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

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 218

[Docket No. 130107014–3024–01]

RIN 0648–BC52

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

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

ACTION: Proposed rule; request for comments and information.

SUMMARY: NMFS has received a request from the U.S. Navy (Navy) for authorization to take marine mammals incidental to the training and testing activities conducted in the Hawaii-Southern California Training and Testing (HSTT) study area from January 2014 through January 2019. Pursuant to the Marine Mammal Protection Act (MMPA), NMFS is requesting comments on its proposal to issue regulations and subsequent Letters of Authorization (LOAs) to the Navy to incidentally harass marine mammals.

DATES: Comments and information must be received no later than March 11, 2013.

ADDRESSES: You may submit comments, identified by 0648–BC52, by either of the following methods:

- *Electronic submissions:* Submit all electronic public comments via the Federal eRulemaking Portal *http://www.regulations.gov.*
- Hand delivery or mailing of paper, disk, or CD–ROM comments should be addressed to P. Michael Payne, Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service, 1315 East-West Highway, Silver Spring, MD 20910–3225.

Instructions: All comments received are a part of the public record and will generally be posted to *http://www.regulations.gov* without change. All Personal Identifying Information (for example, name, address, etc.) voluntarily submitted by the commenter may be publicly accessible. Do not submit Confidential Business Information or otherwise sensitive or protected information.

NMFS will accept anonymous comments (enter N/A in the required fields if you wish to remain anonymous). Attachments to electronic comments will be accepted in Microsoft Word, Excel, WordPerfect, or Adobe PDF file formats only.

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

SUPPLEMENTARY INFORMATION:

Availability

A copy of the Navy's application may be obtained by visiting the internet at: *http://www.nmfs.noaa.gov/pr/permits/incidental.htm#applications.* The Navy's Draft Environmental Impact Statement/Overseas Environmental Impact Statement (DEIS/OEIS) for HSTT was made available to the public on May 11, 2012 (77 FR 27743) and may also be viewed at *http://www.nmfs.noaa.gov/pr/permits/incidental.htm#applications.* Documents cited in this notice may also be viewed, by appointment, during regular business hours, at the aforementioned address.

Background

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

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

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

Summary of Request

On April 13, 2012, NMFS received an application from the Navy requesting two LOAs for the take of 39 species of marine mammals incidental to Navy training and testing activities to be conducted in the HSTT Study Area over 5 years. The Navy submitted an addendum on September 24, 2012 and the application was considered complete. The Navy is requesting regulations that would establish a process for authorizing take, via two separate 5-year LOAs, of marine mammals for training activities and testing activities, each proposed to be conducted from 2014 through 2019. The Study Area includes three existing range complexes (Southern California (SOCAL) Range Complex, Hawaii Range Complex (HRC), and Silver Strand Training Complex (SSTC)) plus pierside locations and areas on the high seas where maintenance, training, or testing may occur. The proposed activities are classified as military readiness activities. Marine mammals present in the Study Area may be exposed to sound from active sonar, underwater detonations, and/or pile driving and removal. In addition, incidental takes of marine mammals may occur from ship strikes. The Navy is requesting authorization to take 38 marine mammal species by Level B harassment and 24 marine mammal species by Level A harassment or mortality.

The Navy's application and the HSTT DEIS/OEIS contain proposed acoustic criteria and thresholds that would, in some instances, represent changes from what NMFS has used to evaluate the Navy's proposed activities for past incidental take authorizations. The revised thresholds are based on evaluation of recent scientific studies; a detailed explanation of how they were derived is provided in the HSTT DEIS/OEIS Criteria and Thresholds Technical Report. NMFS is currently updating and revising all of its acoustic criteria and thresholds. Until that process is complete, NMFS will continue its long-standing practice of considering specific modifications to the acoustic criteria and thresholds currently employed for incidental take authorizations only after providing the public with an opportunity for review and comment. NMFS is requesting comments on all aspects of the proposed rule, and specifically requests comments on the proposed acoustic criteria and thresholds.

