limiting degradation of habitat. Mitigating these types of effects is intended to reduce the likelihood that the activity will result in energetic or other types of impacts that are more likely to result in reduced reproductive success or survivorship. It is also important to consider the degree of impacts 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 for 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, alone or in combination, result in greater emphasis on the importance of a mitigation measure in reducing impacts on a species or stock: (1) the stock is known to be decreasing or status is unknown, but believed to be declining; (2) the known annual mortality (from any source) is approaching or exceeding the PBR level (as defined in MMPA section 3(20)); (3) the affected species or stock is a small, resident population; or (4) the stock is involved in an Unusual Mortality Event (UME) or has other known vulnerabilities (*e.g.,* 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.

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 16 U.S.C. 1371(a)(5)(A)(iii)).

Assessment of Mitigation Measures for the Study Area

NMFS has fully reviewed the specified activities and the mitigation measures included in the application and the 2026 MITT Draft SEIS/OEIS under the least practicable adverse impact standard. NMFS worked with the Action Proponents in the development of their initially proposed measures, which are informed by years of implementation and monitoring. A complete discussion of the Action Proponents' evaluation process used to develop, assess, and select mitigation measures, which was informed by input from NMFS, can be found in chapter 4 (Mitigation) of the 2026 MITT Draft SEIS/OEIS. The process described in chapter 4 (Mitigation) of the 2026 MITT Draft SEIS/OEIS supported NMFS' independent evaluation of whether the mitigation measures would meet the least practicable adverse impact standard. The Action Proponents would be required to implement the mitigation measures identified in this proposed rule for the full 7 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 or habitat.

The Action Proponents have agreed to mitigation measures that would reduce the probability and/or severity of impacts expected to result from acute exposure to acoustic sources or explosives, vessel strike, and impacts to marine mammal habitat. Specifically, the Action Proponents would use a combination of delayed starts, powerdowns, and shutdowns to avoid mortality or serious injury, minimize the likelihood or severity of AUD INJ or non-auditory injury, and reduce instances of TTS or more severe behavioral disturbance caused by acoustic sources or explosives. The Action Proponents 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 (*e.g.,* 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 Action Proponents assessed the practicability of the proposed measures in the context of personnel safety, practicality of implementation, and their impacts on the Action Proponents' ability to meet their congressionally mandated requirements and found that the measures are supportable. As described in more detail below, NMFS has independently evaluated the measures the Action Proponents 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 would significantly minimize impacts on the affected marine mammal species and stocks and their habitat and, further, be practicable for implementation by the Action Proponents. We have preliminarily determined that the mitigation measures satisfy the MMPA's least practicable adverse impact standard.

The Action Proponents also evaluated numerous measures in the 2026 MITT Draft SEIS/OEIS that were not included in the application, and NMFS independently reviewed and preliminarily concurs with the Action Proponents' analysis that their inclusion was not appropriate under the least practicable adverse impact standard based on our assessment. The Action Proponents considered these additional potential mitigation measures in the context of the potential benefits to marine mammals and whether they are practical or impractical.

Section 4.10 (Mitigation Considered but Eliminated) of chapter 4 (Mitigation) of the 2026 MITT Draft SEIS/OEIS 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. These recommendations generally fall into three categories, discussed below: reduction of activity; activity-based operational measures; and time/area limitations.

As described in section 4.10 (Mitigation Considered but Eliminated) of the 2026 MITT Draft SEIS/OEIS, the Action Proponents considered reducing the overall amount of training, reducing explosive use, modifying sound sources, completely replacing live training with computer simulation, and including 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 4 (Mitigation) of the 2026 MITT Draft SEIS/OEIS, the Action Proponents need to train in the conditions in which they fight, and these types of modifications fundamentally change the activity in a manner that would not support the purpose and need for the training (*i.e.,* are entirely impracticable) and, therefore, are not considered further. NMFS finds the Action Proponents' explanation of why adoption of these recommendations would unacceptably undermine the purpose of the training persuasive. After independent review, NMFS finds the Action Proponents' judgment on the impacts of these potential mitigation measures to personnel safety, practicality of implementation, and the effectiveness of training persuasive, and for these reasons, NMFS finds that these measures do not meet the least practicable adverse impact standard because they are not practicable.

In chapter 4 (Mitigation) of the 2026 MITT Draft SEIS/OEIS, the Action Proponents also evaluated additional potential activity-based 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 Action Proponents' analysis, the measures would have significant direct negative effects on mission effectiveness and are considered impracticable. NMFS independently reviewed the Action Proponents' 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.

Lastly, chapter 4 (Mitigation) of the 2026 MITT Draft SEIS/OEIS also describes a comprehensive analysis of 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 an area for training, considering proximity to training ranges and emergency landing fields and other issues). 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 Action Proponents' analysis in chapter 4 (Mitigation) and appendix A (Military Readiness Activities Descriptions) of 2026 MITT Draft SEIS/OEIS, which consider 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 Action Proponents ruled out in the 2026 MITT Draft SEIS/OEIS. Below are the mitigation measures that NMFS has preliminarily determined satisfy the MMPA's least practicable adverse impact standard, including the specific considerations for military readiness activities. Table 31 describes the information designed to aid Lookouts and other applicable personnel with their observation, environmental compliance, and reporting responsibilities. The following sections describe the mitigation measures that

would be implemented in association with the activities analyzed in this document. The mitigation measures are organized into two categories: activity-based mitigation and geographic mitigation areas.

Of note, according to the U.S. Navy, consistent with customary international law, when a foreign military vessel participates in a U.S. Navy exercise within the U.S. territorial sea (*i.e.,* 0 to 22.2 km from shore), the U.S. Navy will request that the foreign vessel follow the U.S. Navy's mitigation measures for that particular event. When a foreign military vessel participates in a U.S. Navy exercise beyond the U.S. territorial sea but within the U.S. EEZ, the U.S. Navy will encourage the foreign vessel to follow the U.S. Navy's mitigation measures for that particular event. In either scenario (*i.e.,* both within and beyond the territorial sea), U.S. Navy personnel will provide the foreign vessels participating with a description of the mitigation measures to follow.

Table 31 -- Environmental Awareness and Education

Stressor or Activity: All training and testing activities, as applicable.
Requirements: Navy personnel (including civilian personnel) involved in mitigation and training or testing activity reporting under the specified activities must 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 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 military readiness activities. The material explains why environmental compliance is important in supporting the Action Proponents' 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. • 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 (PMAP) software tool. • 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.

Activity-Based Mitigation

Activity-based mitigation is mitigation that the Action Proponents would implement whenever and wherever an applicable military readiness activity takes place within the Study Area. Previously referred to as ''procedural mitigation,'' the primary objective of activity-based mitigation is to reduce overlap of marine mammals with stressors that have the potential to cause injury or mortality in real time. Activity-based mitigations are fundamentally consistent across stressor activity, although specific variations account for differences in platform configuration, event characteristics, and stressor types. The Action Proponents customize mitigation for each applicable activity category or stressor. Activity-based mitigation generally involves: (1) the use of one or more trained Lookouts to diligently observe for marine mammals and other specific biological resources (*e.g.,* indicator species like floating vegetation, jelly aggregations, large schools of fish, and flocks of seabirds) within a mitigation zone; (2) requirements for Lookouts to immediately communicate sightings of marine mammals and other 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 remainder of the mitigation measures are activity-based mitigation measures (table 32 through table 45) organized by stressor type and activity category and include acoustic stressors (*i.e.,* active sonar, weapons firing noise), explosive stressors (*i.e.,* bombs, gunnery, mine counter-measure and neutralization activities, missiles and rockets, research-based sub-surface explosives, and sinking exercises), and physical disturbance and strike stressors (*i.e.,* aerial-deployed mines and non-explosive bombs, non-explosive gunnery, non-explosive torpedoes missiles and rockets, vessel movement, towed in-water devices).

The Action Proponents must implement the proposed mitigation measures described in table 32 through

table 45, as appropriate, in response to an applicable sighting of a marine mammal within, or entering into, the relevant mitigation zone for acoustic stressors, explosives, and non-explosive munitions. Each table describes the activities that the requirements apply to, the required mitigation zones in which the action proponents must take a mitigation action, the required number of Lookouts and observation platform, the required mitigation actions that the action proponents must take before, during, and/or after an activity, and a required wait period prior to commencing or recommencing an activity after a delay, power down, or shutdown of an activity.

The Action Proponents proposed wait periods because events cannot be delayed or ceased indefinitely for the purpose of mitigation due to impacts on safety, sustainability, and the ability to meet mission requirements. Wait periods are designed to allow animals the maximum amount of time practical to resurface (*i.e.,* become available to be observed) before activities resume. The action proponents factored in an assumption that mitigation may need to be implemented more than once when developing wait period durations. Wait periods are 10 minutes or 30 minutes depending on the fuel constraints of the platform and feasibility of implementation. NMFS concurs with these proposed wait periods.

If an applicable species (identified in the relevant mitigation tables) is observed within a required mitigation zone prior to the initial start of the activity, the Action Proponents must: (1) relocate the event to a location where applicable species are not observed; or (2) delay the initial start of the event (or stressor use) until one of the ''Mitigation Zone All-Clear Conditions'' (defined below) has been met. If an applicable stressor is observed within a required mitigation zone during the event (*i.e.,* during use of the indicated source), the Action Proponents must take the action described in the Mitigation Zones section of the table until one of the Mitigation Zone All-Clear Conditions has been met.

For all activities, an activity may not commence or recommence until one of the following Mitigation Zone All-Clear Conditions have been met: (1) a Lookout observes the applicable species exiting the mitigation zone; (2) a Lookout concludes that the animal has exited the mitigation zone based on its observed course, speed, and movement relative to the mitigation zone; (3) a Lookout affirms the mitigation zone has been clear from additional sightings for a designated wait period; or (4) for mobile events, the stressor has transited a distance equal to double the mitigation zone size beyond the location of the last sighting.

Activity-Based Mitigation for Active Acoustic Stressors

Mitigation measures for acoustic stressors are provided below and include active acoustic sources (table 32) and weapons firing noise (table 33). For this proposed action, the following ranges apply to the use of small, medium, and large caliber: (1) small is up to and including 50 caliber machine gun rounds; (2) medium is greater than 50 caliber and less than 57 millimeter (mm); and (3) large is 57 mm and larger. Small caliber items are solid projectiles (*i.e.,* bullets). Medium caliber items are 20–57 mm. Large caliber items are greater than or equal to 57 mm, and both medium and large caliber can be either inert non-explosive rounds or high explosive rounds. Activity-based mitigation for acoustic stressors does not apply to:

- Sources not operated under positive control (*e.g.,* moored oceanographic sources);
- Sources used for safety of navigation (*e.g.,* fathometers);
- Sources used or deployed by aircraft operating at high altitudes (*e.g.,* bombs deployed from high altitude (since personnel cannot effectively observe the surface of the water));
- Sources used, deployed, or towed by unmanned platforms except when escort vessels are already participating in the event and have positive control over the source;
- Sources used by submerged submarines (*e.g.,* sonar (since they cannot conduct visual observation));
- De minimis sources (*e.g.,* those >200 kHz);
- Unattended sources (*e.g.,* moored buoys used for acoustic and oceanographic research); and
- Vessel-based, unmanned vehicle-based, or towed in-water sources when marine mammals (*e.g.,* dolphins) are determined to be intentionally swimming at the bow or alongside or directly behind the vessel, vehicle, or device (*e.g.,* to bow-ride or wake-ride).

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Table 32 -- Mitigation for Active Acoustic Sources

Stressor or Activity: Active acoustic sources with power down and shut down capabilities: • Low-frequency active sonar >200 dB • Mid-frequency active sonar sources that are hull mounted on a surface ship (including surfaced submarines) • Broadband and other active acoustic sources >200 dB

• Mitigation Zones
  ○ 1,000 yd (914.4 m) from active acoustic sources (power down of 6 dB total)
  ○ 500 yd (457.2 m) from active acoustic sources (power down of 10 dB total)
  ○ 200 yd (182.9 m) from active acoustic sources (shut down)
• Mitigation Requirements
  ○ One Lookout in/on one of the following:
  ▪ Aircraft
  ▪ Pierside, moored, or anchored vessel
  ▪ Underway vessel with space/crew restrictions (including small boats)
  ▪ Underway vessel already participating in the event that is escorting (and has positive control over sources used, deployed, or towed by) an unmanned platform
  ○ Two Lookouts on an underway vessel without space/crew restrictions
  ○ Lookouts would use information from passive acoustic detections to inform visual observations when passive acoustic devices are already being used in the event
• Mitigation Requirement Timing
  ○ Action Proponent personnel must observe the applicable mitigation zone for marine mammals and floating vegetation immediately prior to the initial start of using active acoustic sources (*e.g.*, while maneuvering on station).
  ○ Action Proponent personnel must observe the applicable mitigation zone for marine mammals during use of active acoustic sources.
• Wait Period
  ○ 10 or 30 minutes (depending on fuel constraints of the platform)

Stressor or Activity: Active acoustic sources with shut down (but not power down) capabilities: • Low-frequency active sonar <200 dB • Mid-frequency active sonar sources that are not hull mounted on a surface ship (*e.g.*, dipping sonar, towed arrays) • High-frequency active sonar • Broadband and other active acoustic sources <200 dB

• Mitigation Zones
  • 200 yd (182.9 m) from active acoustic sources (shut down)
Mitigation Requirements
  • One Lookout in/on one of the following:
  • Aircraft
  • Pierside, moored, or anchored vessel
  • Underway vessel with space/crew restrictions (including small boats)
  • Underway vessel already participating in the event that is escorting (and has positive control over sources used, deployed, or towed by) an unmanned platform
  • Two Lookouts on an underway vessel without space/crew restrictions
  • Lookouts would use information from passive acoustic detections to inform visual observations when passive acoustic devices are already being used in the event
Mitigation Requirement Timing

- Action Proponent personnel must observe the mitigation zone for marine mammals and floating vegetation immediately prior to the initial start of using active acoustic sources (*e.g.*, while maneuvering on station).
- Action Proponent personnel must observe the mitigation zone for marine mammals during use of active acoustic sources.

Wait Period

- 10 or 30 minutes (depending on fuel constraints of the platform)

Table 33 -- Mitigation for Weapons Firing Noise

Stressor or Activity: Explosive and non-explosive large-caliber gunnery firing noise (surface-to-surface and surface-to-air)

- Mitigation Zone
  - 30 degrees on either side of the firing line out to 70 yd (64 m) from the gun muzzle (cease fire)

Mitigation Requirements

- One Lookout on a vessel

Mitigation Requirement Timing

- Action Proponent personnel must observe the mitigation zone for marine mammals and floating vegetation immediately prior to the initial start of large-caliber gun firing (*e.g.*, during target deployment).
- Action Proponent personnel must observe the mitigation zone for marine mammals during large-caliber gun firing.

Wait Period

- 30 minutes

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Activity-Based Mitigation for Explosive Stressors

Mitigation measures for explosive stressors are provided below and include explosive bombs (table 34), explosive gunnery (table 35), explosive mine countermeasure and neutralization without divers (table 36), explosive mine neutralization with divers (table 37), explosive missiles and rockets (table 38), research-based sub-surface explosives (table 39), explosive torpedoes (table 40), and sinking exercises (SINKEX) (table 41). After the event, the Action Proponents must observe the area for marine mammals. Post-event observations are intended to aid incident reporting requirements for marine mammals. Practicality and the duration of post-event observations will be determined on site by fuel restrictions and mission-essential follow-on commitments. For example, it is more challenging to remain on-site for extended periods of time for some activities due to factors such as distance from the target or altitude of an aircraft. For all activities involving explosives, if a marine mammal is visibly injured or killed as a result of detonation, explosives use in the event must be suspended immediately. Activity-based mitigation for explosive stressors does not apply to explosives:

- Deployed by aircraft operating at high altitudes;
- Deployed by submerged submarines, except for explosive torpedoes;
- Deployed against aerial targets;
- During vessel-launched missile or rocket events;
- Used at or below the de minimis threshold; and
- Deployed by unmanned platforms except when escort vessels are already participating in the event and have positive control over the explosive.

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Table 34 -- Mitigation for Explosive Bombs

Stressor or Activity: Any NEW

• Mitigation Zone
  • 2,500 yd (2,286 m) from the intended target (cease fire)
Mitigation Requirements
  • One Lookout in an aircraft
Mitigation Requirement Timing
  • Action Proponent personnel must observe the applicable mitigation zone for marine mammals and floating vegetation immediately prior to the initial start of bomb delivery (*e.g.*, when arriving on station).
  • Action Proponent personnel must observe the applicable mitigation zone for marine mammals during bomb delivery.
  • After the event, when practical, Action Proponent personnel must observe the detonation vicinity for injured or dead marine mammals. If any injured or dead marine mammals are observed, Action Proponent personnel must follow established incident reporting procedures.
Wait Period
  • 10 minutes

Table 35 -- Mitigation for Explosive Gunnery

Stressor or Activity: Air-to-surface medium-caliber, surface-to-surface medium-caliber, surface-to-surface large-caliber

• Mitigation Zones
  • Air-to-surface medium-caliber:
  • 200 yd (182.9 m) from the intended impact location (cease fire)
  • Surface-to-surface medium-caliber:
  • 600 yd (548.6 m) from the intended impact location (cease fire)
  • Surface-to-surface large-caliber:
  • 1,000 yd (914.4 m) from the intended impact location (cease fire)
Mitigation Requirements
  • One Lookout on a vessel or in an aircraft
Mitigation Requirement Timing
  • Action Proponent personnel must observe the applicable mitigation zone for marine mammals and floating vegetation immediately prior to the initial start of gun firing (*e.g.*, while maneuvering on station).
  • Action Proponent personnel must observe the applicable mitigation zone for marine mammals during gunnery fire.
  • After the event, when practical, Action Proponent personnel must observe the detonation vicinity for injured or dead marine mammals. If any injured or dead marine mammals are observed, Action Proponent personnel must follow established incident reporting procedures.
Wait Period
  • 10 or 30 minutes (depending on fuel constraints of the platform)

Table 36 -- Mitigation for Explosive Mine Countermeasure and Neutralization (No Divers)

Stressor or Activity: 0.1-5 lb (0.05-2.3 kg) NEW, >5 lb (2.3 kg) NEW

• Mitigation Zones
  • 0.1-5 lb (0.05-2.3 kg) NEW:
  • 600 yd (548.6 m) from the detonation site (cease fire)
  • >5 lb (2.3 kg) NEW:
  • 2,100 yd (1,920.2 m) from the detonation site (cease fire)
Mitigation Requirements
  • 0.1-5 lb (0.05-2.3 kg) NEW:
  • One Lookout on a vessel or in an aircraft
  • >5 lb (2.3 kg) NEW:
  • Two Lookouts: one on a small boat and one in an aircraft
Mitigation Requirement Timing
  • Action Proponent personnel must observe the applicable mitigation zone for marine mammals and floating vegetation immediately prior to the initial start of detonations (*e.g.*, while maneuvering on station.
  • Action Proponent personnel must observe the applicable mitigation zone for marine mammals during detonations or fuse initiation.
  • After the event, when practical, Action Proponent personnel must observe the detonation vicinity for 10 or 30 minutes (depending on fuel constraints) for injured or dead marine mammals. If any injured or dead marine mammals are observed, Action Proponent personnel must follow established incident reporting procedures.
Wait Period
  • 10 or 30 minutes (depending on fuel constraints of the platform)

Table 37 -- Mitigation for Explosive Mine Neutralization (With Divers)

Stressor or Activity: any NEW under positive control, any NEW using time-delay fuses

• Mitigation Zones
  • Activities under positive control
  • 500 yd (457.2 m) from the detonation site (cease fire)
  • Activities using time-delay fuses
  • 1,000 yd (914.4 m) from the detonation site (cease fire)
Mitigation Requirements
  • Activities under positive control
  • Lookouts in two small boats (one Lookout per boat), or one small boat and one rotary-wing aircraft (with one Lookout each), and one Lookout on shore for shallow-water events
  • Activities using time-delay fuses
  • Four Lookouts in two small boats (two Lookouts per boat), and one additional Lookout in an aircraft (if used in the event)
Mitigation Requirement Timing
  • Time-delay devices must be set not to exceed 10 minutes
  • Action Proponent personnel must observe the applicable mitigation zone for marine mammals and floating vegetation immediately prior to the initial start of detonations or fuse initiation for positive control events (*e.g.*, while maneuvering on station) or for 30 minutes prior for time-delay events.
  • Action Proponent personnel must observe the applicable mitigation zone for marine mammals during detonations or fuse initiation.
  • When practical based on mission, safety, and environmental conditions:
  • Boats must observe from the mitigation zone radius mid-point
  • When two boats are used, boats must observe from opposite sides of the mine location
  • Platforms must travel a circular pattern around the mine location
  • Boats must have one Lookout observe inward toward the mine location and one Lookout observe outward toward the mitigation zone perimeter
  • Divers must be part of the Lookout Team
  • After the event, when practical, Action Proponent personnel must observe the detonation vicinity for 30 minutes for injured or dead marine mammals. If any injured or dead marine mammals are observed, Action Proponent personnel must follow established incident reporting procedures.
Wait Period
  • 10 or 30 minutes (depending on fuel constraints of the platform)

Table 38 -- Mitigation for Explosive Missiles and Rockets

Stressor or Activity: 0.6-20 lb (0.3-9.1 kg) NEW (air-to-surface), >20-500 lb (9.1-226.8 kg) NEW (air-to-surface)

• Mitigation Zones
  • 0.6-20 lb (0.3-9.1 kg) NEW (air-to-surface)
  • 900 yd (823 m) from the intended impact location (cease fire)
  • >20-500 lb (9.1-226.8 kg) NEW (air-to-surface)
  • 2,000 yd (1,828.8 m) from the intended impact location (cease fire)
Mitigation Requirements
  • One Lookout in an aircraft
Mitigation Requirement Timing
  • Action Proponent personnel must observe the applicable mitigation zone for marine mammals and floating vegetation immediately prior to the initial start of missile or rocket delivery (*e.g.*, during a fly-over of the mitigation zone).
  • Action Proponent personnel must observe the applicable mitigation zone for marine mammals during missile or rocket delivery.
  • After the event, when practical, Action Proponent personnel must observe the detonation vicinity for injured or dead marine mammals. If any injured or dead marine mammals are observed, Action Proponent personnel must follow established incident reporting procedures.
Wait Period
  • 10 or 30 minutes (depending on fuel constraints of the platform)

Table 39 -- Mitigation for Research-based Sub-surface Explosives

Stressor or Activity: 0.1-5 lb (0.05-2.3 kg) NEW sub-surface explosives used in research applications

• Mitigation Zone
  • 600 yd (548.6 m) from the device or detonation sites (cease fire)
Mitigation Requirements
  • One Lookout on a small boat or in an aircraft
  • Conduct passive acoustic monitoring for marine mammals when passive acoustic devices are already being used prior to the initial start of detonations; use information from detections to assist visual observations
Mitigation Requirement Timing
  • Action Proponent personnel must observe the mitigation zone for marine mammals and floating vegetation immediately prior to the initial start of detonations.
  • Action Proponent personnel must observe the mitigation zone for marine mammals during detonations.
  • After the event, when practical, Action Proponent personnel must observe the detonation vicinity for injured or dead marine mammals. If any injured or dead marine mammals are observed, Action Proponent personnel must follow established incident reporting procedures.
Wait Period
  • 10 or 30 minutes (depending on fuel constraints of the platform)

Table 40 -- Mitigation for Explosive Torpedoes

Stressor or Activity: Any NEW

• Mitigation Zone
  • 2,100 yd (1,920.2 m) from the intended impact location (cease fire)
Mitigation Requirements
  • One Lookout in an aircraft
  • Conduct passive acoustic monitoring for marine mammals; use information from detections to assist visual observations
Mitigation Requirement Timing
  • Action Proponent personnel must observe the mitigation zone for marine mammals, floating vegetation, and jellyfish aggregations immediately prior to the initial start of detonations (*e.g.*, during target deployment).
  • Action Proponent personnel must observe the mitigation zone for marine mammals during torpedo launches.
  • After the event, when practical, Action Proponent personnel must observe the detonation vicinity for injured or dead marine mammals. If any injured or dead marine mammals are observed, Action Proponent personnel must follow established incident reporting procedures.
Wait Period
  • 10 or 30 minutes (depending on fuel constraints of the platform)

Table 41 -- Mitigation for Sinking Exercises (SINKEX)

Stressor or Activity: Any NEW

• Mitigation Zone
  • 2.5 nmi (4.6 km) from the target ship hull (cease fire)
Mitigation Requirements
  • Two Lookouts: one on a vessel and one in an aircraft
  • Lookouts would use information from passive acoustic detections to inform visual observations when passive acoustic devices are already being used during weapon firing
Mitigation Requirement Timing
  • During aerial observations for 90 minutes prior to the initial start of weapon firing, Action Proponent personnel must observe the mitigation zone for marine mammals, floating vegetation, and jellyfish aggregations.
  • From the vessel during weapon firing, and from the aircraft and vessel immediately after planned or unplanned breaks in weapon firing of more than 2 hours, Action Proponent personnel must observe the mitigation zone for marine mammals.
  • Action Proponent personnel must observe the detonation vicinity for injured or dead marine mammals for 2 hours after sinking the vessel or until sunset, whichever comes first. If any injured or dead marine mammals are observed, Action Proponent personnel must follow established incident reporting procedures.
Wait Period
  • 30 minutes

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Activity-Based Mitigation for Non-Explosive Ordnance

Mitigation measures for non-explosive ordnance are provided below and include aerial-deployed mines and non-explosive bombs (table 42), non-explosive gunnery (table 43), and non-explosive missiles and rockets (table

44). Explosive aerial-deployed mines do not detonate upon contact with the water surface and are therefore considered non-explosive when mitigating the potential for a mine shape to strike a marine mammal at the water surface. Activity-based mitigation for non-explosive ordnance does not apply to non-explosive ordnance:

- Deployed by aircraft operating at high altitudes;
- Deployed against aerial targets and land-based targets;
- Deployed during vessel-launched missile or rocket events; and
- Deployed by unmanned platforms except when escort vessels are already participating in the event and have positive control over ordnance deployment.

Table 42 -- Mitigation for Non-Explosive Aerial-Deployed Mines and Bombs

Stressor or Activity: Non-explosive aerial-deployed mines, non-explosive bombs

• Mitigation Zone
  • 1,000 yd (914.4 m) from the intended target (cease fire)
Mitigation Requirements
  • One Lookout in an aircraft
Mitigation Requirement Timing
  • Action Proponent personnel must observe the mitigation zone for marine mammals and floating vegetation immediately prior to the initial start of mine or bomb delivery (*e.g.*, when arriving on station).
  • Action Proponent personnel must observe the mitigation zone for marine mammals during mine or bomb delivery.
Wait Period
  • 10 minutes

Table 43 -- Mitigation for Non-explosive Gunnery

Stressor or Activity: Non-explosive surface-to-surface large-caliber ordnance, non-explosive surface-to-surface and air-to-surface medium-caliber ordnance, non-explosive surface-to-surface and air-to-surface small-caliber ordnance

• Mitigation Zone
  • 200 yd (182.9 m) from the intended impact location (cease fire)
Mitigation Requirements
  • One Lookout on a vessel or in an aircraft
Mitigation Requirement Timing
  • Action Proponent personnel must observe the mitigation zone for marine mammals and floating vegetation immediately prior to the start of gun firing (*e.g.*, while maneuvering on station).
  • Action Proponent personnel must observe the mitigation zone for marine mammals during gunnery firing.
Wait Period
  • 10 or 30 minutes (depending on fuel constraints of the platform)

Table 44 -- Mitigation for Non-explosive Missiles and Rockets

Stressor or Activity: Non-explosive missiles and rockets (air-to-surface)

• Mitigation Zone
  • 900 yd (823 m) from the intended impact location (cease fire)
Mitigation Requirements
  • One Lookout in an aircraft
Mitigation Requirement Timing
  • Action Proponent personnel must observe the mitigation zone for marine mammals and floating vegetation immediately prior to the start of missile or rocket delivery (*e.g.*, during a fly-over of the mitigation zone).
  • Action Proponent personnel must observe the mitigation zone for marine mammals during missile or rocket delivery.
Wait Period
  • 10 or 30 minutes (depending on fuel constraints of the platform)

Activity-Based Mitigation for Physical Disturbance and Strike Stressors

Mitigation measures for physical disturbance and strike stressors are provided below and include crewed surface vessels (table 45), unmanned vehicles (table 46), and towed in-water devices (table 47). Activity-based mitigation for physical disturbance and strike stressors will not be implemented:

- By submerged submarines;
- By unmanned vehicles except when escort vessels are already participating in the event and have positive control over the unmanned vehicle movements;
- When marine mammals (*e.g.,* dolphins) are determined to be intentionally swimming at the bow, alongside the vessel or vehicle, or directly behind the vessel or vehicle (*e.g.,* to bow-ride or wake-ride); and
- When impractical based on mission requirements (*e.g.,* during certain aspects of amphibious exercises).

Table 45 -- Mitigation for Manned Surface Vessels

Stressor or Activity: Manned surface vessels, including surfaced submarines

• Mitigation Zones
  • Underway manned surface vessels must maneuver themselves (which may include reducing speed) to maintain the following distances as mission and circumstances allow:
  • 500 yd (457.2 m) from whales
  • 200 yd (182.9 m) from other marine mammals
Mitigation Requirements
  • One or more Lookouts on manned underway surface vessels in accordance with the most recent navigation safety instruction.
Mitigation Requirement Timing
  • Action Proponent personnel must observe the mitigation zone for marine mammals immediately prior to manned surface vessels getting underway and while underway.

Table 46 -- Mitigation for Unmanned Vehicles

Stressor or Activity: Unmanned Surface Vehicles and Unmanned Underwater Vehicles already being escorted (and operated under positive control) by a manned surface support vessel

• Mitigation Zones
  • A surface support vessel that is already participating in the event, and has positive control over the unmanned vehicle, must maneuver the unmanned vehicle (which may include reducing its speed) to ensure it maintains the following distances as mission and circumstances allow:
  • 500 yd (457.2 m) from whales
  • 200 yd (182.9 m) from other marine mammals
Mitigation Requirements
  • One Lookout on a surface support vessel that is already participating in the event and has positive control over the unmanned vehicle.
Mitigation Requirement Timing
  • Action Proponent personnel must observe the mitigation zone for marine mammals immediately prior to unmanned vehicles getting underway and while underway.

Table 47 -- Mitigation for Towed In-water Devices

Stressor or Activity: In-water devices towed by an aircraft, a manned surface vessel, or an Unmanned Surface Vehicle or Unmanned Underwater Vehicle already being escorted (and operated under positive control) by a manned surface vessel

• Mitigation Zone
  • Manned towing platforms, or surface support vessels already participating in the event that have positive control over an unmanned vehicle that is towing an in-water device, must maneuver itself or the unmanned vehicle (which may include reducing speed) to ensure towed in-water devices maintain the following distances as mission and circumstances allow:
  • 250 yd (228.6 m) from marine mammals
Mitigation Requirements
  • One Lookout on the manned towing vessel or aircraft, or on a surface support vessel that is already participating in the event and has positive control over an unmanned vehicle that is towing an in-water device.
Mitigation Requirement Timing
  • Action Proponent personnel must observe the mitigation zone for marine mammals immediately prior to and while in-water devices are being towed.

Geographic Mitigation Areas

In addition to activity-based mitigation, the Action Proponents would implement mitigation measures within mitigation areas to avoid or minimize potential impacts on marine mammals (see figure 11–1 of the application). A full technical analysis of the mitigation areas that the Action Proponents considered for marine mammals is provided in appendix I (Geographic Mitigation Assessment) of the 2020 MITT SEIS/OEIS.

Information on the mitigation measures that the Action Proponents propose to implement within mitigation areas (figure 2) is provided in table 48 through table 50. The mitigation applies year-round unless specified otherwise in the tables and does not apply to de minimis sources.

NMFS conducted an independent analysis of the mitigation areas that the Action Proponent proposed, which are described below. NMFS preliminarily concurs with the Action Proponents' analysis, which indicates that the measures in these mitigation areas are both practicable and will reduce the likelihood, magnitude, or severity of adverse impacts to marine mammals or their habitat in the manner described in the Action Proponents' analysis and this proposed rule. NMFS is heavily reliant on the Action Proponents' description of operational practicability, since the Action Proponents are best equipped to describe the degree to which a given mitigation measure affects personnel safety or mission effectiveness, and how practical it is to implement. The Action Proponents consider 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, magnitude, or severity of adverse impacts to marine mammal species or their habitat in the Preliminary Analysis and Negligible Impact Determination section.

Table 48 details geographic mitigation related to the use of active sonar and explosives, as well as awareness messages in the Marpi Reef Mitigation Area.

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Table 48 -- Marpi Reef Mitigation Area

Category	Mitigation Requirements	Mitigation Benefit
Acoustic	From December 1 through April 30, the Action Proponents must not use more than 20 combined hours of MF1 and MF1C surface ship hull-mounted mid-frequency active sonar during training and testing within the Marpi Reef and Chalan Kanoa Reef mitigation areas. The Navy must report the total hours of active sonar (all bins, by bin) used in the Marpi Reef Mitigation Area and Chalan Kanoa Reef Mitigation Area from December 1 through April 30 in its annual training and testing activity reports submitted to NMFS.	Mitigation is designed to reduce exposure of humpback whales in important seasonal reproductive habitat to levels of sound that have the potential to cause injurious or behavioral effects.
Explosives	The Action Proponents must not detonate in-water explosives (including underwater explosives and explosives deployed against surface targets) within the mitigation area year-round.	Mitigation is designed to prevent exposure of humpback whales in important seasonal reproductive habitat to explosives that have the potential to cause injury, mortality, or behavioral disturbance.
Acoustic, Explosives, Physical disturbance and strike	The Navy must issue an annual seasonal awareness notification message to alert ships and aircraft operating in the Marpi Reef Mitigation Area and Chalan Kanoa Reef Mitigation Area to the possible presence of increased concentrations of humpback whales from December 1 through April 30. To maintain safety of navigation and to avoid interactions with large whales during transits, the Navy will instruct vessels to remain vigilant to the presence of humpback whales that, when concentrated seasonally, may become vulnerable to vessel strikes. Platforms must use the information from the awareness notification messages to assist their visual observation of applicable mitigation zones during training and testing activities and to aid in the implementation of activity-based mitigation.	Mitigation is designed to minimize potential humpback whale vessel interactions and exposure to acoustic, explosive, and physical disturbance and strike stressors that have the potential to cause mortality, injury, or behavioral disturbance during the reproductive season.

Table 49 details geographic mitigation related to the use of active sonar and explosives, as well as awareness messages in the Chalan Kanoa Reef Mitigation Area.

Table 49 -- Chalan Kanoa Reef Mitigation Area

Category	Mitigation Requirements	Mitigation Benefits
Acoustic	From December 1 through April 30, the Action Proponents must not use more than 20 combined hours of MF1 and MF1C surface ship hull-mounted mid-frequency active sonar during training and testing within the Marpi Reef and Chalan Kanoa Reef mitigation areas. The Navy must report the total hours of active sonar (all bins, by bin) used in the Marpi Reef Mitigation Area and Chalan Kanoa Reef Mitigation Area from December 1 through April 30 in its annual training and testing activity reports submitted to NMFS.	Mitigation is designed to avoid or reduce exposure of humpback whales in important seasonal reproductive habitat to levels of sound that have the potential to cause injurious or behavioral effects.
Explosives	The Action Proponents must not detonate in-water explosives (including underwater explosives and explosives deployed against surface targets) within the mitigation area year-round.	Mitigation is designed to prevent exposure of humpback whales in important seasonal reproductive habitat to explosives that have the potential to cause injury, mortality, or behavioral disturbance.
Acoustic, Explosives, Physical disturbance and strike	The Navy must issue an annual seasonal awareness notification message to alert ships and aircraft operating in the Marpi Reef Mitigation Area and Chalan Kanoa Reef Mitigation Area to the possible presence of increased concentrations of humpback whales from December 1 through April 30. To maintain safety of navigation and to avoid interactions with large whales during transits, the Navy will instruct vessels to remain vigilant to the presence of humpback whales that, when concentrated seasonally, may become vulnerable to vessel strikes. Platforms must use the information from the awareness notification messages to assist their visual observation of applicable mitigation zones during training and testing activities and to aid in the implementation of activity-based mitigation.	Mitigation is designed to minimize potential for humpback whale vessel strike and exposure to acoustic, explosive, and physical disturbance and strike stressors that have the potential to cause mortality, injury, or behavioral disturbance during the reproductive season.

Table 50 details geographic mitigation related to the use of active sonar and explosives, in the Agat Bay Nearshore Mitigation Area.

Table 50 -- Agat Bay Nearshore Mitigation Area

Category	Mitigation Requirements	Mitigation Benefits
Acoustic	The Action Proponents must not use MF1 or MF1C surface ship hull-mounted mid-frequency active sonar during training and testing within the mitigation area year-round.	Mitigation is designed to avoid or reduce exposure of spinner dolphins in important resting habitat to levels of sound that have the potential to cause injurious or behavioral effects.
Explosives	The Action Proponents must not detonate in-water explosives (including underwater explosives and explosives deployed against surface targets) within the mitigation area year-round.	Mitigation is designed to prevent exposure of spinner dolphins in important resting habitat to explosives that have the potential to cause injury, mortality, or behavioral disturbance.

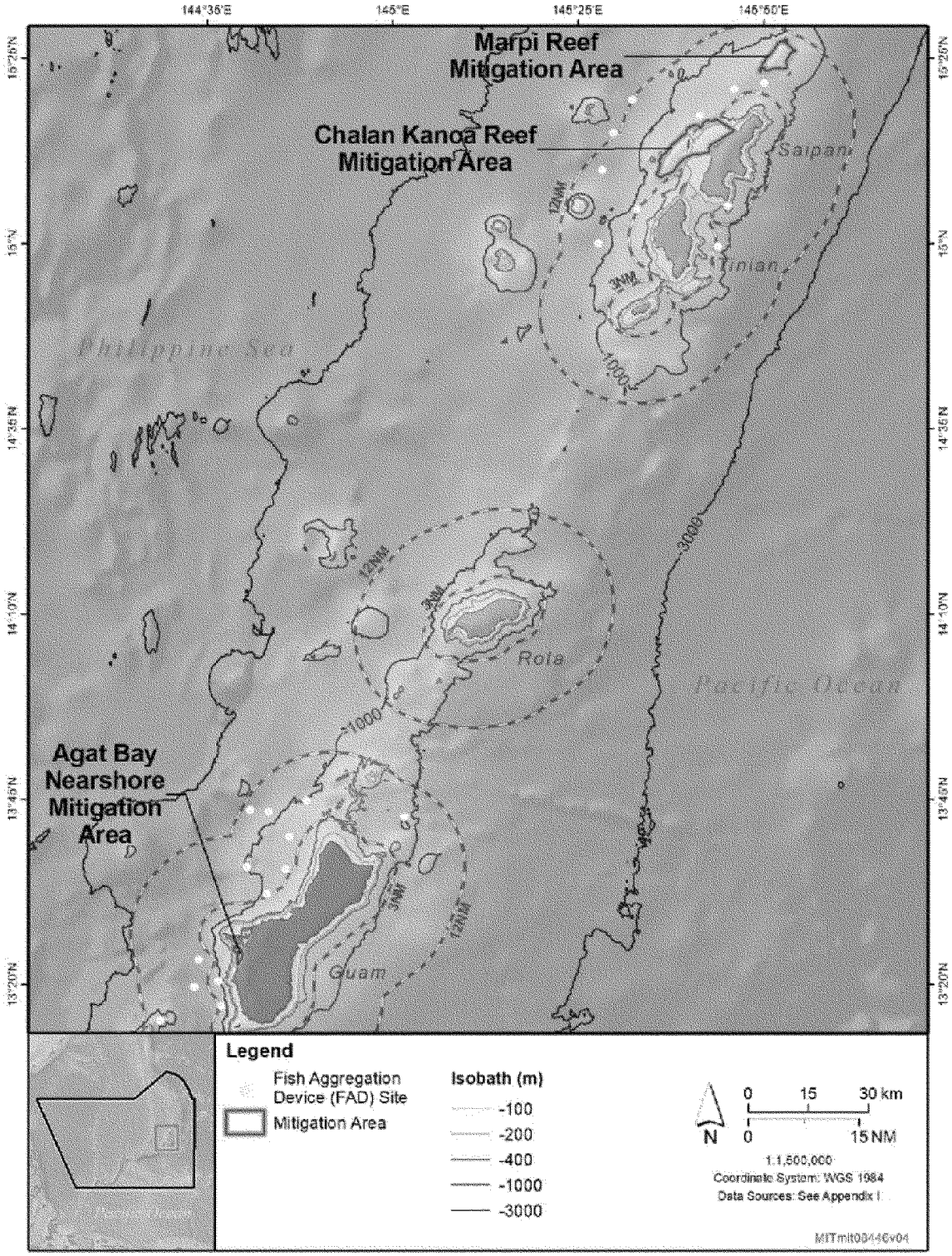


Figure 2 -- Geographic Mitigation Areas in the Study Area

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Mitigation Conclusions

NMFS has carefully evaluated the Action Proponents' proposed mitigation measures—many of which were developed with NMFS' input during the previous phases of MITT authorizations—and considered a broad range of other measures (*i.e.,* the measures considered but eliminated in the 2026 MITT Draft SEIS/OEIS, which reflect many of the comments that have arisen from public input or through discussion with NMFS 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 Action Proponents' proposed measures, as well as other measures considered by the Action Proponents and NMFS (see section 4.10 (Measures Considered but Eliminated) of chapter 4 (Mitigation) of the 2026 MITT Draft SEIS/OEIS), 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.

The proposed rule comment period provides the public an opportunity to submit recommendations, views, and/or concerns regarding the Action Proponents' activities and the proposed mitigation measures. While NMFS has preliminarily determined that the Action Proponents' proposed mitigation measures would satisfy the least practicable adverse impact standard, NMFS will consider all public comments to help inform our final determination. Consequently, proposed mitigation measures may be refined, modified, removed, or added prior to NMFS making a final agency decision on 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 ITAs 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.

The Navy has been conducting research and monitoring for over 20 years in areas where it has been training and testing, and it developed a formal marine species monitoring program in support of the Hawaii and Southern California range complexes MMPA and ESA processes in 2009 and subsequently implemented that program in the Study Area. Across all Navy training and testing study areas, the robust marine species monitoring 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 and data are made available to the public on the Navy's marine species monitoring website (*https://www.navymarinespeciesmonitoring.us*) and Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations (OBIS–SEAMAP) (*https://seamap.env.duke.edu*), respectively.

The Navy would continue collecting monitoring data to inform our understanding of the occurrence of marine mammals in the Study Area, the likely exposure of marine mammals to stressors of concern in the 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 Action Proponents 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 mammals and their habitat, and other 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 Action Proponents through the regulatory process for previous Navy at-sea training and testing activities.

Navy Marine Species Research and Monitoring Strategic Framework

The initial structure for the U.S. Navy's marine species monitoring efforts was developed in 2009 with the Integrated Comprehensive Monitoring Program (ICMP). The intent of the ICMP was to provide an overarching framework for coordination of the Navy's monitoring efforts during the early years of the program's establishment. A Strategic Planning Process (U.S. Department of the Navy, 2013b) was subsequently developed and together with the ICMP framework serves as a planning tool to focus marine species monitoring priorities defined by ESA and MMPA requirements and to coordinate monitoring efforts across regions based on a set of common objectives. Using an underlying conceptual framework incorporating a progression of knowledge from occurrence to exposure/response and ultimately consequences, the Strategic Planning Process was developed as a tool to help guide the investment of resources to address top level objectives and goals of the monitoring program most efficiently. The Strategic Planning Process identifies Intermediate Scientific Objectives (see *https://www.navymarinespeciesmonitoring.us/about/strategic-planning-process*), which form the basis of evaluating, prioritizing, and selecting new monitoring projects or investment topics and serve as the basis for developing and executing new monitoring projects across the Navy's training and testing ranges (both Atlantic and Pacific).

Monitoring activities relating to the effects of military readiness activities on marine species are generally designed to address 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);
- 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 military expended materials), through better understanding of one or more of the following:

○ The nature of the action and its surrounding environment (*e.g.,* sound-source characterization, propagation, and ambient noise levels),
○ The affected species (*e.g.,* life history or dive patterns),
○ The likely co-occurrence of marine mammals and ESA-listed marine species with the action (in whole or part), or
○ 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:
○ The long-term fitness and survival of an individual; or
○ 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 authorized entity complies with the ITA and Incidental Take Statement;
• An increase in the probability of detecting marine mammals (through improved technology or methods), both specifically within the mitigation zone (thus allowing for more effective implementation of the mitigation) and in general, to better achieve the above goals; and
• Ensuring that adverse impact of activities remains at the least practicable level.

The Navy's Marine Species Monitoring Program investments are evaluated through the Adaptive Management Review process to: (1) assess overall progress; (2) review goals and objectives; and (3) make recommendations for refinement and evolution of the monitoring program's focus and direction. The Marine Species Monitoring Program has developed and matured significantly since its inception and now supports a portfolio of numerous active projects across a range of geographic areas and protected species taxa addressing both regional priorities (*i.e.,* particular species of concern) and Navy-wide needs such as the behavioral response of beaked whales to training and testing activities.

A Research and Monitoring Summit was held in early 2023 to evaluate the current state of the Marine Species Monitoring Program in terms of progress, objectives, priorities, and needs and to solicit valuable input from meeting participants including NMFS, Marine Mammal Commission, Navy, and scientific experts. The overarching goal of the summit was to facilitate updating the ICMP framework for guiding marine species research and monitoring investments and to identify data gaps and priorities to be addressed over the next 5–10 years across a range of basic research through applied monitoring. One of the outcomes of this summit meeting was a refreshed strategic framework effectively replacing the ICMP which will provide increased coordination and synergy across the Navy's protected marine species investment programs (see section 13 of the application). This will contribute to the collective goal of supporting improved assessment of effects from training and testing activities through development of first in class science and data.

For over a decade, the Navy has implemented the PMAP software tool, which provides operators with notification of the required mitigation and a visual display of the planned training or testing activity location overlaid with relevant environmental data. PMAP includes the Marine Species Awareness Training (MSAT) module. This module was developed by civilian marine biologists employed by the Navy and was reviewed and approved by NMFS. It provides information on marine species sighting cues, visual observation tools and techniques, and sighting notification procedures. It is a video-based complement to the U.S. Navy Lookout Training Handbook or equivalent. Since 2007, this module has been required for commanding officers, executive officers, equivalent civilian personnel, and personnel who will stand watch as a Lookout.

Additionally, the U.S. Navy Lookout Training Handbook was updated in 2022 to include a more robust chapter on environmental compliance, mitigation, and marine species observation tools and techniques. Environmental awareness and education training is also provided to Navy personnel through the Afloat Environmental Compliance Training program or equivalent. Training is designed to help personnel gain an understanding of their personal environmental compliance roles and responsibilities (including mitigation implementation). Finally, the Navy's current generation of land-based ship bridge simulators now incorporate marine mammal response in team training scenarios for bridge watch standers and Lookouts.

Past and Current Action Proponent Monitoring in the Study Area

The Navy's monitoring program has undergone significant changes since the first rules were issued for the Study Area in 2009 through the process of adaptive management. The monitoring program developed for the first cycle of environmental compliance documents 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. In the Study Area, for example, this includes: (1) glider deployment in offshore areas; (2) analysis of existing PAM datasets; (3) small boat surveys using visual, biopsy and satellite tagging; (4) seasonal humpback whale-specific surveys; and (5) a PAM project that supports updated estimates of abundance and density of beaked whale species.

Numerous publications, dissertations, and conference presentations have resulted from research conducted under the marine species monitoring program (*https://www.navymarinespecies monitoring.us/reading-room*), 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

ONR) and demonstration-validation (*e.g.,* Living Marine Resources (LMR)) 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 Study Area and various other ranges. Publications from the LMR and ONR 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 mitigations as monitoring. Data are collected by shipboard personnel on hours spent training and hours of sonar use. Additionally, during MTEs, data are collected when marine mammals are 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 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 military readiness activities within the Study Area. The Navy's annual 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 supports several monitoring projects in the 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/.* Some projects may only require 1 or 2 years of field effort. Other projects could entail multi-year field efforts (2–5 years).

Specific monitoring under the 2020–2027 regulations included the following projects:

- Small Boat Visual Survey for Humpback Whales at Farallon de Medinilla;
- Large Vessel Visual and Acoustic Cetacean Survey Mariana Archipelago Cetacean Survey (co-funded with NMFS);
- Acoustic Spar Buoy Recorders Analysis from 2021 Mariana Archipelago Survey for Beaked Whale Density Derivation;
- Assessment of Historical Stranding Patterns in the Mariana and Hawaiian Islands and Correlations with Environmental Factors;
- Deployment of Passive Acoustic Monitoring Devices around Guam for Beaked Whales;
- Navy Funding to University of Hawaii supporting Cetacean Stranding Analysis (Mariana Islands, Hawaiian Islands, Wake Island); and
- Pacific Marine Assessment Program for Protected Species (PACMAPPS) Survey.

Future monitoring efforts by the Action Proponents in the Study Area are anticipated to continue along the same objectives: establish the baseline habitat uses and movement patterns; establish the baseline behavior (*e.g.,* foraging, dive patterns); and evaluate potential exposure and behavioral responses of marine mammals exposed to training and testing activities.

The currently planned monitoring project for the 2027–2034 rule, which is a continuation of a project currently underway, and its Intermediate Scientific Objectives is listed below. Beaked whales and humpback whales are species of continued interest in the Study Area. Other than this ongoing project, monitoring projects are typically planned 1 year in advance; therefore, this list does not include all projects that will occur over the entire period of the rule.

- Pacific Islands Comprehensive Stranding Investigations (ongoing)—The objectives are: (1) conduct comprehensive investigations of stranded marine mammals throughout the Pacific Islands with emphasis on the Hawaiian and Mariana Island chains, including conducting necropsies of stranded animals, collecting and archiving samples, conducting disease screening, genetic testing, and analysis of historical data; and (2) examine stranding patterns and causes of death for marine mammals in the Pacific Islands.

Proposed Reporting

In order to issue an ITA for an activity, section 101(a)(5)(A) of the MMPA states that NMFS must set forth requirements pertaining to the monitoring and reporting of such taking. Effective reporting is critical both to compliance as well as ensuring that the most value is obtained from the required monitoring. 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 at: *https://www.navymarinespeciesmonitoring.us.*

There are several different reporting requirements for the Navy pursuant to the current regulations. All of these reporting requirements would be continued for the Navy under this proposed rule for the 7-year period.