Background of Request

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

The Navy proposes to continue conducting training and testing activities within the HSTT Study Area, which have been ongoing since the 1940s. Recently, most of these activities were analyzed in three separate EISs completed between 2008 and 2011; the Hawaii Range Complex (HRC) EIS/OEIS (U.S. Department of the Navy, 2008a), the Southern California (SOCAL) Range Complex EIS/OEIS (U.S. Department of the Navy, 2008b), and the Silver Strand Training Complex (SSTC) EIS (U.S. Department of the Navy, 2011a). These documents, among others, and their associated MMPA regulations and authorizations, describe the baseline of training and testing activities currently conducted in the Study Area. The tempo and types of training and testing activities have fluctuated due to changing requirements; new technologies; the dynamic nature of international events; advances in warfighting doctrine and procedures; and changes in basing locations for ships, aircraft, and personnel. Such developments influence the frequency, duration, intensity, and location of required training and testing. The Navy's LOA request covers training and testing activities that would occur for a 5-year period following the expiration of the current MMPA authorizations. The Navy has also prepared a DEIS/OEIS analyzing the effects on the human environment of implementing their preferred alternative (among others).

Description of the Specified Activity

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

Overview of Training Activities

The Navy routinely trains in the HSTT Study Area in preparation for national defense missions. Training activities are categorized into eight functional warfare areas (anti-air warfare; amphibious warfare; strike warfare; anti-surface warfare; anti-submarine warfare; electronic warfare; mine warfare; and naval special warfare). The Navy determined that the following stressors used in these warfare areas are most likely to result in impacts on marine mammals:

- Amphibious warfare (underwater detonations, pile driving and removal)
- Anti-surface warfare (underwater detonations)
- Anti-submarine warfare (active sonar, underwater detonations)
- Mine warfare (active sonar, underwater detonations, and marine mammal systems (see description below))
- Naval special warfare (underwater detonations)

The Navy's activities in anti-air warfare, strike warfare, and electronic warfare do not involve stressors that could result in harassment of marine mammals. Therefore, these activities are not discussed further.

Amphibious Warfare

The mission of amphibious warfare is to project military power from the sea to the shore through the use of naval firepower and Marine Corps landing forces. The Navy uses amphibious warfare to attack a threat located on land by a military force embarked on ships. Amphibious warfare training ranges from individual, crew, and small unit events to large task force exercises. Individual and crew training include amphibious vehicles and naval gunfire support training for shore assaults, boat raids, airfield or port seizures, and reconnaissance. Large-scale amphibious exercises involve ship-to-shore maneuver, naval fire support, such as shore bombardment, and air strike and close air support training. However, the Navy only analyzed those portions of amphibious warfare training that occur at sea, in particular, underwater detonations associated with naval gunfire support training. The Navy conducts other amphibious warfare support activities that could potentially affect marine mammals (such as pile driving and removal) in the near shore region from the beach to about 914 meters (m) from shore.

Anti-Surface Warfare

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

Anti-Submarine Warfare

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

Mine Warfare

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

Finally, the Navy deploys California sea lions in the HSTT Study Area for integrated training involving two primary missions areas: To find objects such as inert mine shapes, and to detect swimmers or other intruders around Navy facilities such as piers. When deployed, the animals are part of what the Navy refers to as marine mammal systems. These systems include one or more motorized small boats, several crew members, and a trained marine mammal. Each trained animal is deployed under behavioral control to find the intruding swimmer or submerged object.

Naval Special Warfare

The mission of naval special warfare is to conduct unconventional warfare, direct action, combat terrorism, special reconnaissance, information warfare, security assistance, counter-drug operations, and recovery of personnel from hostile situations. Naval special warfare operations are highly specialized and require continual and intense training. Naval special warfare units are required to utilize a combination of specialized training, equipment, and tactics, including insertion and extraction operations using parachutes, submerged vehicles, rubber boats, and helicopters; boat-to-shore and boat-to-boat gunnery; underwater demolition training; reconnaissance; and small arms training.