Special Reporting for Geographic Mitigation Areas

The Action Proponents must report the total hours of active sonar (all bins, by bin) used in the Marpi Reef Mitigation Area and Chalan Kanoa Reef Mitigation Area from December 1 through April 30 in its annual training and testing activity reports submitted to NMFS. Special reporting for this area is designed to aid the Action Proponents and NMFS in continuing to analyze potential impacts of training and testing in the mitigation areas. In addition to the mitigation area-specific requirement, for all mitigation areas, should national security require the Action Proponents to exceed the activity restrictions in a given mitigation area, Action Proponent personnel must provide NMFS with advance notification and include the information (*e.g.,* sonar hours, explosives usage, or restricted area use) in its annual activity reports submitted to NMFS.

Notification of Injured, Live Stranded, or Dead Marine Mammals

The Action Proponents would consult and comply with 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 Study Area Marine Species Monitoring Report

The Action Proponents would submit an annual report of the Study Area marine species monitoring, which would be included in a Pacific-wide monitoring report, describing the implementation and results from the previous calendar year. Data collection

methods will be standardized across range complexes and the Study Area to allow for comparison in different geographic locations. The draft report must be submitted to the Director of the Office of Protected Resources of NMFS annually as specified in the LOA. NMFS will submit comments or questions on the report, if any, within 3 months of receipt. The report will be considered final after the Action Proponents have addressed NMFS' comments or 3 months after submittal of the draft if NMFS does not provide comments on the draft report. The report would describe progress of knowledge made with respect to intermediate scientific objectives within the Study Area associated with the ICMP. Similar study questions would 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 do not provide direct assessment of cumulative progress on the monitoring plan study questions.

Annual MITT Training and Testing Report

In the event that the analyzed sound levels were exceeded, the Action Proponents would submit a preliminary report(s) detailing the exceedance within 21 days after the anniversary date of issuance of the LOA. Regardless of whether analyzed sound levels were exceeded, the Navy would submit a detailed report (MITT Annual Training Exercise Report and Testing Activity Report) to NMFS annually as specified in the LOA. NMFS will submit comments or questions on the report, if any, within 1 month of receipt. The report will be considered final after the Action Proponents have addressed NMFS' comments, or 1 month after submittal of the draft if NMFS does not provide comments on the draft report. The annual report shall contain information on MTEs, SINKEX events, and a summary of all sound sources used (total hours or quantity) 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 (*e.g.,* missiles, bombs, mine neutralization charge) 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 2026 MITT Draft SEIS/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 report at the conclusion of the authorization period (year 7) will 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 7-year annual use compared to 7-year authorization. NMFS must submit comments on the draft close-out report, if any, within 3 months of receipt. The report will be considered final after the Action Proponents have addressed NMFS' comments or 3 months after submittal of the draft if NMFS does not provide comments.

Other Reporting and Coordination

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

- Annual marine species monitoring technical review meetings that include researchers and the Marine Mammal Commission; and
- Annual adaptive management meetings that include the Marine Mammal Commission (and could occur in conjunction with the annual marine species monitoring technical review meetings).

Preliminary Analysis and Negligible Impact Determination

General Negligible Impact Analysis

Introduction

NMFS has defined negligible impact as an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival (50 CFR 216.103). A negligible impact finding is based on the lack of likely adverse effects on annual rates of recruitment or survival (*i.e.,* population-level effects). An estimate of the number of takes alone is not enough information on which to base an impact determination. In addition to considering estimates of the number of marine mammals that might be taken by Level A harassment or Level B harassment (as presented in table 23 and table 24), 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 qualify as take under the MMPA both annually and over the 7-year period covered by this proposed rule and then identified the maximum number of takes we believe are reasonably expected to occur based on the methods described. The impact that any given take will have is dependent on many case-specific factors that need to be considered in the negligible impact analysis (*e.g.,* the context of behavioral exposures such as duration or intensity of a disturbance, the health of impacted animals, the status of a species that incurs fitness-level impacts on individuals). For this proposed rule, we evaluated the likely impacts of the enumerated maximum number of harassment takes that are proposed for authorization and reasonably expected to occur, in the context of the specific circumstances surrounding these predicted takes. Last, we collectively evaluated this information, as well as other more taxa-specific information and mitigation measure effectiveness, in group-specific assessments that support our preliminary negligible impact conclusions for each stock or species.

Harassment

The specified activities reflect representative levels of military readiness activities. The Description of Proposed 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 7-year totals indicated in table 23 and table 24. We base our analysis and preliminary 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 one part of the analysis, which includes extensive qualitative consideration of other contextual factors that influence the degree of impact of the takes on the affected individuals. To avoid repetition, we provide some general analysis immediately below that applies to all the species listed in table 7, given that some of the anticipated effects of the Action Proponents' military readiness activities on marine mammals are expected to be relatively similar in nature. Below that, we provide additional information specific to mysticetes and odontocetes and, finally, 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 Action Proponents' 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 Action Proponents' incidental take request was calculated using a model (NAEMO) for all acoustic stressors, which NMFS reviewed and concurs appropriately estimates the maximum amount of harassment that is reasonably likely to occur. As described in more detail above, NAEMO calculates sound energy propagation from sonar and other transducers and explosives during military readiness 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. The effects of the specified activities are modeled as though they would occur regardless of proximity to marine mammals, meaning that no activity-based mitigation is considered (*e.g.,* no power down or shut down); however, the modeling does quantitatively consider the possibility that marine mammals would avoid continued or repeated sound exposures to some degree, based on a species' sensitivity to behavioral disturbance. NMFS provided input to, independently reviewed, and concurred with the Action Proponents on this process. The Action Proponents' analysis, which is described in detail in section 6 of the application, was used to quantify harassment takes for this proposed rule.

The Action Proponents 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 elicit a response of equal magnitude (Curé *et al.,* 2025; DeRuiter *et al.,* 2013b)). The estimated number of takes by Level A harassment and Level B harassment does not equate to the number of individual animals the Action Proponents expect 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 7-year period. These instances may represent either brief exposures (*i.e.,* seconds or minutes) or, in some cases, longer durations of exposure within a day. In some cases, an animal that incurs a single take by AUD INJ or TTS may also experience a direct behavioral harassment from the same exposure. 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 (number of takes to population abundance) to give us a relative sense of where a larger portion of a species is being taken by the specified activities, where there is a likelihood that the same individuals are being taken across multiple days, and whether the 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 some subset of animals is known to congregate in an area in which activities are regularly occurring (*e.g.,* a small resident population, takes occurring in a known important area such as a Biologically Important Area (BIA), or a large portion of the takes occurring in a certain region and season), the overall likelihood and number of repeated takes is generally considered low. It could, in theory, mean that every take represents a separate individual in the population being taken on 1 day (a minimal impact to an individual) or, more likely, that some smaller number of individuals are taken on 1 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 specified activities and the movement patterns of marine mammals, it is unlikely that individuals from most species or stocks would be taken over more than a few days within a given year. 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 previously described, 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, for most species or stocks, any individuals would be taken a significant portion of the days of the year.

Behavioral Response

The estimates calculated using the BRFs do not differentiate between the

different types of behavioral responses that qualify as Level B harassment. The Action Proponents identified, with NMFS' input, that moderate behavioral responses, as characterized in Southall *et al.* (2021), would be considered a take. The behavioral responses predicted by the BRFs are assumed to be moderate severity exposures (*e.g.,* altered migration paths or dive profiles, interrupted nursing, breeding or feeding, or avoidance) that may last for the duration of an exposure. The Action Proponents then compiled the available data indicating received levels and distances at which those responses have occurred and used the indicated literature to build biphasic behavioral response curves and cut-off conditions that are used to predict how many instances of Level B behavioral harassment occur in a day (see the Criteria and Thresholds Technical Report). Take estimates alone do not provide information regarding the potential fitness or other biological consequences of the responses 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 military readiness activities would be primarily from ASW events. It is important to note that although ASW is one of the warfare areas of focus during MTEs, there are significant periods when active ASW sonars are not in use. Nevertheless, behavioral responses are assumed more likely to be significant during MTEs than during other ASW activities due to the duration (*i.e.,* multiple days), scale (*i.e.,* multiple sonar platforms), and use of high-power hull-mounted sonar in the MTEs. In other words, in the range of potential behavioral effects that might be expected as 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 1 day), the less severe end might include exposure to comparatively lower levels of a sound, at a detectably greater distance from the animal, for a few or several minutes, and that could result in a behavioral response such as avoiding an area that an animal would otherwise have chosen to move through or feed in for some amount of time or breaking off one or a few feeding bouts. More severe effects could occur when the animal is close enough to the source to receive a comparatively higher level, is exposed continuously to one source for a longer time, or is exposed intermittently to different sources throughout a day. Such effects might result in an animal having a more severe flight response and leaving a larger area for a day or more or potentially losing feeding opportunities for a day; however, such severe behavioral effects are expected to occur infrequently.

To help assess this, for sonar (LFAS/MFAS/HFAS) used in the Study Area, the Action Proponents provided information estimating the instances of take by Level B harassment by behavioral disturbance under each BRF that would occur within 6-dB increments (discussed below in the *Group and Species-Specific Analyses* section) and by distance in 5-km bins in section 2.3.2 of the Explosive and Acoustic Analysis Technical Report. 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 (*e.g.,* distance, duration of exposure, and behavioral state of the animals) are also important (Di Clemente *et al.,* 2018; Ellison *et al.,* 2012; Moore and Barlow, 2013; Southall *et al.,* 2019c; Wensveen *et al.,* 2017, *etc.*). The majority of takes by Level B harassment are expected to be in the form of comparatively milder responses (*i.e.,* lower-level exposures that still qualify as take under the MMPA but would likely be less severe along the continuum 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 across 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 the specified activities might result in more severe responses (see the *Group and Species-Specific Analyses* section below for more detailed information).

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 Action Proponents' 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.

Diel Cycle

Many animals perform vital functions such as feeding, resting, traveling, and socializing on a diel cycle (24-hour cycle). Behavioral responses 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 1 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 1 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 responses 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 moving faster than while in transit (typically 18.5–27.8 km/hr or higher) and generally cover large areas that are

relatively far from shore (typically more than 5.6 km from shore) and in waters greater than 182.9 m deep. 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 Action Proponents do 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 Action Proponents conduct 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 described in chapter 2 of the 2026 MITT Draft SEIS/OEIS. Sonar used during ASW would impart the greatest amount of acoustic energy of any category of sonar and other transducers analyzed in the 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 and testing activities using hull-mounted sonar proposed for the Study Area generally last for only a few hours. However, ASW training activities range from several hours to days or more than 10 days for large integrated ASW MTEs (see table 1 and table 2). 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 conducts ASW activities in varying locations. Given the average length and dynamic nature of ASW activities (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 1 day or on successive days.

Most planned explosive events are instantaneous or scheduled to occur over a short duration (less than 2 hours), and the explosive component of these activities only lasts for minutes. Although explosive activities may sometimes be conducted in the same general areas repeatedly, because of their short duration and the fact that they are typically in the open ocean and animals can easily move away, it is similarly unlikely that animals would be exposed for long, continuous amounts of time, or demonstrate sustained behavioral responses. Although SINKEXs may last for up to 48 hours (4–8 hours typically, possibly 1–2 days), they are almost always completed in a single day and only one to two events are planned annually (see table 2). They are stationary and conducted in deep, open water (where fewer marine mammals would typically be expected to be randomly encountered), and they have rigorous monitoring (see table 41) and shutdown procedures, all of which make it unlikely that individuals would be exposed to the exercise for extended periods or on consecutive days, though some individuals may be exposed on multiple 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. 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, though factors such as movement ecology (*e.g.,* is the species resident and more likely to remain in closer proximity to ongoing activities, versus nomadic or migratory; Keen *et al.* (2021)) or whether there are known BIAs where animals are known to congregate can help inform this. 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 once per year or that some smaller number were exposed a few times per 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 the Action Proponents' 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 on each species.

In the ocean, unlike a modeling simulation with static animals, the transient nature of sonar use makes it unlikely to repeatedly expose the same individual animals within a short period, such as within one specific exercise. However, some repeated exposures across different activities could occur over the year with more resident species. In short, we expect 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 Action Proponents' activities and the movement patterns of marine mammals, it is unlikely that any particular subset would be taken over more than several sequential days. In other cases, such as activities that overlap biologically important habitat, repeated exposures of the same individuals may be more likely given the likelihood that a smaller number of animals would routinely use the affected habitat.

When calculating the proportion of a population taken (*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. Herein, NMFS considers two estimates: (1) the SAR abundance estimates; and (2) the number of animals assumed to be in the Study Area during modeling. The latter estimates are either literature-based estimates (if available) (see section 3.4.2 of the 2026 MITT Draft SEIS/OEIS) or the predicted abundance within the Study Area boundary using the NMSDD (see the Density Technical Report). The SARs, where available (Western North Pacific humpback whale and Central North Pacific blue whale only), provide the official population estimate for a given species or stock in U.S. waters in a given year. These estimates are typically generated from the most recent shipboard and/or aerial surveys conducted, and in some cases, the estimates show substantial year-to-year

variability. When the stock is known to range well outside of U.S. EEZ boundaries, population estimates based on surveys conducted only within the U.S. EEZ are known to be underestimates. The NMSDD abundance estimates are abundance estimates for within the boundaries described for the Study Area only and, therefore, differ from SAR abundance estimates.

To estimate repeated impacts across large areas relative to species geographic distributions, comparing the impacts predicted in NAEMO to the number of animals assumed to be in the Study Area during modeling is usually preferable. By comparing estimated take to these abundance estimates, impacts and abundance estimates are based on the same underlying assumptions about a species' presence. NMFS has compared the estimated take to the number of animals assumed to be in the Study Area during modeling herein for all species and stocks. If the abundance information for a stock fit into one of the following scenarios, NMFS would have concluded that comparison to the SAR abundance estimate is more appropriate: (1) a species' or stocks' range extends beyond the U.S. EEZ and the SAR abundance estimate is greater than the number of animals assumed to be in the Study Area during modeling; or (2) when the current minimum population estimate in the SAR is greater than the number of animals assumed to be in the Study Area during modeling, regardless of whether the stock range extends beyond the EEZ. However, neither the Central North Pacific blue whale nor Western North Pacific humpback whale fit into these scenarios. The number of animals assumed to be in the Study Area during modeling are included in table 51, table 53, table 55, and table 57, and the SAR abundance estimate for Central North Pacific blue whale and Western North Pacific humpback whale are included in table 51.

Temporary Threshold Shift

NMFS and the Navy have estimated that all species of marine mammals that occur within the Study Area may incur 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. Table 25 through table 28 indicate the number of takes by TTS that may be incurred by different species from exposure to active sonar and explosives. The TTS incurred by an animal is primarily characterized by three characteristics:

1. Frequency—Available data 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) (Finneran, 2015; Southall *et al.,* 2019c). The Navy's MF ASW sources, which are the highest power and most numerous sources and the ones that cause the most take by TTS, 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 1 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. Sound from HF sources would attenuate more quickly compared to MF sources, and they typically 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 the highest frequencies audible to VHF cetaceans, approaching 200 kHz), which could overlap with the range in which some odontocetes communicate or echolocate. However, HF systems with higher source levels are typically used less frequently and for shorter time periods than surface ship and aircraft MF systems, so TTS from HF sources is less likely than from MF sources. There are fewer LF sources, 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 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.,* it would not affect the majority of an animal's hearing range).

2. Degree of the shift (*i.e.,* by how many dB the sensitivity of hearing is reduced)—Generally, both the degree 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 SPL is higher or the duration is longer). The threshold for the onset of TTS was discussed previously in this proposed rule. An animal would have to approach closer to the source or remain in the vicinity of the sound source appreciably longer to increase the received SEL, which would be difficult considering the Lookouts and the nominal speed of an active sonar vessel (18.5–27.8 km/hr) 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 measured via auditory steady-state response (auditory evoked potential measurement). The SQS–53 (MFAS) hull-mounted sonar (MF1) nominally emits a short (*i.e.,* 1-second) ping typically every 50 seconds, and incurring those levels of TTS due to this source is highly unlikely. Sources with higher duty cycles, such as MF1C (high duty cycle hull-mounted sonar) produce longer ranges to effects and contribute to auditory effects from this action. Since most hull-mounted sonar, such as the SQS–53, engaged in ASW training would be moving at between 18.5 and 27.8 km/hr and nominally pinging every 50 seconds, the vessel will have traveled a minimum distance of approximately 257 m during the time between those pings. For a Navy vessel moving at a nominal 18.5 km/hr, it is unlikely a marine mammal would track with the ship and could maintain speed parallel to the ship to receive adequate energy over successive pings to suffer TTS. In general, there is a higher potential for TTS associated with sources with higher duty cycles, like continuous hull-mounted sonars, compared to those sources that are intermittent or have lower duty cycles (Kastelein *et al.,* 2015a). Of note, high duty cycle or continuous hull-mounted sonars make up a small percentage of the Navy's overall MFAS activities.

In short, given the anticipated duration and levels of sound exposure, we do not expect marine mammals to incur more than relatively low levels of TTS in most cases for sonar exposure. To add context to this degree of TTS, individual marine mammals may regularly experience variations of 6 dB differences in hearing sensitivity in their lifetime (Finneran *et al.,* 2000; Finneran *et al.,* 2002; Schlundt *et al.,* 2000).

3. Duration of TTS (recovery time)—As discussed in the Potential Effects of Specified Activities on Marine Mammals and Their Habitat section, in TTS laboratory studies using exposures of up to an hour in duration or up to 217 dB SEL, most individuals recovered within 1 day (or less, often in minutes) (Kastelein, 2020b). One study resulted in a recovery that took 4 days (Finneran

et al., 2015; Southall *et al.,* 2019c). However, there is evidence that repeated exposures resulting in TTS could potentially lead to residual threshold shifts that persist for longer durations and can result in PTS (Reichmuth *et al.,* 2019).

Compared to laboratory studies, marine mammals are likely to experience lower SELs from sonar used in the Study Area due to movement of the source and animals and because of the lower duty cycles typical of higher power sources (though some of the Navy MF1C sources have higher duty cycles). Therefore, TTS resulting from MFAS would likely be of lesser magnitude and duration compared to laboratory studies. Also, for the same reasons discussed in the Preliminary Analysis and Negligible Impact Determination—Diel Cycle section, and because of the short distance between the source and animals needed to reach high SELs, it is unlikely that animals would be exposed to the levels necessary to induce TTS in subsequent time periods such that hearing recovery is impeded. Additionally, though the frequency range of TTS that marine mammals might incur 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.

As a general point, the majority of the TTS takes are the result of exposure to hull-mounted MFAS, 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, 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, maybe a few hours, or at most in limited circumstances, a few days, a taken individual will have diminished hearing sensitivity (*i.e.,* more than natural variation but not approaching 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 the exposure would occur 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 may not be as impactful. In short, the expected results of any one of these limited 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 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, it is unlikely that individuals would experience repeated or high degree TTS overlapping in frequency and time with signals critical for behaviors that would impact overall fitness.

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, while TTS 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 occurs. 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. 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 sound sources primarily involved in this proposed rule, we do not expect the exposures with the potential for masking to be of a long duration.

Masking is fundamentally more of a concern with low frequency signals because they propagate significantly farther than higher frequencies and are more likely to overlap both the narrower LF calls of mysticetes, as well as many non-communication cues (*e.g.,* 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 and detection and interpretation of auditory signals is likely more challenging. 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 Action Proponents occasionally use LF and more continuous sources, that use does not reach the contemporaneous aggregate amounts that would be expected to accrue to degrees 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. During Kingfisher mode, an increased likelihood of masking in the vicinity of vessel could be expected. 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 1 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 the 1 second pulse of hull-mounted sonar, or 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 CAS systems, but, as described previously, it would be expected to be of a short duration. While data are lacking on behavioral responses of marine mammals to continuously active sonars, mysticete species are known 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 18.5 km/hr, and it is unlikely that the ship and the marine mammal would continue to move in the same direction such that the marine mammal is 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 the Action Proponents' 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 used less frequently, are expected to contribute to masking over far smaller areas and/or times. 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 Action Proponents use would not be expected to result in more than short-term, low-impact masking that would not affect reproduction or survival.

Auditory Injury From Sonar Acoustic Sources and Explosives and Non-Auditory Injury From Explosives

Table 25 through table 28 indicate the number of takes of each species by Level A harassment in the form of auditory injury resulting from exposure to active sonar and/or explosives is estimated to occur, and table 29 indicates the totals across all activities. The number of takes estimated to result from auditory injury annually from sonar and explosives for each species/stock from all activities combined ranges from 0 to 374 (the 374 is for pygmy sperm whale). Two species have the potential to incur non-auditory injury from explosives: Fraser's dolphin and Risso's dolphin, each with a maximum of one annual non-auditory injury. As described previously, the Navy's model likely overestimates the number of injurious takes to some degree. Nonetheless, these Level A harassment take numbers represent the maximum number of instances in which marine mammals would be reasonably expected to incur auditory and/or non-auditory injury, and we have analyzed them accordingly.

If a marine mammal is able to approach a surface vessel within the distance necessary to incur auditory injury in spite of the mitigation measures, the likely speed of the vessel (nominally 10–15 kn (18.5–27.8 km/hr)) 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 auditory injury. As discussed previously in relation to TTS, the likely consequences to the health of an individual that incurs auditory injury can range from mild to more serious and is dependent upon the degree of auditory injury and the frequency band associated with auditory injury. The majority of any auditory injury 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. Because of the broadband nature of explosives, auditory injury incurred from exposure to explosives would occur over a lower, but wider, frequency range. 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 and at younger ages, as the result of stressor exposure. While a small loss of hearing sensitivity may result in 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 Action Proponents implement 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, thereby improving the sightability of marine mammals and mitigation effectiveness. Observing for marine mammals during the explosive activities would include visual and passive acoustic detection methods (the latter when they are available and part of the activity) before the activity begins, in order to cover the mitigation zones that can range from 183 m to 2,286 m depending on the source (*e.g.,* explosive torpedo, explosive gunnery, explosive bombs) and 4.6 km for sinking exercises (see table 34 through table 41).

The type and amount of take by Level A harassment are indicated for all species and species groups in table 51, table 53, table 55, and table 57. Generally speaking, non-auditory injuries from explosives could range from minor lung injuries (which is the most sensitive organ and first to be affected) that consist of some short-term reduction of health and fitness immediately following the injury that heals quickly and will not have any discernible long-term effects, up to more impactful permanent injuries across multiple organs that may cause health problems and negatively impact reproductive success (*i.e.,* increase the time between pregnancies or even render reproduction unlikely) but fall just short of a ''serious injury'' by virtue of the fact that mortality is unexpected. Nonetheless, due to the Navy's mitigation and detection capabilities, we would not expect marine mammals to typically be exposed to a more severe blast located closer to the source—so the impacts likely would be less severe. In addition, the non-auditory injuries are predicted for two delphinid stocks with medium to large group sizes, which increases sightability. It is still difficult to evaluate how these injuries may or may not impact an animal's fitness; however, these effects are only seen in limited numbers (single instances for both stocks annually) and mostly in

species of moderate to high abundances. In short, it is unlikely that any, much less all, of the limited number of injuries accrued to any one stock would result in reduced reproductive success of any individuals. Even if a few injuries did result in reduced reproductive success of individuals, the status of the affected stocks are such that it would not be expected to adversely impact rates of reproduction, and auditory injury of the low severity anticipated here is not expected to affect the survival of any individual marine mammals.

Group and Species-Specific Analyses

In this section, we build on the general analysis that applies to all marine mammals in the Study Area from the previous sections. We first include information and analysis that applies to mysticetes or, separately, odontocetes and then, within those two sections, include more specific information that applies to smaller groups, where applicable, and the affected species or stocks. The specific take numbers proposed for authorization are also included in the analyses below, and we provide some additional context and discussion regarding how we consider the proposed authorized take numbers in those 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 7-year activity period are shown in table 23 and table 24.

In the discussions below, the estimated takes by Level B harassment 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. As part of our evaluation of the magnitude and severity of impacts to marine mammal individuals and species, and specifically in an effort to better understand the degree to which the modeled and estimated takes likely represent repeated takes of the individuals of a given species/stock, we consider the total annual numbers of take by harassment (auditory injury, non-auditory injury, TTS, and behavioral disturbance) for species or stocks as compared to their associated abundance estimates. Specifically, take numbers higher than the stock abundance clearly indicate that some number of individuals are being taken on more than 1 day in the year, and broadly higher or lower ratios of take to abundance may reasonably be considered to equate to higher or lower likelihood of repeated takes, respectively, other potentially influencing factors being equal. In addition to the mathematical consideration of estimated take compared to abundance, we also consider other factors or circumstances that may influence the likelihood of repeated takes, where known, such as circumstances where activities resulting in take are focused in an area and time (*e.g.,* instrumented ranges or a homeport or long-duration activities such as MTEs) and/or where the same individual marine mammals are known to congregate over longer periods of time (*e.g.,* mysticetes in a known foraging area or resident odontocetes with smaller home ranges). Similarly, and all else being equal, estimated takes that are largely focused in one season (see table 51, table 53, table 55, and table 57) may indicate a higher likelihood of repeated takes of the same individuals.

Occasional, milder behavioral responses 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 a comparatively longer duration of 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.,* 2018b; Harris *et al.,* 2018; King *et al.,* 2015; NAS, 2017; New *et al.,* 2014; Southall *et al.,* 2007; Villegas-Amtmann *et al.,* 2015; Hoekendijk *et al.,* 2018; Wisniewska *et al.,* 2018; Czapanskiy *et al.,* 2021; Pirotta, 2022). Generally speaking, and in the case of most species impacted by the proposed activities, in the cases where some number of individuals may reasonably be expected to be taken on more than 1 day within a year, that number of days would be comparatively small, and we have no reason to expect that those takes would occur on sequential days.

To assist in understanding what this analysis means, we include a few clarifications related to estimated takes and the analysis here. An individual that incurs AUD INJ or TTS may sometimes, for example, also be subject to behavioral disturbance at the same time. As described above in this section, the degree of auditory injury 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 auditory injury 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 impacted. Accordingly, in analyzing the number of takes and the likelihood of repeated and sequential takes, we consider the total takes, not just the takes by Level B harassment by behavioral disturbance, so that individuals potentially exposed to both threshold shift and behavioral disturbance are appropriately considered. The number of takes by Level A harassment by auditory injury are so low (and zero in some 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 most marine mammal stocks from sonar and other active sound sources during the specified military readiness activities would be primarily from ASW events. 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. In addition to the proximity to the source, the type of activity and the season and location during which an animal is exposed can inform the impacts. These factors, including the numbers and types of effects that are estimated in areas known to be biologically important for certain

species, are discussed in the group and species-specific sections below.

As described in the Proposed Mitigation Measures section, this proposed rule includes mitigation measures that would reduce the probability and/or severity of impacts expected to result from acute exposure to acoustic sources or explosives, and impacts to marine mammal habitat. Specifically, the Action Proponents would use a combination of delayed starts, power downs, and shutdowns to avoid mortality or serious injury, minimize the likelihood or severity of AUD INJ or non-auditory injury, and reduce instances of TTS or more severe behavioral disturbance caused by acoustic sources or explosives. The Action Proponents 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. Finally, the Action Proponents would implement measures to further reduce the already unlikely potential that a marine mammal would be struck by a vessel.

These time/area restrictions include a Marpi Reef Mitigation Area, a Chalan Kanoa Reef Mitigation Area, and an Agat Bay Nearshore Mitigation Area. The Marpi Reef Mitigation Area and Chalan Kanoa Reef Mitigation Area are discussed in the humpback whale section below. The Agat Bay Nearshore Mitigation Area is discussed in the Dolphins and Small Whales section below. However, it is important to note that measures in that area, while developed to protect humpback whales and spinner dolphins, respectively, would also benefit other marine mammals in those areas. Therefore, they are discussed here also.

Within the Marpi Reef Mitigation Area and the Chalan Kanoa Reef Mitigation Area, from December 1 through April 30, the Action Proponents must not use more than 20 combined hours of MF1 and MF1C surface ship hull-mounted MFAS during training and testing annually. Further, the Action Proponents must not detonate in-water explosives (including underwater explosives and explosives deployed against surface targets) within either mitigation area year-round. These measures are designed to avoid or reduce exposure of humpback whales in important seasonal reproductive habitat to explosives that could cause mortality or levels of sound that have the potential to cause injury or behavioral disturbance, or, in the case of explosives, mortality. The Navy must also issue an annual seasonal awareness notification message to alert ships and aircraft operating in the Marpi Reef Mitigation Area and Chalan Kanoa Reef Mitigation Area to the possible presence of increased concentrations of humpback whales from December 1 through April 30. To maintain safety of navigation and to avoid interactions with large whales during transits, the Navy will instruct vessels to remain vigilant to the presence of humpback whales that, when concentrated seasonally, may become vulnerable to vessel strikes. Platforms must use the information from the awareness notification messages to assist their visual observation of applicable mitigation zones during training and testing activities and to aid in the implementation of activity-based mitigation. These awareness messages and subsequent actions are designed to minimize the potential for vessel strike of humpback whales, as well as exposure to acoustic, explosive, and physical disturbance and strike stressors that have the potential to cause mortality, injury, or behavioral disturbance during the reproductive season.

Within the Agat Bay Nearshore Mitigation Area, the Action Proponents must not use MF1 or MF1C surface ship hull-mounted MFAS or detonate in-water explosives (including underwater explosives and explosives deployed against surface targets) during training and testing year-round. These measures are designed to prevent exposure of spinner dolphins in important resting habitat to levels of sound and explosives that have the potential to cause injury, behavioral disturbance, or, in the case of explosives, mortality.

In addition to the nature and context of the disturbance, including whether take occurs in an area of known biological importance, species-specific factors affect the severity of impacts to individual animals and population consequences of disturbance. Keen *et al.* (2021) identifies three population consequences of disturbance themes: life history traits, environmental conditions, and disturbance source characteristics. Life history traits considered in Keen *et al.* (2021) include movement ecology (whether animals are resident, nomadic, or migratory), reproductive strategy (capital breeders, income breeders, or mixed), body size (based on size and life stage), and pace of life (slow or fast).

Regarding movement ecology, resident animals that have small home ranges relative to the size and duration of an impact zone would have a higher risk of repeated exposures to an ongoing activity. Animals that are nomadic over a larger range may have less predictable risk of repeated exposure. For resident and nomadic populations, overlap of a stressor with feeding or reproduction depends more on time of year rather than location in their habitat range. In contrast, migratory animals may have higher or reduced potential for exposure during feeding and reproduction based on location, time of the year, and duration of an activity. The risk of repeated exposure during individual events may be lower during migration as animals maintain directed transit through an area.

Reproduction is energetically expensive for female marine mammals, and reproductive strategy can influence an animal's sensitivity to disturbance. Mysticetes are capital breeders. Capital breeders rely on their capital, or energy stores, to migrate, maintain pregnancy, and nurse a calf. Capital breeders would be more resilient to short-term foraging disruption due to their reliance on built-up energy reserves but are vulnerable to prolonged foraging impacts during gestation. Most odontocetes are income breeders, which rely on some level of income, or regular foraging, to give birth and nurse a calf. Income breeders would be more sensitive to the consequences of disturbances that impact foraging during lactation. Some species exhibit traits of both, such as beaked whales.

Smaller animals require more food intake per unit body mass than large animals. They must consume food on a regular basis and are likely to be non-migratory and income breeders. The smallest odontocetes, the porpoises, must maintain high metabolisms to maintain thermoregulation and cannot rely on blubber stores for long periods of time, whereas larger odontocetes can more easily thermoregulate. The larger size of other odontocetes is an adaptation for deep diving that allows them to access high quality mesopelagic and bathypelagic prey. Both small and large odontocetes have lower foraging efficiency than the large whales. The filter-feeding large whales (*i.e.,* mysticetes) consume most of their food within several months of the year and rely on extensive lipid reserves for the remainder of the year. The metabolism of mysticetes allows for fasting while seeking prey patches during foraging season and prolonged periods of fasting outside of foraging season (Goldbogen *et al.,* 2023). Their energy stores support capital breeding and long migrations. The effect of a temporary feeding disturbance is likely to have

inconsequential impacts to a mysticete but may be consequential for small cetaceans. For purposes of this assessment, marine mammals were generally categorized as small (less than 3.05 m), medium (3.05–9.1 m), or large (more than 9.1 m) based on length.

Populations with a fast pace of life are characterized by early age of maturity, high birth rates, and short life spans, whereas populations with a slow pace of life are characterized by later age of maturity, low birth rates, and long life spans. The consequences of disturbance in these populations differ. Although reproduction in populations with a fast pace of life are more sensitive to foraging disruption, these populations are quick to recover. Reproduction in populations with a slow pace of life is resilient to foraging disruption, but late maturity and low birth rates mean that long-term impacts to breeding adults have a longer-term effect on population growth rates. Pace of life was categorized for each species in this analysis by comparing age at sexual maturity, birth rate interval, life span, body size, and feeding and reproductive strategy.

Southall *et al.* (2023) also identified factors that inform a population's vulnerability. The authors describe a framework to assess risk to populations from specific industry impact scenarios at different locations or times of year. While this approach may not be suitable for many military readiness activities, for which alternate spatial or seasonal scenarios are not usually feasible, the concepts considered in that framework's population vulnerability assessment are useful in this analysis, including population status (endangered or threatened), population trend (decreasing, stable, or increasing), population size, and chronic exposure to other anthropogenic or environmental stressors (*e.g.,* fisheries interactions, pollution). These factors are also considered when assessing the overall vulnerability of a stock to repeated effects from acoustic and explosive stressors.

In consideration of the factors outlined above, if impacts to individuals increase in magnitude or severity such that repeated and sequential higher-severity impacts occur (the probability of which 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 accrue only to females, which comprise approximately 50 percent of the population. 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, 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 previously explained, such severe impacts from the specified activities for any species or stocks are not expected to occur. We note that the negligible impact analysis is inherently a two-tiered assessment that first evaluates the anticipated impacts of the activities on marine mammal individuals, and then if impacts are expected to affect reproduction or survival of any individuals, the analysis further evaluates the effects of those individual impacts on rates of reproduction and survival of the species or stock in the context of the status of the species or stock. The analyses below in some cases address species collectively if they occupy the same functional hearing group (*i.e.,* very-low, low, high, and very 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 specified 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, those differences are either described within the section or the discussion for those species or stocks. Specifically, we first give broad descriptions of the mysticete and odontocete groups and then differentiate into further groups as appropriate below.

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 or stocks will incur, the applicable mitigation for species or stocks, and the status and life history of the stocks to support the negligible impact determinations for each species or stock. We have already described above why we believe the incremental addition of the limited number of low-level auditory injury takes will not have any meaningful effect towards inhibiting reproduction or survival. We have also described above the unlikelihood of any masking or habitat impacts having effects that would impact the reproduction or survival of any of the individual marine mammals affected by the Action Proponents' activities. For mysticetes, there is no predicted non-auditory injury from explosives for any species or stock. Regarding the severity of individual takes by Level B harassment by behavioral disturbance for mysticetes, the majority of these responses are anticipated to occur at received levels below 172 dB and last from a few minutes to a few hours, at most, with associated responses most likely in the form of moving away from the source, foraging interruptions, vocalization changes, or disruption of other social behaviors. Much of the discussion below focuses on the behavioral effects and the mitigation measures that reduce the probability or severity of effects in areas known to be biologically important. Because there are multiple stock-specific factors in relation to the status of the species, at the end of the section, we break out stock-specific findings.

In table 51 below for mysticetes, we indicate the total annual Level A harassment and Level B harassment and a number indicating the instances of total take as a percentage of abundance, noting the Central North Pacific stock of blue whale and the Western North Pacific stock of humpback whale have SAR abundance estimates in addition to Study Area abundance estimates.

In table 52 below, we indicate the status, life history traits, important habitats, and threats that inform our analysis of the potential impacts of the estimated take on the affected mysticete stocks.

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Table 51 -- Annual Estimated Take by Level B harassment and Level A harassment and Related Information for Mysticetes in the Study Area

Marine Mammal Species	Stock	Study Area Abundance	Maximum Annual Level B Harassment	Maximum Annual Level A Harassment	Maximum Annual Take	Maximum Annual Harassment As Percentage of Abundance	Season with 70 Percent of Take or Greater **
Blue Whale	Central North Pacific	232*	42	1	43	19	Cold (73 percent)
Bryde's Whale	NSD	233	68	1	69	30	N/A
Fin Whale	NSD	309	35	1	36	12	Cold (74 percent)
Humpback Whale	Western North Pacific	5,287*	1,517	21	1,538	29	Cold (89 percent)
Minke Whale	NSD	91	25	1	26	29	Cold (75 percent)
Omura's Whale	NSD	154	52	1	53	34	N/A
Sei Whale	NSD	166	37	1	38	23	Cold (73 percent)

Note: NSD – No stock designated. N/A – Not Applicable.
*The stock abundance reported in the NMFS SAR for Central North Pacific blue whale is 133 (Carretta *et al.*, 2023) and for Western North Pacific humpback whale is 1,084 (Young *et al.*, 2023).
** The cold season includes the period from winter to spring.

Table 52 -- Life History Traits, Important Habitat[1], and Threats to Mysticetes in the Study Area

Marine Mammal Species	Stock	ESA Status	MMPA Status	Movement Ecology	Body Size	Reproductive Strategy	Pace of Life	Chronic Risk Factors	UME, Oil Spill, Other	Important Habitat	Population Trend
Blue Whale	Central North Pacific	Endangered	Depleted, Strategic	Migratory	Large	Capital	Slow	Vessel strikes, fisheries interactions, ingestion of marine debris, ocean noise, disease, predation by killer whales	No	No	Unknown
Bryde's Whale	NSD	Not listed	N/A	Nomadic	Large	Capital	Slow	Vessel strikes, fisheries interactions, ocean noise, predation by killer whales	No	No	Unknown
Fin Whale	NSD	Endangered	N/A	Migratory	Large	Capital	Slow	Vessel strikes, fisheries interactions, ocean noise, disease, parasites, predation by killer whales	No	No	Unknown
Humpback Whale	Western North Pacific	Not listed	Depleted, Strategic	Migratory	Large	Capital	Slow	Vessel strikes, fisheries interactions, ingestion of marine debris, disease, parasites, predation by (false) killer whales	No	Marpi Reef and Chalan Kanoa Reef	Unknown
Minke Whale	NSD	Not listed	N/A	Nomadic	Med-Large	Capital	Slow	Vessel strikes, fisheries interactions, prey availability	No	No	Unknown
Omura's Whale	NSD	Not listed	N/A	Unk, likely nomadic	Large	Capital	Slow	Vessel strike, fisheries interactions	No	No	Unknown
Sei Whale	NSD	Endangered	N/A	Migratory	Large	Capital	Slow	Vessel strikes, fisheries interactions, ocean noise, disease, parasites, predation by killer whales	No	No	Unknown

Note: NSD = No stock designated. N/A = Not Applicable.
[1] There are no areas of critical habitat designated under the ESA in the Study Area.

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Blue Whale (Central North Pacific Stock)—

Blue whales are listed as endangered under the ESA and as both depleted and strategic under the MMPA. The Central North Pacific stock of blue whales is a migratory population that can occur near the coast, over the continental shelf, and in oceanic waters. Blue whales face several chronic anthropogenic and non-anthropogenic risk factors, including vessel strike, fisheries interactions, ingestion of marine debris, ocean noise, disease, and predation by killer whales, among others. The Navy estimates the abundance as 232 animals in the Study Area, and NMFS' SAR states the PBR is 0.1 Central North Pacific blue whales per year and the annual M/SI (from other human activities) is 0 (note that the SAR abundance estimate, as noted

in table 51, is 133). There are no UMEs or other factors that cause particular concern for this stock, and there are no known biologically important areas for the Central North Pacific stock of blue whales in the Study Area. This stock migrates from their feeding grounds in the Gulf of Alaska to Hawaii in winter. While they occur in the Study Area, they are not sighted frequently or year-round. As shown in table 51, the maximum annual allowable instances of take under this proposed rule by Level A harassment and Level B harassment is 1 and 42, respectively. No mortality is anticipated or proposed for authorization, nor is any non-auditory injury. The total take allowable across all 7 years of the rule is indicated in table 29.

Regarding the potential takes associated with auditory impairment, as described in the Auditory Injury from Sonar Acoustic Sources and Explosives and Non-Auditory Injury from Explosives section above, any takes in the form of TTS are expected to be lower-level, of short duration (from minutes to, at most, several hours or less than a day), and mostly not in a frequency band that would be expected to interfere with blue whale communication or other important low-frequency cues. Any associated lost opportunities or capabilities individuals might experience as a result of TTS would not be at a level or duration that would be expected to impact reproductive success or survival. For similar reasons, while auditory injury impacts last longer, the low anticipated levels of AUD INJ that could be reasonably expected to result from these activities are unlikely to have any effect on fitness.

Regarding the likely severity of any single instance of take by behavioral disturbance, as described above, the majority of the predicted exposures are expected to be below 172 dB SPL and last from a few minutes to a few hours, at most, with associated responses most likely in the form of moving away from the source, foraging interruptions, vocalization changes, or disruption of other social behaviors, lasting from a few minutes to several hours. Blue whales are large-bodied capital breeders with a slow pace of life and are, therefore, generally less susceptible to impacts from shorter duration foraging disruptions. Further, as described in the *Group and Species-Specific Analyses* section above and the Proposed Mitigation Measures section, mitigation measures are expected to further reduce the potential severity of impacts through real-time operational measures that minimize higher level/longer duration exposures and time/area measures that reduce impacts in high value habitat.

As described above, in addition to evaluating the anticipated impacts of the single instances of takes, it is important to understand the degree to which individual marine mammals may be disturbed repeatedly across multiple days of the year. In this case, given the lower number of takes by harassment as compared to the stock abundance (see table 51) and their movement pattern, it is unlikely that any individual blue whales would be taken on more than a limited number of days within a year and, therefore, the anticipated behavioral disturbance is not expected to affect reproduction or survival.

Given the magnitude and severity of the impacts discussed above to the Central North Pacific stock of blue whales (considering annual take maximum and the total across 7 years) and their habitat, and in consideration of the required mitigation measures and other information presented, the Action Proponents' activities are not expected to result in impacts on the reproduction or survival of any individuals, much less affect annual rates of recruitment or survival. For these reasons, we have determined that the total take (considering annual maximum and across 7 years) estimated and proposed for authorization would have a negligible impact on the Central North Pacific stocks of blue whale.

Bryde's Whale—

Little is known about the movements of Bryde's whales in the Study Area, but most survey efforts have observed Bryde's whales in deep waters (*e.g.,* the West Mariana Ridge and Mariana Trench), and some surveys have identified calves. In general, Bryde's whales occur primarily in offshore oceanic warm waters of the North Pacific. There are no UMEs or other factors that cause particular concern for this stock, and there are no known biologically important areas for Bryde's whales in the Study Area. Bryde's whales face several chronic anthropogenic and non-anthropogenic risk factors, including vessel strike, fisheries interactions, ocean noise, and predation by killer whales, among others.

As shown in table 51, the maximum annual allowable instances of take under this proposed rule by Level A harassment and Level B harassment is 1 and 68, respectively. No mortality is anticipated or proposed for authorization, nor is any non-auditory injury. The total take allowable across all 7 years of the rule is indicated in table 29.

Regarding the potential takes associated with auditory impairment, as described in the Auditory Injury from Sonar Acoustic Sources and Explosives and Non-Auditory Injury from Explosives section above, any takes in the form of TTS are expected to be lower-level, of short duration (from minutes to, at most, several hours or less than a day), and mostly not in a frequency band that would be expected to interfere with Bryde's whale communication or other important low-frequency cues.

Regarding the likely severity of any single instance of take by behavioral disturbance, as described above, the majority of the predicted exposures are expected to be below 172 dB SPL and last from a few minutes to a few hours, at most, with associated responses most likely in the form of moving away from the source, foraging interruptions, vocalization changes, or disruption of other social behaviors, lasting from a few minutes to several hours. Bryde's whales are large-bodied capital breeders with a slow pace of life and are therefore generally less susceptible to impacts from shorter duration foraging disruptions. Further, as described in the *Group and Species-Specific Analyses* section above and the Proposed Mitigation Measures section, mitigation measures are expected to further reduce the potential severity of impacts through real-time operational measures that minimize higher level/longer duration exposures.

As described above, in addition to evaluating the anticipated impacts of the single instances of takes, it is important to understand the degree to which individual marine mammals may be disturbed repeatedly across multiple days of the year. In this case, given the number of takes by harassment as compared to the abundance (see table 51), it is likely that some portion of Bryde's whale individuals would be taken repeatedly over a moderate number of days. However, given the variety of activity types that contribute to take across separate exercises conducted at different times and in different areas, and the fact that many result from transient activities conducted at sea, it is unlikely that repeated takes would occur either in numbers or clumped across sequential days in a manner likely to impact foraging success and energetics or other behaviors such that reproduction or survival of any individuals is likely to be impacted. Given the lower number of takes by harassment as compared to the species abundance (see table 51), their migratory movement pattern, and the absence of take concentrated in areas in

which animals are known to congregate, it is unlikely that any individual Bryde's whales would be taken on more than a limited number of days within a year and, therefore, the anticipated behavioral disturbance is not expected to affect reproduction or survival.

Given the magnitude and severity of the impacts discussed above to Bryde's whales (considering annual take maximum and the total across 7 years) and their habitat, and in consideration of the required mitigation measures and other information presented, the Action Proponents' activities are not expected to result in impacts on the reproduction or survival of any individuals, much less affect annual rates of recruitment or survival. For these reasons, we have determined that the take estimated and proposed for authorization would have a negligible impact on Bryde's whales.

Fin Whale—

Fin whales are listed as endangered under the ESA. Fin whales are not likely to occur in the Study Area in the summer due to low productivity, nor are they likely to occur near Guam at any time. There have been no recorded visual sightings of fin whales in the Study Area, although acoustic recordings of fin whale calls were identified around Tinian, Saipan, and in the Transit Corridor between Guam and Hawaii. The Study Area abundance estimate is 209 fin whales. There are no UMEs or other factors that cause particular concern for this stock, and there are no known biologically important areas for fin whales in the Study Area. Fin whales face several chronic anthropogenic and non-anthropogenic risk factors, including vessel strike, fisheries interactions, ocean noise, disease, parasites, and predation by killer whales, among others.

As shown in table 51, the maximum annual allowable instances of take under this proposed rule by Level A harassment and Level B harassment is 1 and 35, respectively. No mortality is anticipated or proposed for authorization, nor is any non-auditory injury. The total take allowable across all 7 years of the rule is indicated in table 29.

Regarding the potential takes associated with auditory impairment, as described in the Auditory Injury from Sonar Acoustic Sources and Explosives and Non-Auditory Injury from Explosives section above, any takes in the form of TTS are expected to be lower-level, of short duration (from minutes to, at most, several hours or less than a day), and mostly not in a frequency band that would be expected to interfere with fin whale communication and other important low-frequency cues.

Regarding the likely severity of any single instance of take by behavioral disturbance, as described above, the majority of the predicted exposures are expected to be below 172 dB SPL and last from a few minutes to a few hours, at most, with associated responses most likely in the form of moving away from the source, foraging interruptions, vocalization changes, or disruption of other social behaviors, lasting from a few minutes to several hours. Fin whales are large-bodied capital breeders with a slow pace of life and are therefore generally less susceptible to impacts from shorter duration foraging disruptions. Further, as described in the *Group and Species-Specific Analyses* section above and the Proposed Mitigation Measures section, mitigation measures are expected to further reduce the potential severity of impacts through real-time operational measures that minimize higher level/longer duration exposures and time/area measures that reduce impacts in high value habitat.

As described above, in addition to evaluating the anticipated impacts of the single instances of takes, it is important to understand the degree to which individual marine mammals may be disturbed repeatedly across multiple days of the year. In this case, given the lower number of takes by harassment as compared to the abundance (see table 51), their migratory movement pattern, and the absence of take concentrated in areas in which animals are known to congregate, it is unlikely that any individual fin whales would be taken on more than a limited number of days within a year and, therefore, the anticipated behavioral disturbance is not expected to affect reproduction or survival.

Given the magnitude and severity of the impacts discussed above to fin whales (considering annual take maximum and the total across 7 years) and their habitat, and in consideration of the required mitigation measures and other information presented, the Action Proponents' activities are not expected to result in impacts on the reproduction or survival of any individuals, much less affect annual rates of recruitment or survival. For these reasons, we have determined that the take estimated and proposed for authorization would have a negligible impact on fin whales.

Humpback Whale (Western North Pacific Stock)—

The Western North Pacific stock of humpback whale is listed as endangered under the ESA and as both depleted and strategic under the MMPA. The Humpback whales in the Mariana Islands/Ogasawara-Northern Pacific unit of the Western North Pacific stock are migratory and expected to occur in the Study Area between December and April during their breeding season, with higher densities around the Northern Mariana Islands (*i.e.,* Saipan, Tinian, and Pagan). This stock will then migrate north to their feeding grounds in Russia and the Aleutian Islands/Bering Sea in the summer. The Study Area abundance estimate is 5,287 humpback whales, and NMFS' SAR states the PBR is 3.4 Western North Pacific humpback whales per year (the PBR for the whales that use U.S. waters (minimum population size of 75) is 0.2) and the annual M/SI (from other human activities) is 5.82 (0.06 in U.S. waters) (note that the SAR abundance estimate, as noted in table 51, is 1,084). There are no UMEs or other factors that cause particular concern for this stock, and no ESA-designated critical habitat in the Study Area. However, the areas of Marpi and Chalan Kanoa Reefs (out to the 400-m isobath) are known specifically to be used by mother/calf pairs of humpback whales (Hill *et al.,* 2016b, 2017, 2018, 2020b). Currently, no other areas have been identified for mother/calf pairs of humpback whales in the Mariana Islands. Humpback whales face several anthropogenic and non-anthropogenic risk factors, including vessel strikes, fisheries interactions, ingestion of marine debris, disease, parasites, and predation by false killer whales and killer whales, among others.

As shown in table 51, the maximum annual allowable instances of take under this proposed rule by Level A harassment and Level B harassment is 21 and 1,517, respectively. No mortality is anticipated or proposed for authorization, nor is any non-auditory injury. The total take allowable across all 7 years of the rule is indicated in table 29.

Regarding the potential takes associated with auditory impairment, as described in the Auditory Injury from Sonar Acoustic Sources and Explosives and Non-Auditory Injury from Explosives section above, any takes in the form of TTS are expected to be lower-level, of short duration (from minutes to, at most, several hours or less than a day), and mostly not in a frequency band that would be expected to interfere with humpback whale communication or other important low-frequency cues. Any associated lost opportunities or capabilities individuals might experience as a result of TTS would not be at a level or duration that would be expected to impact

reproductive success or survival. For similar reasons, while auditory injury impacts last longer, the low anticipated levels of AUD INJ that could be reasonably expected to result from these activities are unlikely to have any effect on fitness.

Regarding the likely severity of any single instance of take by behavioral disturbance, as described above, the majority of the predicted exposures are expected to be below 172 dB SPL and last from a few minutes to a few hours, at most, with associated responses most likely in the form of moving away from the source, foraging interruptions, vocalization changes, or disruption of other social behaviors, lasting from a few minutes to several hours. Humpback whales are large-bodied capital breeders with a slow pace of life and are therefore generally less susceptible to impacts from shorter duration foraging disruptions. Further, as described in the *Group and Species-Specific Analyses* section above and the Proposed Mitigation Measures section, mitigation measures are expected to further reduce the potential severity of impacts through real-time operational measures that minimize higher level/longer duration exposures and time/area measures that reduce impacts in high value habitat. Within the Marpi Reef Mitigation Area and the Chalan Kanoa Reef Mitigation Area, from December 1 through April 30, the Action Proponents must not use more than 20 combined hours of MF1 and MF1C surface ship hull-mounted MFAS during training and testing annually. Further, the Action Proponents must not detonate in-water explosives (including underwater explosives and explosives deployed against surface targets) within either mitigation area year-round. These measures are designed to avoid or reduce exposure of humpback whales in important seasonal reproductive habitat to explosives or levels of sound that have the potential to cause injury or behavioral disturbance, or, in the case of explosives, mortality. Additionally, the Navy must issue an annual seasonal awareness notification message to alert ships and aircraft operating in the Marpi Reef Mitigation Area and Chalan Kanoa Reef Mitigation Area to the possible presence of increased concentrations of humpback whales from December 1 through April 30 to minimize the potential for vessel strike of humpback whales, as well as exposure to acoustic, explosive, and physical disturbance and strike stressors that have the potential to cause mortality, injury, or behavioral disturbance during the reproductive season.

As described above, in addition to evaluating the anticipated impacts of the single instances of takes, it is important to understand the degree to which individual marine mammals may be disturbed repeatedly across multiple days of the year. In this case, for the Western North Pacific stock of humpback whale, given the number of takes by harassment as compared to the stock abundance (see table 51), that 89 percent of the takes are expected to occur during the cold season, and that a portion of the takes occur in an area known to be important for reproduction, it is likely that some portion of the individuals taken are taken repeatedly over a limited number of days. However, the reduction in exposure of humpback whales to sonar and explosive detonations in the Geographic Mitigation Areas and the short overall and daily exposure will reduce the likelihood of impacts that could affect reproduction or survival by minimizing impacts on calves during this sensitive life stage, avoiding the additional energetic costs to mothers of avoiding the area during explosive exercises, and minimizing the chances that important breeding behaviors are interrupted to the point that reproduction is inhibited or abandoned for the year or otherwise interfered with. The Navy expects current and future use of the geographic mitigation areas to remain low, but the sonar cap allows the Navy to engage in a small amount of necessary training and testing, most likely a Small Coordinated ASW Exercise or TRACKEX event(s), which could, for example, occur up to 5 days, but no more than 4 hours per day (or similar configuration totaling no more than 20 hours annually). However, given the variety of activity types that contribute to take across separate exercises conducted at different times and in different areas and the fact that many result from transient activities conducted at sea, it is unlikely that repeated takes would occur either in numbers or clumped across sequential days in a manner likely to impact foraging success and energetics or other behaviors such that reproduction or survival of any individuals is likely to be impacted.

Given the magnitude and severity of the impacts discussed above to the Western North Pacific stock of humpback whales (considering annual take maximum and the total across 7 years) and their habitat, and in consideration of the required mitigation measures and other information presented, the Action Proponents' activities are unlikely to result in impacts on the reproduction or survival of any individuals and, therefore, unlikely to affect annual rates of recruitment or survival. For these reasons, we have determined that the take estimated and proposed for authorization would have a negligible impact on the Western North Pacific stock of humpback whales.

Minke Whale—

Minke whales in the Study Area are not listed as threatened or endangered under the ESA. Minke whales have not been visually observed in the Study Area, but they are one of the most common mysticetes acoustically detected in the area. Minke whales are presumed to be present in the Study Area from the fall through the spring and are not expected to be in the Study Area or associated Transit Corridor during summer months due to low productivity in the region. The Study Area abundance estimate is 91 minke whales. There are no UMEs or other factors that cause particular concern for either stock and there are no known biologically important areas for minke whales in the Study Area. Minke whales face several chronic anthropogenic and non-anthropogenic risk factors, including vessel strike, fisheries interactions, and prey availability, among others.

As shown in table 51, the maximum annual allowable instances of take under this proposed rule by Level A harassment and Level B harassment is 1 and 25, respectively. No mortality is anticipated or proposed for authorization, nor is any non-auditory injury. The total take allowable across all 7 years of the rule is indicated in table 29.

Regarding the potential takes associated with auditory impairment, as described in the Auditory Injury from Sonar Acoustic Sources and Explosives and Non-Auditory Injury from Explosives section above, any takes in the form of TTS are expected to be lower-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. Any associated lost opportunities or capabilities individuals might experience as a result of TTS would not be at a level or duration that would be expected to impact reproductive success or survival. For similar reasons, while auditory injury impacts last longer, the low anticipated levels of AUD INJ that could be reasonably expected to result from these activities are unlikely to have any effect on fitness.

Regarding the likely severity of any single instance of take by behavioral disturbance, as described above, the majority of the predicted exposures are expected to be below 172 dB SPL and last from a few minutes to a few hours, at most, with associated responses most likely in the form of moving away from the source, foraging interruptions, vocalization changes, or disruption of other social behaviors, lasting from a few minutes to several hours. Minke whales are medium-to-large-bodied capital breeders with a slow pace of life and are therefore generally less susceptible to impacts from shorter duration foraging disruptions. Further, as described in the *Group and Species-Specific Analyses* section above and the Proposed Mitigation Measures section, mitigation measures are expected to further reduce the potential severity of impacts through real-time operational measures that minimize higher level/longer duration exposures.

As described above, in addition to evaluating the anticipated impacts of the single instances of takes, it is important to understand the degree to which individual marine mammals may be disturbed repeatedly across multiple days of the year. In this case, given the lower number of takes by harassment as compared to the abundance (see table 51), it is likely that some portion of the individuals taken are taken repeatedly over a limited number of days. However, given the variety of activity types that contribute to take across separate exercises conducted at different times and in different areas, and the fact that many result from transient activities conducted at sea, it is unlikely that repeated takes would occur either in numbers or clumped across sequential days in a manner likely to impact foraging success and energetics or other behaviors such that reproduction or survival of any individuals is likely to be impacted. Further, this stock is nomadic, and there are no known foraging areas or other areas within which animals are known to congregate.

Given the magnitude and severity of the impacts discussed above to minke whales (considering annual take maximum and the total across 7 years) and their habitat, and in consideration of the required mitigation measures and other information presented, the Action Proponents' activities are not expected to result in impacts on the reproduction or survival of any individuals, much less affect annual rates of recruitment or survival. For these reasons, we have determined that the take estimated and proposed for authorization would have a negligible impact on minke whales.

Omura's Whale—

Omura's whales are not listed as threatened or endangered under the ESA. Omura's whales are nomadic across their range of the tropical and subtropical waters of the western Pacific and eastern Indian oceans where individuals tend to occur in nearshore waters (Jefferson *et al.,* 2015). While there is a lack of confirmed sightings, Omura's whales may be present in the Study Area year-round. The Study Area abundance estimate is 154 Omura's whales. There are no UMEs or other factors that cause particular concern for this species, and there are no known biologically important areas for Omura's whales in the Study Area. Omura's whales face chronic anthropogenic and non-anthropogenic risk factors, including vessel strike and fisheries interactions, among others.

As shown in table 51, the maximum annual allowable instances of take under this proposed rule by Level A harassment and Level B harassment is 1 and 52, respectively. No mortality is anticipated or proposed for authorization, nor is any non-auditory injury. The total take allowable across all 7 years of the rule is indicated in table 29.

Regarding the potential takes associated with auditory impairment, as described in the Auditory Injury from Sonar Acoustic Sources and Explosives and Non-Auditory Injury from Explosives section above, any takes in the form of TTS are expected to be lower-level, of short duration (from minutes to, at most, several hours or less than a day), and mostly not in a frequency band that would be expected to interfere with Omura's whale communication or other important low-frequency cues.

Regarding the likely severity of any single instance of take by behavioral disturbance, as described above, the majority of the predicted exposures are expected to be below 172 dB SPL and last from a few minutes to a few hours, at most, with associated responses most likely in the form of moving away from the source, foraging interruptions, vocalization changes, or disruption of other social behaviors, lasting from a few minutes to several hours. Omura's whales are large-bodied capital breeders with a slow pace of life and are therefore generally less susceptible to impacts from shorter duration foraging disruptions. Further, as described in the *Group and Species-Specific Analyses* section above and the Proposed Mitigation Measures section, mitigation measures are expected to further reduce the potential severity of impacts through real-time operational measures that minimize higher level/longer duration exposures and time/area measures that reduce impacts in high value habitat.

As described above, in addition to evaluating the anticipated impacts of the single instances of takes, it is important to understand the degree to which individual marine mammals may be disturbed repeatedly across multiple days of the year. In this case, given the lower number of takes by harassment as compared to the abundance (see table 51) and the absence of take concentrated in areas in which animals are known to congregate, it is unlikely that any individual Omura's whales would be taken on more than a limited number of days within a year and, therefore, the anticipated behavioral disturbance is not expected to affect reproduction or survival.

Given the magnitude and severity of the impacts discussed above to Omura's whales (considering annual take maximum and the total across 7 years) and their habitat, and in consideration of the required mitigation measures and other information presented, the Action Proponents' activities are not expected to result in impacts on the reproduction or survival of any individuals, much less affect annual rates of recruitment or survival. For these reasons, we have determined that the take estimated and proposed for authorization would have a negligible impact on Omura's whales.

Sei Whale—

Sei whales are listed as endangered under the ESA. They are migratory and are typically found in the open ocean, away from the coast. Sei whales generally have higher abundances in the cold temperate to subpolar latitudes and are therefore considered rare in this region, although they have been sighted in the Study Area. Since sei whales migrate between higher latitude summer feeding grounds to lower latitude breeding grounds in the winter, they are more likely to be around the Study Area in the cold season (winter to spring) and are not expected to be in the Study Area or associated Transit Corridor during summer months due to low productivity. The Study Area abundance estimate is 166 sei whales. There are no UMEs or other factors that cause particular concern for sei whales, and there are no known biologically important areas for sei whales in the Study Area. Sei whales face several chronic anthropogenic and non-anthropogenic risk factors, including vessel strike, fisheries interactions, ocean noise, disease, parasites, and predation by killer whales, among others.

As shown in table 51, the maximum annual allowable instances of take under this proposed rule by Level A harassment and Level B harassment is 1 and 37, respectively. No mortality is anticipated or proposed for authorization, nor is any non-auditory injury. The total take allowable across all 7 years of the rule is indicated in table 29.

Regarding the potential takes associated with auditory impairment, as described in the Auditory Injury from Sonar Acoustic Sources and Explosives and Non-Auditory Injury from Explosives section above, any takes in the form of TTS are expected to be lower-level, of short duration (from minutes to, at most, several hours or less than a day), and mostly not in a frequency band that would be expected to interfere with sei whale communication or other important low-frequency cues.

Regarding the likely severity of any single instance of take by behavioral disturbance, as described above, the majority of the predicted exposures are expected to be below 172 dB SPL and last from a few minutes to a few hours, at most, with associated responses most likely in the form of moving away from the source, foraging interruptions, vocalization changes, or disruption of other social behaviors, lasting from a few minutes to several hours. Sei whales are large-bodied capital breeders with a slow pace of life and are therefore generally less susceptible to impacts from shorter duration foraging disruptions. Further, as described in the *Group and Species-Specific Analyses* section above and the Proposed Mitigation Measures section, mitigation measures are expected to further reduce the potential severity of impacts through real-time operational measures that minimize higher level/longer duration exposures and time/area measures that reduce impacts in high value habitat.

As described above, in addition to evaluating the anticipated impacts of the single instances of takes, it is important to understand the degree to which individual marine mammals may be disturbed repeatedly across multiple days of the year. In this case, given the lower number of takes by harassment as compared to the abundance (see table 51), their migratory movement pattern, and the absence of take concentrated in areas in which animals are known to congregate, it is unlikely that any individual sei whales would be taken on more than a limited number of days within a year and, therefore, the anticipated behavioral disturbance is not expected to affect reproduction or survival.

Given the magnitude and severity of the impacts discussed above to sei whales (considering annual take maximum and the total across 7 years) and their habitat, and in consideration of the required mitigation measures and other information presented, the Action Proponents' activities are not expected to result in impacts on the reproduction or survival of any individuals, much less affect annual rates of recruitment or survival. For these reasons, we have determined that the take estimated and proposed for authorization would have a negligible impact on sei 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 stocks will incur, the applicable mitigation for each stock, and the status and life history of the stocks to support the negligible impact determinations for each stock. We have already described above why we believe the incremental addition of the limited number of low-level auditory injury takes will not have any meaningful effect towards inhibiting reproduction or survival on any marine mammal species or stock. We have also described above the unlikelihood of any masking or habitat impacts having effects that would impact the reproduction or survival of any of the individual marine mammals affected by the Action Proponents' activities. Two odontocete species have predicted non-auditory injury from explosives (Frasier's dolphin and Risso's dolphin), discussed further below. Regarding the severity of individual takes by Level B harassment by behavioral disturbance for odontocetes, the majority of these responses are anticipated to occur at received levels below 178 dB for most odontocete species and below 154 dB for sensitive species (*i.e.,* beaked whales, for which a lower behavioral disturbance threshold is applied), and last from a few minutes to a few hours, at most, with associated responses most likely in the form of moving away from the source, foraging interruptions, vocalization changes, or disruption of other social behaviors, lasting from a few minutes to several hours. Much of the discussion below focuses on the behavioral effects and the mitigation measures that reduce the probability or severity of effects in biologically important areas or other habitats. Because there are multiple stock-specific factors in relation to the status of the species, at the end of the section we break out stock- or group-specific findings.

In table 53 (sperm whales, dwarf sperm whales, and pygmy sperm whales), table 55 (beaked whales), and table 57 (dolphins and small whales) below, we indicate the total annual Level A harassment and Level B harassment, and a number indicating the instances of total take as a percentage of abundance.

In table 54 (sperm whales, dwarf sperm whales, and pygmy sperm whales), table 56 (beaked whales), and table 58 (dolphins and small whales), below, we indicate the status, life history traits, important habitats, and threats that inform our analysis of the potential impacts of the estimated take on the affected odontocete stocks.

Table 53 -- Annual Estimated Take by Level B harassment and Level A harassment and Related Information for Sperm Whale, Dwarf Sperm Whale, and Pygmy Sperm Whale in the MITT Study

Marine Mammal Species	Stock	Study Area Abundance	Maximum Annual Level B Harassment	Maximum Annual Level A Harassment	Maximum Annual Take	Maximum Annual Harassment As Percentage of Abundance	Season with 70 Percent of Take or Greater
Sperm Whale	NSD	1,574	225	0	225	14	N/A
Dwarf Sperm Whale	NSD	59,040	18,716	323	19,039	32	N/A
Pygmy Sperm Whale	NSD	66,333	20,992	374	21,366	32	N/A

Note: NSD = No stock designated. N/A = Not Applicable.

Table 54 -- Life History Traits, Important Habitat[1], and Threats to Sperm Whale, Dwarf Sperm Whale, and Pygmy Sperm Whale in the Study Area

Marine Mammal Species	Stock	ESA Status	MMPA Status	Movement Ecology	Body Size	Reproductive Strategy	Pace of Life	Chronic Risk Factors	UME, Oil Spill, Other	Population Trend
Sperm Whale	NSD	Endangered	N/A	Nomadic	Large	Income	Slow	Vessel strikes, fisheries interactions, ingestion of marine debris, ocean noise, disease, parasites, predation by (false) killer whales and pilot whales, pollution	No	Unknown
Dwarf Sperm Whale	NSD	Not listed	N/A	Unknown, likely nomadic	Small-Med	Income	Fast	Vessel strike, fisheries interactions, ingestion of marine debris, ocean noise, disease	No	Unknown
Pygmy Sperm Whale	NSD	Not listed	N/A	Unknown, likely nomadic	Small-Med	Income	Fast	Vessel strike, fisheries interactions, ingestion of marine debris, ocean noise, disease	No	Unknown

Note: NSD = No stock designated. N/A = Not Applicable.
[1] There are no areas of critical habitat designated under the ESA or known important habitat for sperm whale, dwarf sperm whale, or pygmy sperm whale in the Study Area.

Sperm Whales, Dwarf Sperm Whales, and Pygmy Sperm Whales—

Sperm Whale

Sperm whales are listed as endangered under the ESA. Sperm whales are known to prefer deep water and steep topography. They can be somewhat migratory; however, sperm whales within the Study Area are more residential, have been observed with calves, and have been acoustically detected throughout the year in areas around the Study Area, including Guam, Saipan and Tinian. For modeling impacts, 1,574 sperm whales were assumed in the Study Area. There are no UMEs or other factors that cause particular concern for these stocks, and there are no known biologically important areas for the sperm whales in the Study Area. Sperm whales face several chronic anthropogenic and non-anthropogenic risk factors, including vessel strike, fisheries interactions, ingestion of marine debris, ocean noise, disease, parasites, predation by (false) killer whales and pilot whales, and pollution.

As shown in table 53, the maximum annual allowable instances of take under this proposed rule by Level B harassment is 225. No mortality is anticipated or proposed for authorization, nor is any non-auditory or auditory injury. The total take allowable across all 7 years of the rule is indicated in table 29.

Regarding the potential takes associated with TTS, as described in the Temporary Threshold Shift section above, any takes in the form of TTS are expected to be lower-level, of short duration (from minutes to, at most, several hours or less than a day), and mostly not in a frequency band that would be expected to interfere with sperm whale communication or other important low-frequency cues.

Regarding the likely severity of any single instance of take by behavioral disturbance, as described above, the majority of the predicted exposures are expected to be below 178 dB SPL and last from a few minutes to a few hours, at most, with associated responses most likely in the form of moving away from the source, foraging interruptions, vocalization changes, or disruption of other social behaviors, lasting from a few minutes to several hours. Sperm whales are large-bodied income breeders with a slow pace of life and are likely more resilient to missed foraging opportunities due to acoustic disturbance than smaller odontocetes. However, they may be more susceptible to impacts due to lost foraging opportunities during reproduction, especially if they occur during lactation (Farmer *et al.,* 2018b). Further, as described in the *Group and Species-Specific Analyses* section above and the Proposed Mitigation Measures section, mitigation measures are expected to further reduce the potential severity of impacts through real-time operational measures that minimize higher level/longer duration exposures.

As described above, in addition to evaluating the anticipated impacts of the single instances of takes, it is important to understand the degree to which individual marine mammals may be disturbed repeatedly across multiple days of the year. In this case, given the lower number of takes by harassment as compared to the abundance (see table 53), and the absence of take concentrated in areas in which animals are known to congregate, it is unlikely that any individual sperm whales would be taken on more than a limited number of days within a year and, therefore, the anticipated behavioral disturbance is not expected to affect reproduction or survival.

Given the magnitude and severity of the impacts discussed above to sperm whales (considering annual take maximum and the total across 7 years) and their habitat, and in consideration of the required mitigation measures and other information presented, the proposed take by harassment is not expected to impact the reproduction or survival of any individuals and, therefore, unlikely to affect annual rates of recruitment or survival. For these reasons, we have determined that the take estimated and proposed for authorization would have a negligible impact on sperm whales.

Dwarf Sperm Whale and Pygmy Sperm Whale

Neither dwarf sperm whales nor pygmy sperm whales are listed under the ESA. Dwarf sperm whales generally occur offshore and are found in warmer tropical waters more often than pygmy sperm whales. The Study Area abundance estimate is 59,040 dwarf sperm whales and 66,333 pygmy sperm whales. There are no UMEs or other factors that cause particular concern for these stocks, and no known BIAs in the Study Area. Dwarf and pygmy sperm whales face several chronic anthropogenic and non-anthropogenic risk factors, including vessel strike, fisheries interactions, ingestion of marine debris, ocean noise, and disease.

As shown in table 53, the maximum annual allowable instances of take under this proposed rule by Level A harassment and Level B harassment is 323 and 18,716, respectively, for dwarf

sperm whale, and 374 and 20,922, respectively, for pygmy sperm whale. No mortality is anticipated or proposed for authorization, nor is any non-auditory injury. The total take allowable across all 7 years of the rule is indicated in table 29.

Regarding the potential takes associated with auditory impairment, as described in the Auditory Injury from Sonar Acoustic Sources and Explosives and Non-Auditory Injury from Explosives section above, any takes in the form of TTS are expected to be lower-level, of short duration (from minutes to, at most, several hours or less than a day), and mostly not in a frequency band that would be expected to interfere with dwarf and pygmy sperm whale communication, overlap more than a relatively narrow portion of the vocalization range of any single species or stock, or preclude detection or interpretation of important low-frequency cues.

Regarding the likely severity of any single instance of take by behavioral disturbance, as described above, the majority of the predicted exposures are expected to be below 178 dB SPL and last from a few minutes to a few hours, at most, with associated responses most likely in the form of moving away from the source, foraging interruptions, vocalization changes, or disruption of other social behaviors, lasting from a few minutes to several hours. Dwarf and pygmy sperm whales are small-to-medium-bodied income breeders with a fast pace of life. They are generally more sensitive to missed foraging opportunities than larger odontocetes, especially during lactation, but would be quick to recover given their fast pace of life. Further, as described in the *Group and Species-Specific Analyses* section above and the Proposed Mitigation Measures section, mitigation measures are expected to further reduce the potential severity of impacts through real-time operational measures that minimize higher level/longer duration exposures.

As described above, in addition to evaluating the anticipated impacts of the single instances of takes, it is important to understand the degree to which individual marine mammals may be disturbed repeatedly across multiple days of the year. In this case, given the lower number of takes by harassment as compared to the stock/species abundance (see table 53), their likely nomadic movement pattern, and the absence of take concentrated in areas in which animals are known to concentrate, it is unlikely that any individual dwarf or pygmy sperm whale would be taken on more than a limited number of days within a year and, therefore, the anticipated behavioral disturbance is not expected to affect reproduction or survival.

Given the magnitude and severity of the impacts discussed above to dwarf and pygmy sperm whales (considering annual take maxima and the total across 7 years) and their habitat, and in consideration of the required mitigation measures and other information presented, the Action Proponents' activities are unlikely to result in impacts on the reproduction or survival of any individuals and, therefore, unlikely to affect annual rates of recruitment or survival. For these reasons, we have determined that the take estimated and proposed for authorization would have a negligible impact on the dwarf and pygmy sperm whales.

Beaked Whales—

This section builds on the broader odontocete discussion above (*i.e.,* that information applies to beaked whales as well), and brings together the discussion of the different types and amounts of take that different beaked whale species and stocks will likely incur, any additional applicable mitigation, and the status of the species and stocks to support the preliminary negligible impact determinations for each species or stock.

Table 55 -- Annual Estimated Take by Level B harassment and Level A Harassment and Related Information for Beaked Whales in the Study Area

Marine Mammal Species	Stock	Study Area Abundance	Maximum Annual Level B Harassment	Maximum Annual Level A Harassment	Maximum Annual Take	Maximum Annual Harassment As Percentage of Abundance	Season with 70 Percent of Take or Greater
Blainville's Beaked Whale	NSD	15,705	3,120	0	3,120	20	N/A
Deraniyagala Beaked Whale	NSD	4,592	4,973	1	4,974	108	N/A
Ginkgo-toothed Beaked Whale	NSD	4,592	5,929	0	5,929	129	N/A
Goose-Beaked Whale	NSD	6,007	2,618	0	2,618	44	N/A
Longman's Beaked Whale	NSD	730	1,015	0	1,015	139	N/A

Note: NSD – No stock designated. N/A – Not Applicable.

Table 56 -- Life History Traits, Important Habitat[1], and Threats to Beaked Whales in the Study Area

Marine Mammal Species	Stock	ESA Status	MMPA Status	Movement Ecology	Body Size	Reproductive Strategy	Pace of Life	Chronic Risk Factors	UME, Oil Spill, Other	Population Trend
Blainville's Beaked Whale	NSD	Not listed	N/A	Nomadic	Med	Mixed	Med	Fisheries interactions, ingestion of marine debris, ocean noise	No	Unknown
Deraniyagala Beaked Whale	NSD	Not listed	N/A	Unk, likely nomadic	Med	Mixed	Med	Fisheries interactions, ingestion of marine debris, ocean noise	No	Unknown
Ginkgo-toothed Beaked Whale	NSD	Not listed	N/A	Unknown, likely nomadic	Med	Mixed	Med	Fisheries interactions, ocean noise	No	Unknown
Goose-Beaked Whale	NSD	Not listed	N/A	Unknown, likely nomadic	Med	Mixed	Med	Fisheries interactions, ocean noise	No	Unknown
Longman's Beaked Whale	NSD	Not listed	N/A	Unknown, likely nomadic	Med	Mixed	Med	Fisheries interactions, ocean noise, disease, predation by killer whales	No	Unknown

Note: NSD = No stock designated. N/A = Not Applicable.

[1] There are no areas of critical habitat designated under the ESA or known BIAs for beaked whales in the Study Area.

These stocks are not listed as endangered or threatened under the ESA. The abundance estimates for the Study Area range from 730 (Longman's beaked whale) to 15,705 (Blainville's beaked whale). There are no UMEs or other factors that cause particular concern for these stocks in the Study Area. Beaked whales occur in deep, offshore waters, and all beaked whale stocks are assumed to occur in the Study Area year-round. Beaked whales face several chronic anthropogenic and non-anthropogenic risk factors, including fisheries interactions, ingestion of marine debris, predation by killer whales, and ocean noise, among others.

As shown in table 55, the maximum annual allowable instances of take under this proposed rule by Level A harassment and Level B Harassment range from 0 to 1 and 1,015 to 5,929, respectively. No mortality is anticipated or proposed for authorization, nor is any non-auditory injury. The total take allowable across all 7 years of the rule is indicated in table 29.

Regarding the potential takes associated with auditory impairment, as described in the Auditory Injury from Sonar Acoustic Sources and Explosives and Non-Auditory Injury from Explosives section above, any takes in the form of TTS are expected to be lower-level, of short duration (from minutes to, at most, several hours or less than a day), and mostly not in a frequency band that would be expected to interfere with echolocation, overlap more than a relatively narrow portion of the vocalization range of any single species or stock, or preclude detection or interpretation of important low-frequency cues. Any associated lost opportunities or capabilities individuals might experience as a result of TTS would not be at a level or duration that would be expected to impact reproductive success or survival. For similar reasons, while auditory injury impacts last longer, the low anticipated levels of AUD INJ that could be reasonably expected to result from these activities are unlikely to have any effect on fitness of Daeraniyagala beaked whales.

Regarding the likely severity of any single instance of take by behavioral disturbance, as described above, the majority of the predicted exposures are expected to be below 154 dB SPL and last from a few minutes to a few hours, at most, with associated responses most likely in the form of moving away from the source, foraging interruptions, vocalization changes, or disruption of other social behaviors, lasting from a few minutes to several hours. Beaked whales are medium-bodied odontocetes with a medium pace of life and likely moderately resilient to missed foraging opportunities due to acoustic disturbance. They are mixed breeders (*i.e.,* behaviorally income breeders), and they demonstrate capital breeding strategies during gestation and lactation (Keen *et al.,* 2021), so they may be more vulnerable to prolonged loss of foraging opportunities during gestation. Further, as described in the *Group and Species-Specific Analyses* section above and the Proposed Mitigation Measures section, mitigation measures are expected to further reduce the potential severity of impacts through real-time operational measures that minimize higher level/longer duration exposures.

Beaked whales have also been found to respond to naval sonar, in certain circumstances, in a manner that can lead to stranding and in a few cases, globally, beaked whale strandings have been causally associated with active sonar operation. However, as discussed in the *Stranding and Mortality* section of the Potential Effects of Specified Activities on Marine Mammals and Their Habitat section, NMFS has determined that the activities included in this 7-year rule are not reasonably likely to result in the mortality of beaked whales.

As described above, in addition to evaluating the anticipated impacts of the single instances of takes, it is important to understand the degree to which individual marine mammals may be disturbed repeatedly across multiple days of the year. In this case, given the number of takes by harassment as compared to abundance (see table 55), it is likely that some portion of the individuals taken are taken repeatedly over a limited number of days. However, given the variety of activity types that contribute to take across separate exercises conducted at different times and in different areas, and the fact that many result from transient activities conducted at sea, it is unlikely that repeated takes would occur either in numbers or clumped across sequential days in a manner likely to impact foraging success and energetics or other behaviors such that reproduction or survival of any individuals is likely to be impacted. Further, these species are nomadic or likely nomadic, there are no known foraging areas or other areas within which animals are known to congregate, nor are the takes concentrated within a specific season.

Given the magnitude and severity of the impacts discussed above to beaked whale stock/species (considering annual take maxima and the total across 7 years) and their habitat, and in consideration of the required mitigation measures and other information

presented, the Action Proponents' activities are not expected to result in impacts on the reproduction or survival of any individuals, much less affect annual rates of recruitment or survival. For these reasons, we have determined that the take estimated and proposed for authorization would have a negligible impact on Blainville's beaked whale, Deraniyagala beaked whale, ginkgo-toothed beaked whale, goose-beaked whale, and Longman's beaked whale.

Dolphins and Small Whales—

Of the 12 stocks of dolphins and small whales (Delphinidae) for which incidental take is proposed for authorization (see table 57), none are listed under the ESA. As shown in table 57 and table 58, these delphinids vary in stock abundance, body size, and movement ecology from, for example, the small-bodied, nomadic Fraser's dolphin with a Study Area abundance estimate of 62,714, to the medium-sized killer whale with a Study Area abundance estimate of 285. There are no known UMEs or other factors that cause particular concern for these stocks. Agat Bay nearshore waters are known to provide important resting habitat for spinner dolphins. Delphinids face a number of chronic anthropogenic and non-anthropogenic risk factors including fishery interactions, ingestion of marine debris, prey availability, disease, predation, and ocean noise, the impacts of which vary depending whether the stock is more or less deep-diving (*e.g.,* entanglement more common in deep divers like pygmy killer whales and pilot whales) and other behavioral differences (*e.g.,* vessels strikes more concern for killer whales).

Table 57 -- Annual Estimated Take by Level B harassment and Level A harassment and Related Information for Dolphins and Small Whales in the Study Area

Marine Mammal Species	Stock	Study Area Abundance	Maximum Annual Level B Harassment	Maximum Annual Level A Harassment	Maximum Annual Take	Maximum Annual Harassment As Percentage of Abundance	Season with 70 Percent of Take or Greater
False Killer Whale	NSD	1,059	228	0	228	22	N/A
Killer Whale	NSD	285	54	0	54	19	N/A
Melon-Headed Whale	NSD	2,455	475	1	476	19	N/A
Pygmy Killer Whale	NSD	4,351	885	1	886	20	N/A
Short-Finned Pilot Whale	NSD	1,192	228	0	228	19	N/A
Bottlenose Dolphin	NSD	1,800	356	1	357	20	N/A
Fraser's Dolphin	NSD	62,714	11,425	6	11,431	18	N/A
Pantropical Spotted Dolphin	NSD	33,518	4,555	3	4,558	14	N/A
Risso's Dolphin	NSD	9,554	1,781	2	1,783	19	N/A
Rough-Toothed Dolphin	NSD	9,256	1,984	1	1,985	21	N/A
Spinner Dolphin	NSD	10,202	4,091	2	4,093	40	N/A
Striped Dolphin	NSD	7,676	1,563	1	1,564	20	N/A

Note: NSD = No stock designated. N/A = Not Applicable.

Table 58 -- Life History Traits, Important Habitat[1], and Threats to Dolphins and Small Whales in the Study Area

Marine Mammal Species	Stock	ESA Status	MMPA Status	Movement Ecology	Body Size	Reproductive Strategy	Pace of Life	Chronic Risk Factors	UME, Oil Spill, Other	Population Trend
False Killer Whale	NSD	Not listed	N/A	Nomadic	Med	Income	Med	Fisheries interactions, ingestion of marine debris, prey availability, disease, predation by killer whales	No	Unknown
Killer Whale	NSD	Not listed	N/A	Nomadic	Large	Income	Slow	Fisheries interactions, ocean noise, disease, pollution	No	Unknown
Melon-Headed Whale	NSD	Not listed	N/A	Nomadic	Small	Income	Med	Fisheries interactions, ocean noise, pollution, predation by killer whales	No	Unknown
Pygmy Killer Whale	NSD	Not listed	N/A	Nomadic	Small	Income	Med	Fisheries interactions, ocean noise, predation by killer whales	No	Unknown
Short-Finned Pilot Whale	NSD	Not listed	N/A	Nomadic	Med	Income	Slow	Vessel strikes, fisheries interactions, predation by killer whales	No	Unknown
Bottlenose Dolphin	NSD	Not listed	N/A	Resident-nomadic	Small-Med	Income	Med	Fisheries interactions, disease, pollution	No	Unknown
Fraser's Dolphin	NSD	Not listed	N/A	Nomadic	Small	Income	Fast	Fisheries interactions	No	Unknown
Pantropical Spotted Dolphin	NSD	Not listed	N/A	Nomadic	Small	Income	Med	Fisheries interactions, predation from (pygmy and false) killer whales, sharks, and short-finned pilot whales	No	Unknown
Risso's Dolphin	NSD	Not listed	N/A	Nomadic	Small-Med	Income	Med	Fisheries interactions, ocean noise, pollution, predation by killer whales and sharks	No	Unknown
Rough-Toothed Dolphin	NSD	Not listed	N/A	Resident, nomadic	Small	Income	Med	Fisheries interactions, ocean noise, predation by killer whales	No	Unknown
Spinner Dolphin	NSD	Not listed	N/A	Resident-nomadic	Small	Income	Fast	Fisheries interactions, ingestion of marine debris, ocean noise, disease, predation by (pygmy) killer whales, sharks, and short-finned pilot whales	No	Unknown
Striped Dolphin	NSD	Not listed	N/A	Nomadic	Small	Income	Med	Fisheries interactions, disease, predation by killer whales and sharks	No	Unknown

Note: NSD = No stock designated. N/A = Not Applicable.
[1]There are no areas of critical habitat designated under the ESA for dolphins or small whales in the Study Area.

As shown in table 57, the maximum annual allowable instances of take by Level B harassment for Delphinid stocks ranges from 54 (killer whale) to 11,425 for Fraser's dolphin, with 3 stocks below 300, 6 stocks above 1,000, and the remainder between 200 and 1,000. Take by Level A harassment is 0 for 12 of the 39 stocks, at or below 15 for 20 stocks, and above 15 for 10 stocks. No mortality is anticipated or proposed for authorization. The rule allows for one instance of take by non-auditory injury annually of both Fraser's dolphin and Risso's dolphin. As described above, given the limited number of potential exposures and the anticipated effectiveness of the mitigation measures in minimizing the pressure levels to which any individuals are exposed, these injuries are unlikely to impact reproduction or survival. The total take allowable across all 7 years of the rule is indicated in table 29.

All delphinid stocks are expected to incur some number of takes in the form of TTS. As described in the Auditory Injury from Sonar Acoustic Sources and Explosives and Non-Auditory Injury from Explosives section above, these temporary hearing impacts are expected to be lower-level, of short duration (from minutes to at most several hours or less than a day), and mostly not in a frequency band that would be expected to interfere with delphinid echolocation, overlap more than a relatively narrow portion of the vocalization range of any single species or stock, or preclude detection or interpretation of important low-frequency cues. Any associated lost opportunities or capabilities individuals might experience as a result of TTS would not be at a level or duration that would be expected to impact reproductive success or survival.

Three-quarters of the affected delphinid stocks (9 of 12) will incur some number of takes by AUD INJ. Six stocks have single instances of AUD INJ proposed for authorization annually, and the remaining three stocks have two to five instances of AUD INJ proposed for authorization annually. For reasons similar to those discussed for TTS, while auditory injury impacts last longer, given the anticipated effectiveness of mitigation measures and the likelihood that individuals are expected to avoid higher levels associated with more severe impacts, the lower anticipated levels of AUD INJ that could be reasonably expected to result from these activities are unlikely to affect the fitness of any individuals. The rule would also allow for single instances of non-auditory injury annually of Fraser's dolphin and Risso's dolphin. As described above in the Auditory Injury from Sonar Acoustic Sources and Explosives and Non-Auditory Injury from Explosives section, given the limited number of potential exposures and the anticipated effectiveness of the mitigation measures in minimizing the pressure levels to which any individuals are exposed, these non-auditory injuries are unlikely to be of a nature or level that would impact reproduction or survival.

Regarding the likely severity of any single instance of take by behavioral disturbance, as described above, the majority of the predicted exposures are expected to be below 178 dB SPL and last from a few minutes to a few hours, at most, with associated responses most likely in the form of moving away from the source, foraging interruptions,

vocalization changes, or disruption of other social behaviors, lasting from a few minutes to several hours. Most delphinids are income breeders with a medium pace of life, meaning that while they can be sensitive to the consequences of disturbances that impact foraging during lactation, from a population standpoint, they can be moderately quick to recover. Further, as described in the *Group and Species-Specific Analyses* section (and the Proposed Mitigation Measures section), mitigation measures are expected to further reduce the potential severity of impacts through real-time operational measures that minimize higher level/longer duration exposures and time/area measures that reduce impacts in higher value habitat. Within the Agat Bay Nearshore Mitigation Area, the Action Proponents must not use MF1 or MF1C surface ship hull-mounted MFAS or detonate in-water explosives (including underwater explosives and explosives deployed against surface targets) during training and testing year-round. These measures are designed to prevent exposure of spinner dolphins in important resting habitat to levels of sound and explosives that have the potential to cause injury or behavioral disturbance or, in the case of explosives, mortality.

As described above, in addition to evaluating the anticipated impacts of the single instances of takes, it is important to understand the degree to which individual marine mammals may be disturbed repeatedly across multiple days of the year. In this case of all delphinid stocks, given the lower number of takes by harassment as compared to abundance (see table 57), the nomadic movement patterns of many species, and the absence of take concentrated in areas in which animals are known to congregate, it is unlikely that any individuals of any species would be taken on more than a limited number of days within a year and, therefore, the anticipated behavioral disturbance is not expected to affect reproduction or survival.

Given the magnitude and severity of the impacts discussed above to delphinid species (considering annual take maxima and the total across 7 years) and their habitat, and in consideration of the required mitigation measures and other information presented, the Action Proponents' activities are not expected to result in impacts on the reproduction or survival of any individuals, much less affect annual rates of recruitment or survival. For these reasons, we have determined that the take estimated and proposed for authorization would have a negligible impact on all delphinid stocks.

Preliminary Determination

Based on the analysis contained herein of the likely effects of the specified activities 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 activity would have a negligible impact on all affected marine mammal species or stocks.

Unmitigable Adverse Impact Analysis and Determination

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

Letters of Authorization

Action Proponents seeking incidental take coverage under the proposed regulations must apply for LOAs (50 CFR 216.106, 50 CFR 217.186). LOAs may be issued for any time period that does not exceed the effective period of the regulations, provided that NMFS is able to make the relevant determinations. Such LOA requests must include, at minimum, the information described at 50 CFR 216.104(a)(1) and (2), and an affirmation of intent to adhere to the mitigation, monitoring, and reporting requirements described in the regulations.

Consistent with the 1989 preamble for NMFS' implementing regulations (54 FR 40338, 40345, September 29, 1989), modifications to LOAs will be achieved through withdrawal of applicable LOAs and issuance of new LOAs consistent with 50 CFR 216.106 and 50 CFR 218.96. The proposed regulations governing the take of marine mammals incidental to military readiness activities allow for NMFS to adaptively manage mitigation, monitoring, or reporting measures, consistent with the regulations, at an LOA holder's request or NMFS' initiative in light of new information, including information collected through required reporting.

Some of the data sources that may be considered through adaptive management include: (1) monitoring and exercise reports, as required by the proposed regulations; (2) compiled results of Navy-funded research and development studies; (3) results of specific stranding investigations; (4) results of 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.*

Classification

Endangered Species Act

There are five marine mammal species under NMFS jurisdiction that are listed as endangered or threatened under the ESA with confirmed or possible occurrence in the Study Area: (1) blue whale; (2) fin whale; (3) humpback whale (Western North Pacific DPS); (4) sei whale; and (5) sperm whale. Details of the anticipated impacts to these species are as described in the Potential Effects of Specified Activities on Marine Mammals section of this proposed rule. The Proposed Mitigation Measures section describes the mitigation measures. We have preliminarily determined that the take estimated and proposed for authorization would have a negligible impact on these species. There are no areas of marine mammal critical habitat designated under the ESA in the Study Area.

The Action Proponents will consult with NMFS pursuant to section 7 of the ESA for the Study Area activities. NMFS will also consult internally on the issuance of these proposed regulations and three LOAs under section 101(a)(5)(A) of the MMPA.

National Marine Sanctuaries Act

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

National Environmental Policy Act

To comply with the National Environmental Policy Act of 1969 (NEPA) (42 U.S.C. 4321 *et seq.*) and NOAA Administrative Order (NAO) 216–6A, NMFS must review its proposed actions with respect to potential impacts on the human environment. NMFS is a cooperating agency on the 2026 MITT Draft SEIS/OEIS and has worked extensively with the Navy in developing the document. Accordingly, NMFS plans to rely upon the 2026 MITT Draft SEIS/OEIS for the 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. The 2026 MITT Draft SEIS/OEIS was made available for public comment at: *https://www.nepa.navy.mil/mitteis/,* which also provides additional information about the NEPA process, from March 2, 2026, through May 1, 2026. We will review all comments prior to concluding our NEPA process and making a final decision on the MMPA rulemaking and request for LOAs.

Executive Order 12866

This proposed rule is significant under Executive Order 12866.

The Action Proponents initiated a request for a MMPA incidental take authorization, which suggests that the agencies are relying on NMFS' authorization to proceed with their proposed action. While a MMPA incidental take authorization is not a pre-condition for conducting the proposed action (the Action Proponents are ultimately responsible for this decision), it would provide the Action Proponents with two key benefits: (1) a legal exemption from the MMPA's general prohibition on the take of marine mammals (assuming the Action Proponents comply with the terms and conditions of their authorization); and (2) regulatory certainty because the Action Proponents will be fully cognizant of NMFS' expectations in regard to the steps needed to be taken to address risks to marine mammals and how to minimize its legal exposure under the statute. The Action Proponents will also incur costs to comply with certain mitigation and monitoring requirements, as required by the MMPA. Despite the additional costs of such measures, the costs related to MMPA compliance for the military readiness activities are small compared with expenditures on other aspects of military readiness, and direct compliance costs of the regulatory requirements are unlikely to result in material impacts to the activities.

In addition, cost savings may be generated by the reduced administrative effort required to obtain a LOA under the framework established by a rule compared to what would be required to obtain annual IHAs under section 101(a)(5)(D). Absent the rule, to attain equivalent compliance with the MMPA, the Action Proponents would need to apply for IHAs annually over the 7-year duration of the rule. Although not monetized, NMFS' analysis indicates that the upfront work associated with the rule (*e.g.,* analyses, modeling, process for obtaining LOA valid for 7 years) likely saves significant time and money.

Executive Order 14192

This proposed rule is not an E.O. 14192 regulatory action. It is expressly exempt because it is related to military readiness.

Paperwork Reduction Act

The Action Proponents are federal applicants and not subject to the PRA.

Regulatory Flexibility Act

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 Action Proponents are the only entities that would be affected by this proposed rulemaking, and the Action Proponents are 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 Action Proponents. 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 only the Action Proponents and not any small entities, NMFS concludes that the action would not result in a significant economic impact on a substantial number of small entities. As a result, an initial regulatory flexibility analysis is not required and none has been prepared.

List of Subjects in 50 CFR Part 218

Administrative practice and procedure, Endangered and threatened species, Fish, Fisheries, Marine mammals, Penalties, Reporting and recordkeeping requirements, Transportation, Wildlife.

Dated: November 16, 2026.

Samuel D. Rauch III,

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

For reasons set forth in the preamble, NMFS proposes to amend 50 CFR part 218 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.*

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

Subpart J—Taking and Importing Marine Mammals; Military Readiness Activities in the Mariana Islands Training and Testing Study Area

Sec.

218.90 Specified activity and geographical region.
218.91 Effective dates.
218.92 Permissible methods of taking.
218.93 Prohibitions.
218.94 Mitigation requirements.
218.95 Requirements for monitoring and reporting.
218.96–218.99 [Reserved]

Subpart J—Taking and Importing Marine Mammals; Military Readiness Activities in the Mariana Islands Training and Testing Study Area

§ 218.90 Specified activity and geographical region.

(a) Regulations in this subpart apply to the U.S. Navy (including the U.S. Marine Corps; Navy), U.S. Coast Guard (Coast Guard), U.S. Air Force, and U.S. Army (collectively referred to as the ''Action Proponents'') 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. Requirements imposed on the Action Proponents must be implemented by those persons they authorize or funds to conduct activities on their behalf.

(b) The incidental taking of marine mammals by the Action Proponents under this subpart may be authorized in Letters of Authorization (LOAs) only if it occurs within the Mariana Island Training and Testing (MITT) Study Area. The Study Area comprises three components: the Mariana Islands Range Complex (MIRC); additional areas on the high seas; and a transit corridor between the MIRC and the Hawaii Range Complex (HRC). The MIRC contains the waters south of Guam to north of Pagan (Commonwealth of the

Northern Mariana Islands (CNMI)), and from the Pacific Ocean east of the Mariana Islands to the Philippine Sea to the west, encompassing 501,873 square nautical miles of open ocean. The additional areas of the high seas include the areas to the north of the MIRC that is within the U.S. Exclusive Economic Zone of the CNMI and the areas to the west of the MIRC. The transit corridor is outside the geographic boundaries of the MIRC and represents a great circle route (*i.e.,* the shortest distance) across the high seas for Navy ships transiting between the MIRC and the HRC. Additionally, the Study Area includes pierside locations in the Apra Harbor Naval Complex. Figure 1 to this paragraph (b) shows the location of the Study Area.

(c) The taking of marine mammals by the Action Proponents is only authorized if it occurs incidental to the Action Proponents conducting military readiness activities, including the following:

(1) Anti-submarine warfare;

(2) Mine warfare;

(3) Surface warfare;

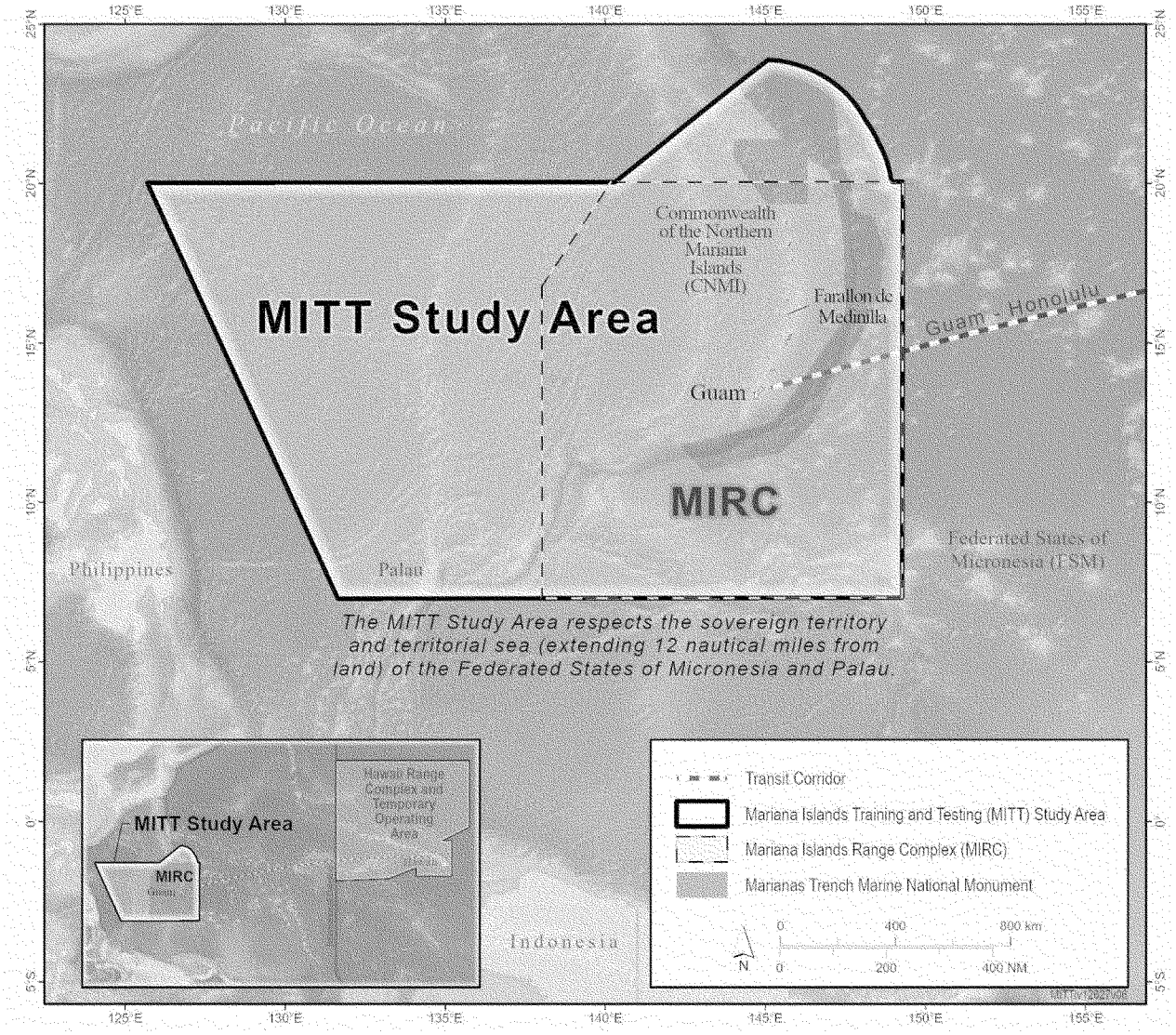
(4) Unmanned systems;

(5) Vessel evaluation; and

(6) Other training and testing activities.

BILLING CODE 3510–22–P

Figure 1 to Paragraph (b)—Study Area



BILLING CODE 3510–22–C

§ 218.91 Effective dates.

Regulations in this subpart are effective from July 31, 2027, through July 30, 2034.

§ 218.92 Permissible methods of taking.

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

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

TABLE 1 TO PARAGRAPH (b)

Species	Stock
Blue Whale	Central North Pacific.
Bryde's Whale	No stock designation (NSD).
Fin Whale	NSD.
Humpback Whale	Western North Pacific.
Minke Whale	NSD.
Omura's Whale	NSD.
Sei Whale	NSD.
Sperm Whale	NSD.
Dwarf Sperm Whale	NSD.
Pygmy Sperm Whale	NSD.
Blainville's Beaked Whale	NSD.
Deraniyagala Beaked Whale	NSD.
Ginkgo-toothed Beaked Whale	NSD.
Goose-Beaked Whale	NSD.
Longman's Beaked Whale	NSD.
False Killer Whale	NSD.
Killer Whale	NSD.
Melon-Headed Whale	NSD.
Pygmy Killer Whale	NSD.
Short-Finned Pilot Whale	NSD.
Bottlenose Dolphin	NSD.
Fraser's Dolphin	NSD.
Pantropical Spotted Dolphin	NSD.
Risso's Dolphin	NSD.
Rough-Toothed Dolphin	NSD.
Spinner Dolphin	NSD.
Striped Dolphin	NSD.

§ 218.93 Prohibitions.

(a) Except incidental take described in § 218.92 and authorized by a LOA issued pursuant to § 216.106 of this chapter and this subpart, it shall be unlawful for any person to do the following in connection with the activities described in this subpart:

(1) Violate or fail to comply with the terms, conditions, and requirements of this subpart or a LOA issued under § 216.106 of this chapter and this subpart;

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

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

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

(b) [Reserved]

§ 218.94 Mitigation requirements.

(a) When conducting the activities identified in § 218.90(c), the mitigation measures contained in this section and any LOA issued pursuant to § 216.106 of this chapter and under this subpart must be implemented by Action Proponent personnel or contractors who are trained according to the requirements in the LOA. If Action Proponent contractors are serving in a role similar to Action Proponent personnel, Action Proponent contractors must follow the mitigation applicable to Action Proponent personnel. These mitigation measures include, but are not limited to:

(1) *Activity-based mitigation.* Activity-based mitigation is mitigation that the Action Proponents must implement whenever and wherever an applicable military readiness activity takes place within the Study Area. The Action Proponents must implement the mitigation described in paragraphs (a)(1)(i) through (a)(1)(xviii) of this section, except as provided in paragraph (a)(1)(xix) through (a)(1)(xx) of this section.

(i) *Active acoustic sources with power down and shut down capabilities.* For active acoustic sources with power down and shutdown capabilities (low-frequency active sonar ≥200 dB, mid-frequency active sonar sources that are hull mounted on a surface ship (including surfaced submarines), and broadband and other active acoustic sources >200 dB):

(A) *Mitigation zones and requirements.* During use of active acoustic sources with power down and shutdown capabilities, the following mitigation zone requirements apply:

(*1*) At 1,000 yd (914.4 m) from a marine mammal, Action Proponent personnel must power down active acoustic sources by 6 decibels (dB) total.

(*2*) At 500 yd (457.2 m) from a marine mammal, Action Proponent personnel must power down active acoustic sources by an additional 4 dB (10 dB total).

(*3*) At 200 yd (182.9 m) from a marine mammal, Action Proponent personnel must shut down active acoustic sources.

(B) *Lookout requirements.* The following Lookout requirements apply:

(*1*) One Lookout in or on one of the following: aircraft; pierside, moored, or anchored vessel; underway vessel with space/crew restrictions (including small boats); or underway vessel already participating in the event that is escorting (and has positive control over sources used, deployed, or towed by) an unmanned platform.

(*2*) Two Lookouts on an underway vessel without space or crew restrictions.

(*3*) Lookouts must use information from passive acoustic detections to inform visual observations when passive acoustic devices are already being used in the event.

(C) *Mitigation zone observation.* Action Proponent personnel must observe the mitigation zones in accordance with the following:

(*1*) Action Proponent personnel must observe the applicable mitigation zone for marine mammals and floating vegetation immediately prior to the initial start of using active acoustic sources (*e.g.,* while maneuvering on station).

(*2*) Action Proponent personnel must observe the applicable mitigation zone

for marine mammals during use of active acoustic sources.

(D) *Commencement or recommencement conditions.* Action Proponent personnel must ensure one of the commencement or recommencement conditions in paragraph (a)(1)(xviii) of this section is met 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). The wait period for this activity is 30 minutes for activities conducted from vessels and for activities conducted by aircraft that are not fuel constrained and 10 minutes for activities involving aircraft that are fuel constrained (*e.g.,* rotary-wing aircraft, fighter aircraft).

(ii) *Active acoustic sources with shut down capabilities only (no power down capability).* For active acoustic sources with shut down capabilities only (no power down capability) (low-frequency active sonar <200 dB, mid-frequency active sonar sources that are not hull mounted on a surface ship (*e.g.,* dipping sonar, towed arrays), high-frequency active sonar and broadband and other active acoustic sources <200 dB):

(A) *Mitigation zones and requirements.* During use of active acoustic sources with shut down capabilities only, the following mitigation zone requirements apply:

(*1*) At 200 yd (182.9 m) from a marine mammal, Action Proponent personnel must shut down active acoustic sources.

(*2*) [Reserved]

(B) *Lookout requirements.* The following Lookout requirements apply:

(*1*) One Lookout in or on one of the following: aircraft; pierside, moored, or anchored vessel; underway vessel with space/crew restrictions (including small boats); or underway vessel already participating in the event that is escorting (and has positive control over sources used, deployed, or towed by) an unmanned platform.

(*2*) Two Lookouts on an underway vessel without space or crew restrictions.

(*3*) Lookouts must use information from passive acoustic detections to inform visual observations when passive acoustic devices are already being used in the event.

(C) *Mitigation zone observation.* Action Proponent personnel must observe the mitigation zones in accordance with the following:

(*1*) Action Proponent personnel must observe the applicable mitigation zone for marine mammals and floating vegetation immediately prior to the initial start of using active acoustic sources (*e.g.,* while maneuvering on station).

(*2*) Action Proponent personnel must observe the applicable mitigation zone for marine mammals during use of active acoustic sources.

(D) *Commencement or recommencement conditions.* Action Proponent personnel must ensure one of the commencement or recommencement conditions in paragraph (a)(1)(xviii) of this section is met 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). The wait period for this activity is 30 minutes for activities conducted from vessels and for activities conducted by aircraft that are not fuel constrained and 10 minutes for activities involving aircraft that are fuel constrained (*e.g.,* rotary-wing aircraft, fighter aircraft).

(iii) *Weapons firing noise.* For weapons firing noise:

(A) *Mitigation zones and requirements.* During explosive and non-explosive large-caliber (57 mm and larger) gunnery firing noise (surface-to-surface and surface-to-air), the following mitigation zone requirements apply:

(*1*) Action Proponent personnel must cease weapons firing if a marine mammal is sighted within 30 degrees on either side of the firing line out to 70 yd (64 m) from the gun muzzle (cease fire).

(*2*) [Reserved]

(B) *Lookout requirements.* The following Lookout requirements apply:

(*1*) One Lookout on a vessel.

(*2*) [Reserved]

(C) *Mitigation zone observation.* Action Proponent personnel must observe the mitigation zones in accordance with the following:

(*1*) Action Proponent personnel must observe the mitigation zone for marine mammals and floating vegetation immediately prior to the initial start of large-caliber gun firing (*e.g.,* during target deployment).

(*2*) Action Proponent personnel must observe the mitigation zone for marine mammals during large-caliber gun firing.

(D) *Commencement or recommencement conditions.* Action Proponent personnel must ensure one of the commencement or recommencement conditions in paragraph (a)(1)(xviii) of this section is met prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing explosive and non-explosive large-caliber gunnery firing noise (surface-to-surface and surface-to-air)). The wait period for this activity is 30 minutes.

(iv) *Explosive bombs.* For explosive bombs:

(A) *Mitigation zones and requirements.* During the use of explosive bombs of any net explosive weight (NEW), the following mitigation zone requirements apply:

(*1*) Action Proponent personnel must cease explosive bomb use if a marine mammal is sighted within 2,500 yd (2,286 m) from the intended target (cease fire).

(*2*) [Reserved]

(B) *Lookout requirements.* The following Lookout requirements apply:

(*1*) One Lookout in an aircraft.

(*2*) [Reserved]

(C) *Mitigation zone observation.* Action Proponent personnel must observe the mitigation zones in accordance with the following:

(*1*) Action Proponent personnel must observe the applicable mitigation zone for marine mammals and floating vegetation immediately prior to the initial start of explosive bomb delivery (*e.g.,* when arriving on station).

(*2*) Action Proponent personnel must observe the applicable mitigation zone for marine mammals during explosive bomb delivery. If a marine mammal is visibly injured or killed as a result of detonation, explosives use in the event must be suspended immediately.

(*3*) After the event, when practical, Action Proponent personnel must observe the detonation vicinity for injured or dead marine mammals. If any injured or dead marine mammals are observed, Action Proponent personnel must follow established incident reporting procedures.

(D) *Commencement or recommencement conditions.* Action Proponent personnel must ensure one of the commencement or recommencement conditions in paragraph (a)(1)(xviii) of this section is met prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing use of explosive bombs of any NEW). The wait period for this activity is 10 minutes.

(v) *Explosive gunnery.* For explosive gunnery:

(A) *Mitigation zones and requirements.* During air-to-surface medium-caliber (larger than 50 caliber and less than 57 mm), surface-to-surface medium-caliber, and surface-to-surface large-caliber explosive gunnery, the following mitigation zone requirements apply:

(*1*) Action Proponent personnel must cease air-to-surface medium-caliber use if a marine mammal is sighted within 200 yd (182.9 m) of the intended impact location (cease fire).

(*2*) Action Proponent personnel must cease surface-to-surface medium-caliber use if a marine mammal is sighted

within 600 yd (548.6 m) of the intended impact location (cease fire).

(*3*) Action Proponent personnel must cease surface-to-surface large-caliber use if a marine mammal is sighted within 1,000 yd (914.4 m) of the intended impact location (cease fire).

(B) *Lookout requirements.* The following Lookout requirements apply:

(*1*) One Lookout on a vessel or in an aircraft.

(*2*) [Reserved]

(C) *Mitigation zone observation.* Action Proponent personnel must observe the mitigation zones in accordance with the following:

(*1*) Action Proponent personnel must observe the applicable mitigation zone for marine mammals and floating vegetation immediately prior to the initial start of gun firing (*e.g.,* while maneuvering on station).

(*2*) Action Proponent personnel must observe the applicable mitigation zone for marine mammals during gunnery fire. If a marine mammal is visibly injured or killed as a result of detonation, explosives use in the event must be suspended immediately.

(*3*) After the event, when practical, Action Proponent personnel must observe the detonation vicinity for injured or dead marine mammals. If any injured or dead marine mammals are observed, Action Proponent personnel must follow established incident reporting procedures.

(D) *Commencement or recommencement conditions.* Action Proponent personnel must ensure one of the commencement or recommencement conditions in paragraph (a)(1)(xviii) of this section is met prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing air-to-surface medium-caliber, surface-to-surface medium-caliber, surface-to-surface large-caliber explosive gunnery). The wait period for this activity is 30 minutes for activities conducted from vessels and for activities conducted by aircraft that are not fuel constrained and 10 minutes for activities involving aircraft that are fuel constrained (*e.g.,* rotary-wing aircraft, fighter aircraft).

(vi) *Explosive mine countermeasure and neutralization (no divers).* For explosive mine countermeasure and neutralization (no divers):

(A) *Mitigation zones and requirements.* During explosive mine countermeasure and neutralization using 0.1–5 pound (lb) (0.05–2.3 kilogram (kg)) NEW and >5 lb (2.3 kg) NEW, the following mitigation zone requirements apply:

(*1*) Action Proponent personnel must cease 0.1–5 lb (0.05–2.3 kg) NEW use if a marine mammal is sighted within 600 yd (548.6 m) from the detonation site (cease fire).

(*2*) Action Proponent personnel must cease >5 lb (2.3 kg) NEW use if a marine mammal is sighted within 2,100 yd (1,920.2 m) from the detonation site (cease fire).

(B) *Lookout requirements.* The following Lookout requirements apply:

(*1*) One Lookout on a vessel or in an aircraft during 0.1–5 lb (0.05–2.3 kg) NEW use.

(*2*) Two Lookouts, one on a small boat and one in an aircraft during >5 lb (2.3 kg) NEW use.

(C) *Mitigation zone observation.* Action Proponent personnel must observe the mitigation zones in accordance with the following:

(*1*) Action Proponent personnel must observe the applicable mitigation zone for marine mammals and floating vegetation immediately prior to the initial start of detonations (*e.g.,* while maneuvering on station; typically, 10 or 30 minutes depending on fuel constraints).

(*2*) Action Proponent personnel must observe the applicable mitigation zone for marine mammals during detonations or fuse initiation. If a marine mammal is visibly injured or killed as a result of detonation, explosives use in the event must be suspended immediately.

(*3*) After the event, when practical, Action Proponent personnel must observe the detonation vicinity for 10 or 30 minutes (depending on fuel constraints) for injured or dead marine mammals. If any injured or dead marine mammals are observed, Action Proponent personnel must follow established incident reporting procedures.

(D) *Commencement or recommencement conditions.* Action Proponent personnel must ensure one of the commencement or recommencement conditions in paragraph (a)(1)(xviii) of this section is met prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing explosive mine countermeasure and neutralization). The wait period for this activity is 30 minutes for activities conducted from vessels and for activities conducted by aircraft that are not fuel constrained and 10 minutes for activities involving aircraft that are fuel constrained.

(vii) *Explosive mine neutralization (with divers).* For explosive mine neutralization (with divers):

(A) *Mitigation zones and requirements.* During explosive mine neutralization (with divers) using any NEW under positive control and any NEW using time-delay fuses, the following mitigation zone requirements apply:

(*1*) Action Proponent personnel must cease use of any NEW under positive control if a marine mammal is sighted within 500 yd (457.2 m) of the detonation site (cease fire).

(*2*) Action Proponent personnel must cease use of any NEW using time-delay fuses if a marine mammal is sighted within 1,000 yd (914.4 m) of the detonation site (cease fire).

(B) *Lookout requirements.* The following Lookout requirements apply:

(*1*) Lookouts in two small boats (one Lookout per boat) or one small boat and one rotary-wing aircraft (with one Lookout each), and one Lookout on shore for shallow-water events during use of any NEW under positive control.

(*2*) Four Lookouts in two small boats (two Lookouts per boat) and one additional Lookout in an aircraft, if used in the event, during use of any NEW using time-delay fuses.

(C) *Mitigation zone observation.* Action Proponent personnel must observe the mitigation zones in accordance with the following:

(*1*) Time-delay devices must be set not to exceed 10 minutes.

(*2*) Action Proponent personnel must observe the applicable mitigation zone for marine mammals and floating vegetation immediately prior to the initial start of detonations or fuse initiation for positive control events (*e.g.,* while maneuvering on station) or for 30 minutes prior to time-delay events.

(*3*) Action Proponent personnel must observe the applicable mitigation zone for marine mammals during detonations or fuse initiation. If a marine mammal is visibly injured or killed as a result of detonation, explosives use in the event must be suspended immediately.

(*4*) When practical based on mission, safety, and environmental conditions:

(*i*) Boats must observe from the mitigation zone radius mid-point.

(*ii*) When two boats are used, boats must observe from opposite sides of the mine location.

(*iii*) Platforms must travel a circular pattern around the mine location.

(*iv*) Boats must have one Lookout observe inward toward the mine location and one Lookout observe outward toward the mitigation zone perimeter.

(*v*) Divers must be part of the Lookout Team.

(*5*) After the event, when practical, Action Proponent personnel must observe the detonation vicinity for 30 minutes for injured or dead marine mammals. If any injured or dead marine mammals are observed, Action

Proponent personnel must follow established incident reporting procedures.

(D) *Commencement or recommencement conditions.* Action Proponent personnel must ensure one of the commencement or recommencement conditions in paragraph (a)(1)(xviii) of this section is met prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing explosive mine neutralization (with divers) using any NEW under positive control and any NEW using time-delay fuses). The wait period for this activity is 30 minutes for activities conducted from vessels and for activities conducted by aircraft that are not fuel constrained and 10 minutes for activities involving aircraft that are fuel constrained (*e.g.,* rotary-wing aircraft, fighter aircraft).

(viii) *Explosive missiles and rockets.* For explosive missiles and rockets:

(A) *Mitigation zones and requirements.* During the use of explosive missiles and rockets using 0.6–20 lb (0.3–9.1 kg) NEW (air-to-surface) and >20–500 lb (9.1–226.8 kg) NEW (air-to-surface), the following mitigation zone requirements apply:

(*1*) Action Proponent personnel must cease 0.6–20 lb (0.3–9.1 kg) NEW (air-to-surface) use if a marine mammal is sighted within 900 yd (823 m) of the intended impact location (cease fire).

(*2*) Action Proponent personnel must cease >20–500 lb (9.1–226.8 kg) NEW (air-to-surface) use if a marine mammal is sighted within 2,000 yd (1,828.8 m) of the intended impact location (cease fire).

(B) *Lookout requirements.* The following Lookout requirements apply:

(*1*) One Lookout in an aircraft.

(*2*) [Reserved]

(C) *Mitigation zone observation.* Action Proponent personnel must observe the mitigation zones in accordance with the following:

(*1*) Action Proponent personnel must observe the applicable mitigation zone for marine mammals and floating vegetation immediately prior to the initial start of missile or rocket delivery (*e.g.,* during a fly-over of the mitigation zone).

(*2*) Action Proponent personnel must observe the applicable mitigation zone for marine mammals during missile or rocket delivery. If a marine mammal is visibly injured or killed as a result of detonation, explosives use in the event must be suspended immediately.

(*3*) After the event, when practical, Action Proponent personnel must observe the detonation vicinity for injured or dead marine mammals. If any injured or dead marine mammals are observed, Action Proponent personnel must follow established incident reporting procedures.

(D) *Commencement or recommencement conditions.* Action Proponent personnel must ensure one of the commencement or recommencement conditions in paragraph (a)(1)(xviii) of this section is met prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing use of explosive missiles and rockets using 0.6–20 lb (0.3–9.1 kg) NEW (air-to-surface) and >20–500 lb (9.1–226.8 kg) NEW (air-to-surface)). The wait period for this activity is 30 minutes for activities conducted by aircraft that are not fuel constrained and 10 minutes for activities involving aircraft that are fuel constrained (*e.g.,* rotary-wing aircraft, fighter aircraft).

(ix) *Research-based sub-surface explosives.* For research-based sub-surface explosives:

(A) *Mitigation zones and requirements.* During the use of 0.1–5 lb (0.05–2.3 kg) NEW sub-surface explosives used in research applications, the following mitigation zone requirements apply:

(*1*) Action Proponent personnel must cease use of 0.1–5 lb (0.05–2.3 kg) NEW sub-surface explosives used in research applications if a marine mammal is sighted within 600 yd (548.6 m) of the device or detonation sites (cease fire).

(*2*) [Reserved]

(B) *Lookout requirements.* The following Lookout requirements apply:

(*1*) One Lookout on a small boat or in an aircraft.

(*2*) Conduct passive acoustic monitoring for marine mammals when passive acoustic devices are already being used prior to the initial start of detonations; use information from detections to assist visual observations.

(C) *Mitigation zone observation.* Action Proponent personnel must observe the mitigation zones in accordance with the following:

(*1*) Action Proponent personnel must observe the mitigation zone for marine mammals and floating vegetation immediately prior to the initial start of detonations.

(*2*) Action Proponent personnel must observe the mitigation zone for marine mammals during detonations. If a marine mammal is visibly injured or killed as a result of detonation, explosives use in the event must be suspended immediately.

(*3*) After the event, when practical, Action Proponent personnel must observe the detonation vicinity for injured or dead marine mammals. If any injured or dead marine mammals are observed, Action Proponent personnel must follow established incident reporting procedures.

(D) *Commencement or recommencement conditions.* Action Proponent personnel must ensure one of the commencement or recommencement conditions in paragraph (a)(1)(xviii) of this section is met prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing use of 0.1–5 lb (0.05–2.3 kg) NEW sub-surface explosives used in research applications). The wait period for this activity is 30 minutes for activities conducted from vessels and for activities conducted by aircraft that are not fuel constrained and 10 minutes for activities involving aircraft that are fuel constrained (*e.g.,* rotary-wing aircraft, fighter aircraft).

(x) *Explosive torpedoes.* For explosive torpedoes:

(A) *Mitigation zones and requirements.* During the use of explosive torpedoes of any NEW, the following mitigation zone requirements apply:

(*1*) Action Proponent personnel must cease use of explosive torpedoes of any NEW if a marine mammal is sighted within 2,100 yd (1,920.2 m) of the intended impact location (cease fire).

(*2*) [Reserved]

(B) *Lookout requirements.* The following Lookout requirements apply:

(*1*) One Lookout in an aircraft.

(*2*) Conduct passive acoustic monitoring for marine mammals; use information from detections to assist visual observations.

(C) *Mitigation zone observation.* Action Proponent personnel must observe the mitigation zones in accordance with the following:

(*1*) Action Proponent personnel must observe the mitigation zone for marine mammals, floating vegetation, and jellyfish aggregations immediately prior to the initial start of detonations (*e.g.,* during target deployment).

(*2*) Action Proponent personnel must observe the mitigation zone for marine mammals and jellyfish aggregations during torpedo launches. If a marine mammal is visibly injured or killed as a result of detonation, explosives use in the event must be suspended immediately.

(*3*) After the event, when practical, Action Proponent personnel must observe the detonation vicinity for injured or dead marine mammals. If any injured or dead marine mammals are observed, Action Proponent personnel must follow established incident reporting procedures.

(D) *Commencement or recommencement conditions.* Action Proponent personnel must ensure one of

the commencement or recommencement conditions in paragraph (a)(1)(xviii) of this section is met prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing use of explosive torpedoes of any NEW). The wait period for this activity is 30 minutes for activities conducted from vessels and for activities conducted by aircraft that are not fuel constrained and 10 minutes for activities involving aircraft that are fuel constrained (*e.g.,* rotary-wing aircraft, fighter aircraft).

(xi) *Sinking Exercises.* For Sinking Exercises (SINKEX):

(A) *Mitigation zones and requirements.* During SINKEX using any NEW, the following mitigation zone requirements apply:

(*1*) Action Proponent personnel must cease SINKEX of any NEW if a marine mammal is sighted within 2.5 nmi (4.6 km) of the target ship hull (cease fire).

(*2*) [Reserved]

(B) *Lookout requirements.* The following Lookout requirements apply:

(*1*) Two Lookouts: one on a vessel and one in an aircraft.

(*2*) Conduct passive acoustic monitoring for marine mammals when passive acoustic devices are already being used prior to the initial start of detonations; use information from detections to assist visual observations.

(C) *Mitigation zone observation.* Action Proponent personnel must observe the mitigation zones in accordance with the following:

(*1*) During aerial observations for 90 minutes prior to the initial start of weapon firing, Action Proponent personnel must observe the mitigation zone for marine mammals, floating vegetation, and jellyfish aggregations.

(*2*) From the vessel during weapon firing, and from the aircraft and vessel immediately after planned or unplanned breaks in weapon firing of more than 2 hours, Action Proponent personnel must observe the mitigation zone for marine mammals. If a marine mammal is visibly injured or killed as a result of detonation, explosives use in the event must be suspended immediately.

(*3*) Action Proponent personnel must observe the detonation vicinity for injured or dead marine mammals for 2 hours after sinking the vessel or until sunset, whichever comes first. If any injured or dead marine mammals are observed, Action Proponent personnel must follow established incident reporting procedures.

(D) *Commencement or recommencement conditions.* Action Proponent personnel must ensure one of the commencement or recommencement conditions in paragraph (a)(1)(xviii) of this section is met prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing SINKEX). The wait period for this activity is 30 minutes.

(xii) *Aerial-deployed mines and non-explosive bombs.* For aerial-deployed mines and non-explosive bombs:

(A) *Mitigation zones and requirements.* During the use of non-explosive aerial-deployed mines and non-explosive bombs, the following mitigation zone requirements apply:

(*1*) Action Proponent personnel must cease using non-explosive aerial-deployed mines and non-explosive bombs if a marine mammal is sighted within 1,000 yd (914.4 m) of the intended target (cease fire).

(*2*) [Reserved]

(B) *Lookout requirements.* The following Lookout requirements apply:

(*1*) One Lookout in an aircraft.

(*2*) [Reserved]

(C) *Mitigation zone observation.* Action Proponent personnel must observe the mitigation zones in accordance with the following:

(*1*) Action Proponent personnel must observe the mitigation zone for marine mammals and floating vegetation immediately prior to the initial start of mine or bomb delivery (*e.g.,* when arriving on station).

(*2*) Action Proponent personnel must observe the mitigation zone for marine mammals during mine or bomb delivery. If a marine mammal is visibly injured or killed as a result of detonation, explosives use in the event must be suspended immediately.

(D) *Commencement or recommencement conditions.* Action Proponent personnel must ensure one of the commencement or recommencement conditions in paragraph (a)(1)(xviii) of this section is met prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing use of non-explosive aerial-deployed mines and non-explosive bombs). The wait period for this activity is 10 minutes.

(xiii) *Non-explosive gunnery.* For non-explosive gunnery:

(A) *Mitigation zones and requirements.* During the use of non-explosive surface-to-surface large-caliber ordnance, non-explosive surface-to-surface and air-to-surface medium-caliber ordnance, and non-explosive surface-to-surface and air-to-surface small-caliber ordnance, the following mitigation zone requirements apply:

(*1*) Action Proponent personnel must cease non-explosive surface-to-surface large-caliber ordnance, non-explosive surface-to-surface and air-to-surface medium-caliber ordnance, and non-explosive surface-to-surface and air-to-surface small-caliber ordnance use if a marine mammal is sighted within 200 yd (182.9 m) of the intended impact location (cease fire).

(*2*) [Reserved]

(B) *Lookout requirements.* The following Lookout requirements apply:

(*1*) One Lookout on a vessel or in an aircraft.

(*2*) [Reserved]

(C) *Mitigation zone observation.* Action Proponent personnel must observe the mitigation zones in accordance with the following:

(*1*) Action Proponent personnel must observe the mitigation zone for marine mammals and floating vegetation immediately prior to the start of gun firing (*e.g.,* while maneuvering on station).

(*2*) Action Proponent personnel must observe the mitigation zone for marine mammals during gunnery firing.

(D) *Commencement or recommencement conditions.* Action Proponent personnel must ensure one of the commencement or recommencement conditions in paragraph (a)(1)(xviii) of this section is met prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing use of non-explosive surface-to-surface large-caliber ordnance, non-explosive surface-to-surface and air-to-surface medium-caliber ordnance, and non-explosive surface-to-surface and air-to-surface small-caliber ordnance). The wait period for this activity is 30 minutes for activities conducted from vessels and for activities conducted by aircraft that are not fuel constrained and 10 minutes for activities involving aircraft that are fuel constrained (*e.g.,* rotary-wing aircraft, fighter aircraft).

(xiv) *Non-explosive missiles and rockets.* For non-explosive missiles and rockets:

(A) *Mitigation zones and requirements.* During the use of non-explosive missiles and rockets (air-to-surface), the following mitigation zone requirements apply:

(*1*) Action Proponent personnel must cease non-explosive missile and rocket (air-to-surface) use if a marine mammal is sighted within 900 yd (823 m) of the intended impact location (cease fire).

(*2*) [Reserved]

(B) *Lookout requirements.* The following Lookout requirements apply:

(*1*) One Lookout in an aircraft.

(*2*) [Reserved]

(C) *Mitigation zone observation.* Action Proponent personnel must observe the mitigation zones in accordance with the following:

(*1*) Action Proponent personnel must observe the mitigation zone for marine

mammals and floating vegetation immediately prior to the start of missile or rocket delivery (*e.g.,* during a fly-over of the mitigation zone).

(*2*) Action Proponent personnel must observe the mitigation zone for marine mammals during missile or rocket delivery.

(D) *Commencement or recommencement conditions.* Action Proponent personnel must ensure one of the commencement or recommencement conditions in paragraph (a)(1)(xviii) of this section is met prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing use of non-explosive missiles and rockets (air-to-surface)). The wait period for this activity is 30 minutes for activities conducted by aircraft that are not fuel constrained and 10 minutes for activities involving aircraft that are fuel constrained (*e.g.,* rotary-wing aircraft, fighter aircraft).

(xv) *Manned surface vessels.* For manned surface vessels:

(A) *Mitigation zones and requirements.* During the use of manned surface vessels, including surfaced submarines, the following mitigation zone requirements apply:

(*1*) Underway manned surface vessels must maneuver themselves (which may include reducing speed) to maintain the following distances as mission and circumstances allow:

(*i*) 500 yd (457.2 m) from whales.

(*ii*) 200 yd (182.9 m) from other marine mammals.

(*2*) [Reserved]

(B) *Lookout requirements.* The following Lookout requirements apply:

(*1*) One or more Lookouts on manned underway surface vessels in accordance with the most recent navigation safety instruction.

(*2*) [Reserved]

(C) *Mitigation zone observation.* Action Proponent personnel must observe the mitigation zones in accordance with the following:

(*1*) Action Proponent personnel must observe the mitigation zone for marine mammals immediately prior to manned surface vessels getting underway and while underway.

(*2*) [Reserved]

(xvi) *Unmanned vehicles.* For unmanned vehicles:

(A) *Mitigation zones and requirements.* During the use of unmanned surface vehicles and unmanned underwater vehicles already being escorted (and operated under positive control) by a manned surface support vessel, the following mitigation zone requirements apply:

(*1*) A surface support vessel that is already participating in the event and has positive control over the unmanned vehicle must maneuver the unmanned vehicle, which may include reducing its speed, to ensure it maintains the following distances as mission and circumstances allow:

(*i*) 500 yd (457.2 m) from whales.

(*ii*) 200 yd (182.9 m) from other marine mammals.

(*2*) [Reserved]

(B) *Lookout requirements.* The following Lookout requirements apply:

(*1*) One Lookout on a surface support vessel that is already participating in the event and has positive control over the unmanned vehicle.

(*2*) [Reserved]

(C) *Mitigation zone observation.* Action Proponent personnel must observe the mitigation zones in accordance with the following:

(*1*) Action Proponent personnel must observe the mitigation zone for marine mammals immediately prior to unmanned vehicles getting underway and while underway.

(*2*) [Reserved]

(xvii) *Towed in-water devices.* For towed in-water devices:

(A) *Mitigation zones and requirements.* During the use of in-water devices towed by an aircraft, a manned surface vessel, or an Unmanned Surface Vehicle or Unmanned Underwater Vehicle already being escorted (and operated under positive control) by a manned surface vessel, the following mitigation zone requirements apply:

(*1*) Manned towing platforms or surface support vessels already participating in the event that have positive control over an unmanned vehicle that is towing an in-water device must maneuver itself or the unmanned vehicle, which may include reducing speed, to ensure towed in-water devices maintain the following distances as mission and circumstances allow:

(*i*) 250 yd (228.6 m) from marine mammals.

(*ii*) [Reserved]

(*2*) [Reserved]

(B) *Lookout requirements.* The following Lookout requirements apply:

(*1*) One Lookout on the manned towing vessel or aircraft or on a surface support vessel that is already participating in the event and has positive control over an unmanned vehicle that is towing an in-water device.

(*2*) [Reserved]

(C) *Mitigation zone observation.* Action Proponent personnel must observe the mitigation zones in accordance with the following:

(*1*) Action Proponent personnel must observe the mitigation zone for marine mammals immediately prior to and while in-water devices are being towed.

(*2*) [Reserved]

(xviii) *Commencement or recommencement conditions.* Action Proponents must not commence or recommence an activity after a marine mammal is observed within a relevant mitigation zone until one of the following conditions has been met:

(A) *Observed exiting.* A Lookout observes the animal exiting the mitigation zone;

(B) *Concluded to have exited.* A Lookout concludes that the animal has exited the mitigation zone based on its observed course, speed, and movement relative to the mitigation zone;

(C) *Clear from additional sightings.* A Lookout affirms the mitigation zone has been clear from additional sightings for the activity-specific wait period; or

(D) *Platform or target transit.* For mobile events, the platform or target has transited a distance equal to double the mitigation zone size beyond the location of the last sighting.

(xix) *Exceptions to activity-based mitigation for acoustic and explosive stressors and non-explosive ordnance.* Activity-based mitigation for acoustic and explosive stressors and non-explosive ordnance will not apply to:

(A) *Not operated under positive control.* Acoustic sources not operated under positive control (*e.g.,* moored oceanographic sources);

(B) *Safety of navigation.* Acoustic sources used for safety of navigation (*e.g.,* fathometers);

(C) *Aircraft operating at high altitudes.* Acoustic sources used or deployed by aircraft operating at high altitudes (*e.g.,* bombs deployed from high altitude (since personnel cannot effectively observe the surface of the water));

(D) *Unmanned platforms.* Acoustic sources used, deployed, or towed by unmanned platforms except when escort vessels are already participating in the event and have positive control over the source;

(E) *Submerged submarines.* Acoustic sources used by submerged submarines (*e.g.,* sonar (since they cannot conduct visual observation));

(F) *De minimis sources.* De minimis acoustic sources (*e.g.,* those >200 kHz);

(G) *Unattended sources.* Unattended sources (*e.g.,* moored buoys used for acoustic and oceanographic research);

(H) *Bow- or wake-riding.* Vessel-based, unmanned vehicle-based, or towed in-water acoustic sources when marine mammals (*e.g.,* dolphins) are determined to be intentionally swimming at the bow or alongside or directly behind the vessel, vehicle, or device (*e.g.,* to bow-ride or wake-ride);

(I) *Aircraft operating at high altitudes.* Explosives deployed by aircraft operating at high altitudes;

(J) *Submerged submarines.* Explosives deployed by submerged submarines, except for explosive torpedoes;

(K) *Aerial targets.* Explosives deployed against aerial targets;

(L) *Vessel-launched missile or rocket events.* Explosives during vessel-launched or rocket events;

(M) *De minimis.* Explosives used at or below the de minimis threshold;

(N) *Unmanned platforms.* Explosives deployed by unmanned platforms except when escort vessels are already participating in the event and have positive control over the explosive;

(O) *Aircraft operating at high altitudes.* Non-explosive ordnance deployed by aircraft operating at high altitudes;

(P) *Aerial targets and land-based targets.* Non-explosive ordnance deployed against aerial targets and land-based targets;

(Q) *Vessel-launched missile or rocket events.* Non-explosive ordnance deployed during vessel-launched missile or rocket events; and

(R) *Unmanned platforms.* Non-explosive ordnance deployed by unmanned platforms except when escort vessels are already participating in the event and have positive control over ordnance deployment.

(xx) *Exceptions to activity-based mitigation for physical disturbance and strike stressors.* Activity-based mitigation for physical disturbance and strike stressors will not be implemented:

(A) *Submerged submarines.* By submerged submarines;

(B) *Unmanned vehicles.* By unmanned vehicles except when escort vessels are already participating in the event and have positive control over the unmanned vehicle movements;

(C) *Bow- or wake-riding.* When marine mammals (*e.g.,* dolphins) are determined to be intentionally swimming at the bow, alongside the vessel or vehicle, or directly behind the vessel or vehicle (*e.g.,* to bow-ride or wake-ride); and

(D) *Mission requirements.* When impractical based on mission requirements (*e.g.,* during certain aspects of amphibious exercises).

(2) *Geographic mitigation areas.* The Action Proponents must implement the geographic mitigation requirements of this section.

(i) *Marpi Reef mitigation area.* Figure 1 to paragraph (a)(2) shows the location of the mitigation areas. Within the Marpi Reef mitigation area, the following requirements apply:

(A) *Surface ship hull-mounted mid-frequency active sonar.* From December 1 through April 30, the Action Proponents must not use more than 20 combined hours of mid-frequency 1 (MF1) and MF1 continuous (MF1C) surface ship hull-mounted mid-frequency active sonar during training and testing within the Marpi Reef and Chalan Kanoa Reef mitigation area annually.

(B) *In-water explosives.* The Action Proponents must not detonate in-water explosives, including underwater explosives and explosives deployed against surface targets, within the mitigation area year-round.

(C) *Seasonal awareness notification message.* The Navy must issue an annual seasonal awareness notification message to alert ships and aircraft operating in the Marpi Reef Mitigation Area to the possible presence of increased concentrations of humpback whales from December 1 through April 30. To maintain safety of navigation and to avoid interactions with large whales during transits, the Navy must instruct vessels to remain vigilant to the presence of humpback whales that, when concentrated seasonally, may become vulnerable to vessel strikes. Platforms must use the information from the awareness notification messages to assist their visual observation of applicable mitigation zones during training and testing activities and to aid in the implementation of activity-based mitigation.

(ii) *Chalan Kanoa Reef mitigation area.* Figure 1 to paragraph (a)(2) shows the location of the mitigation areas. Within the Chalan Kanoa Reef mitigation area, the following requirements apply:

(A) *Surface ship hull-mounted mid-frequency active sonar.* From December 1 through April 30, the Action Proponents must not use more than 20 combined hours of MF1 and MF1C surface ship hull-mounted mid-frequency active sonar during training and testing within the Marpi Reef and Chalan Kanoa Reef mitigation area annually.

(B) *In-water explosives.* The Action Proponents must not detonate in-water explosives, including underwater explosives and explosives deployed against surface targets, within the mitigation area year-round.

(C) *Seasonal awareness notification message.* The Navy must issue an annual seasonal awareness notification message to alert ships and aircraft operating in the Chalan Kanoa Reef Mitigation Area to the possible presence of increased concentrations of humpback whales from December 1 through April 30. To maintain safety of navigation and to avoid interactions with large whales during transits, the Navy must instruct vessels to remain vigilant to the presence of humpback whales that, when concentrated seasonally, may become vulnerable to vessel strikes. Platforms must use the information from the awareness notification messages to assist their visual observation of applicable mitigation zones during training and testing activities and to aid in the implementation of activity-based mitigation.

(iii) *Agat Bay mitigation area.* Figure 1 to paragraph (a)(2) shows the location of the mitigation areas. Within the Agat Bay mitigation area, the following requirements apply:

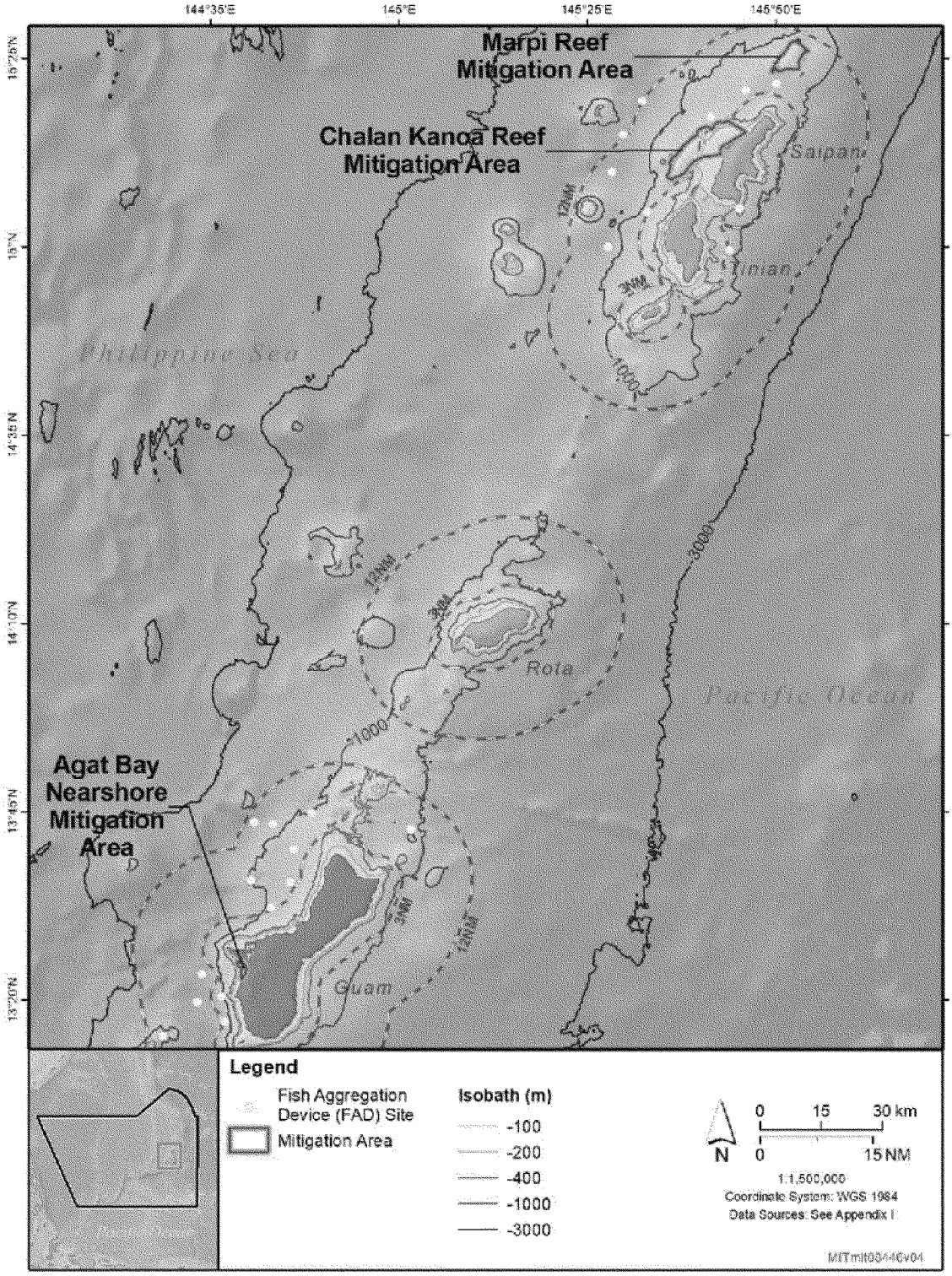
(A) *Surface ship hull-mounted mid-frequency active sonar.* The Action Proponents must not use MF1 or MF1C surface ship hull-mounted mid-frequency active sonar during training and testing annually within the mitigation area year-round.

(B) *In-water explosives.* The Action Proponents must not detonate in-water explosives, including underwater explosives and explosives deployed against surface targets, within the mitigation area year-round.

(iv) *National security requirement.* Should national security require the Action Proponents to exceed a requirement(s) in paragraph (a)(2) of this section, Action Proponent personnel must provide NMFS with advance notification and include the information (*e.g.,* sonar hours, explosives usage) in its annual activity reports submitted to NMFS.

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Figure 1 to Paragraph (a)(2)—Geographic Mitigation Areas for Marine Mammals in the Study Area



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(b) [Reserved]

§ 218.95 Requirements for monitoring and reporting.

The Action Proponents must implement the following monitoring and reporting requirements when conducting the specified activities:

(a) *Notification of take.* If the Action Proponent reasonably believes that the specified activity identified in § 218.90(c) 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, then the Action Proponent shall notify NMFS immediately or as soon as operational security considerations allow.

(b) *Monitoring and reporting under the LOAs.* The Action Proponents must conduct all monitoring needed to produce the reports in paragraphs (f) and (g) of this section consistent with the requirements in the LOA. The Action Proponents must also conduct

all reporting required in paragraphs (c) through (h) of this section consistent with requirements in the LOA.

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

(d) *Annual MITT Study Area marine species monitoring report.* The Action Proponents must submit an annual Study Area marine species monitoring report describing the implementation and results from the previous calendar year. Data collection methods must be standardized across range complexes and the Study Area to allow for comparison in different geographic locations. The draft report must be submitted to the Director, Office of Protected Resources, NMFS, annually. NMFS will submit comments or questions on the report, if any, within 3 months of receipt. The report will be considered final after the Action Proponents have addressed NMFS' comments or 3 months after submittal of the draft if NMFS does not provide comments on the draft report. The report must describe progress of knowledge made with respect to intermediate scientific objectives within the 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 do not provide direct assessment of cumulative progress on the monitoring plan study questions.

(e) *Quick look reports.* In the event that the sound levels analyzed in promulgation of these regulations are exceeded within a given reporting year, the Action Proponents must submit a preliminary report(s) detailing the exceedance within 21 days after the anniversary date of issuance of the LOAs.

(f) *Annual MITT Training and Testing Reports.* Regardless of whether analyzed sound levels were exceeded, the Navy must submit a detailed report (MITT Annual Training Exercise Report and Testing Activity Report) to the Director, Office of Protected Resources, NMFS annually. NMFS will submit comments or questions on the reports, if any, within 1 month of receipt. The reports will be considered final after the Action Proponents have addressed NMFS' comments or 1 month after submittal of the drafts if NMFS does not provide comments on the draft reports. The annual reports must 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 reports must 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 reports 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 2026 MITT Draft EIS/OEIS and MMPA final rule. The annual reports must also include the details regarding specific requirements associated with the mitigation areas listed in paragraph (f)(4) 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 detailed reports shall also contain special reporting for the Marpi Reef and Chalan Kanoa Reef Mitigation Area. The final annual/close-out reports at the conclusion of the authorization period (year 7) will also serve as the comprehensive close-out reports and include both the final year annual incidental take compared to annual authorized incidental take as well as a cumulative 7-year incidental take compared to 7-year authorized incidental take. The MITT Annual Training and Testing Reports must include the specific information described in the LOAs.

(1) *Major Training Exercises (MTEs).* This section of the report must contain the following information for MTEs completed that year in the Study Area.

(i) *Exercise information (for each MTE).* For exercise information (for each MTE):

(A) Exercise designator.

(B) Date that exercise began and ended.

(C) Location.

(D) Number and types of active sonar sources used in the exercise.

(E) Number and types of passive acoustic sources used in exercise.

(F) Number and types of vessels, aircraft, and other platforms participating in each exercise.

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

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

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

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

(A) Date, time, and location of sighting.

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

(C) Number of individuals.

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

(E) Indication of specific type of platform observation was made from.

(F) Length of time observers maintained visual contact with marine mammal.

(G) Sea state.

(H) Visibility.

(I) Sound source in use at the time of sighting.

(J) Indication of whether animal was less than 200 yd (182.9 m), 200 to 500 yd (182.9 to 457.2 m), 500 to 1,000 yd (457.2 m to 914.4 m), 1,000 to 2,000 yd (914.4 m to 1,828.8 m), or greater than 2,000 yd (1,828.8 m) from sonar source.

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

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

(M) Lookouts must report, in plain language and without trying to categorize in any way, the observed behavior of the animal(s) (such as animal closing to bow ride, paralleling course/speed, floating on surface and not swimming, *etc.*) and if any calves were present.

(iii) *An evaluation (based on data gathered during all of the MTEs) of the effectiveness of mitigation measures designed to minimize the received level to which marine mammals may be exposed.* For an evaluation (based on data gathered during all of the MTEs) of the effectiveness of mitigation measures designed to minimize the received level to which marine mammals may be exposed:

(A) This evaluation must identify the specific observations that support any conclusions the Navy reaches about the effectiveness of the mitigation.

(B) [Reserved]

(2) *Sinking Exercises.* This section of the report must include the following

information for each SINKEX completed that year in the Study Area:

(i) *Exercise information.* For exercise information:

(A) Location.

(B) Date and time exercise began and ended.

(C) Total hours of observation by Lookouts before, during, and after exercise.

(D) Total number and types of explosive source bins detonated.

(E) Number and types of passive acoustic sources used in exercise.

(F) Total hours of passive acoustic search time.

(G) Number and types of vessels, aircraft, and other platforms participating in exercise.

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

(I) Narrative description of sensors and platforms utilized for marine mammal detection and timeline illustrating how marine mammal detection was conducted.

(ii) *Individual marine mammal observation (by Action Proponent Lookouts) information for each sighting where mitigation was implemented.* For individual marine mammal observation (by Action Proponent Lookouts) information for each sighting where mitigation was implemented:

(A) Date/Time/Location of sighting.

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

(C) Number of individuals.

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

(E) Length of time observers maintained visual contact with marine mammal.

(F) Sea state.

(G) Visibility.

(H) Whether sighting was before, during, or after detonations/exercise, and how many minutes before or after.

(I) Distance of marine mammal from actual detonations (or target spot if not yet detonated): Less than 200 yd (182.9 m), 200 to 500 yd (182.9 to 457.2 m), 500 to 1,000 yd (457.2 m to 914.4 m), 1,000 to 2,000 yd (914.4 m to 1,828.8 m), or greater than 2,000 yd (1,828.8 m).

(J) Lookouts must report the observed behavior of the animal(s) in plain language and without trying to categorize in any way (such as animal closing to bow ride, paralleling course/speed, floating on surface and not swimming, *etc.*), including speed and direction and if any calves were present.

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

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

(3) *Summary of sources used.* This section of the report must include the following information summarized from the authorized sound sources used in all training and testing events:

(i) *Totals for sonar or other acoustic source bins.* Total annual hours or quantity (per the LOA) of each bin of sonar or other transducers; and

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

(4) *Special Reporting for Geographic Mitigation Areas.* This section of the report must contain the following information for activities conducted in geographic mitigation areas in the Study Area:

(i) *Marpi Reef and Chalan Kanoa Reef Mitigation Areas.* The Action Proponents must report the total hours of active sonar (all bins, by bin) used in the Marpi Reef Mitigation Area and Chalan Kanoa Reef Mitigation Area from December 1 through April 30.

(ii) *National security requirement.* If an Action Proponent(s) invokes the national security requirement described in § 218.94 (a)(2)(iv), the Action Proponent personnel must include information about the event in its Annual MITT Training and Testing Report.

(g) *Foreign military sonar and explosives.* Navy personnel must confirm that foreign military use of sonar and explosives, when such militaries are participating in a U.S. Navy-led exercise or event, combined with the Action Proponents' use of sonar and explosives, would not cause exceedance of the analyzed levels within each NAEMO modeled sonar and explosive bin used for estimating predicted impacts.

(h) *MTE sonar exercise notification.* The Action Proponents must submit to NMFS an electronic report within 15 calendar days after the completion of any MTE indicating:

(1) *Location.* Location of the exercise;

(2) *Dates.* Beginning and end dates of the exercise; and

(3) *Type.* Type of exercise.

§§ 218.96–218.99 [Reserved]

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