Overview of Testing Activities

The Navy researches, develops, tests, and evaluates new platforms, systems, and technologies. Testing activities may occur independently of or in conjunction with training activities. Many testing activities are conducted similarly to Navy training activities and are also categorized under one of the primary mission areas. Other testing activities are unique and are described within their specific testing categories. The Navy determined that stressors used during the following testing activities are most likely to result in impacts on marine mammals:

- Naval Air Systems Command (NAVAIR) Testing
  - Anti-surface warfare testing (underwater detonations)
  - Anti-submarine warfare testing (active sonar, underwater detonations)
  - Mine warfare testing (active sonar, underwater detonations)
- Naval Sea Systems command (NAVSEA) Testing
  - New ship construction (active sonar, underwater detonations)
  - Life cycle activities (active sonar, underwater detonations)
  - Anti-surface warfare/anti-submarine warfare testing (active sonar, underwater detonations)
  - Mine warfare testing (active sonar, underwater detonations)
  - Ship protection systems and swimmer defense testing (active sonar, airguns)
  - Unmanned vehicle testing (active sonar)
  - Other testing (active sonar)
- Space and Naval Warfare Systems Commands (SPAWAR) Testing
  - SPAWAR research, development, test, and evaluation (active sonar)
- Office of Naval Research (ONR) and Naval Research Laboratory (NRL) Testing
  - ONR/NRL research, development, test, and evaluation (active sonar)

Other Navy testing activities do not involve stressors that could result in marine mammal harassment. Therefore, these activities are not discussed further.

Naval Air Systems Command Testing (NAVAIR)

NAVAIR events include testing of new aircraft platforms, weapons, and systems before delivery to the fleet for training activities. NAVAIR also conducts lot acceptance testing of weapons and systems, such as sonobuoys. In general, NAVAIR conducts its testing activities the same way the fleet conducts its training activities. However, NAVAIR testing activities may occur in different locations than equivalent fleet training activities and testing of a particular system may differ slightly from the way the fleet trains with the same system.

Anti-surface Warfare Testing—Anti-surface warfare testing includes air-to-surface gunnery, missile, and rocket exercises. Testing is required to ensure the equipment is fully functional for defense from surface threats. Testing may be conducted on new guns or run rounds, missiles, rockets, and aircraft, and also in support of scientific research to assess new and emerging technologies. Testing events are often integrated into training activities and in most cases the systems are used in the same manner in which they are used for fleet training activities.

Anti-submarine Warfare Testing—Anti-submarine warfare testing addresses basic skills such as detection and classification of submarines, distinguishing between sounds made by enemy submarines and those of friendly submarines, ships, and marine life. More advanced, integrated anti-submarine warfare testing is conducted in coordinated, at-sea training events involving submarines, ships, and aircraft. This testing integrates the full spectrum of anti-submarine warfare from detecting and tracking a submarine to attacking a target using various torpedoes and weapons.

Mine Warfare Testing—Mine warfare testing includes activities in which aircraft detection systems are used to search for and record the location of mines for subsequent neutralization. Mine neutralization tests evaluate a system's effectiveness at intentionally detonating or otherwise disabling the mine. Different mine neutralization systems are designed to neutralize mines either at the sea surface or deployed deeper within the water column. All components of these systems are tested in the at-sea environment to ensure they meet mission requirements.

Naval Sea Systems Command Testing (NAVSEA)

NAVSEA testing activities are aligned with its mission of new ship construction, life cycle support, and other weapon systems development and testing.

New Ship Construction Activities—Ship construction activities include pierside testing of ship systems, tests to determine how the ship performs at sea (sea trials), and developmental and operational test and evaluation programs for new technologies and systems. Pierside and at-sea testing of systems aboard a ship may include sonar, acoustic countermeasures, radars, and radio equipment. During sea trials, each new ship propulsion engine is operated at full power and subjected to high-speed runs and steering tests. At-sea test firing of shipboard weapon systems, including guns, torpedoes, and missiles, are also conducted.

Life Cycle Activities—Testing activities are conducted throughout the life of a Navy ship to verify performance and mission capabilities. Sonar system testing occurs pierside during maintenance, repair, and overhaul availabilities, and at sea immediately following most major overhaul periods. A Combat System Ship Qualification

Trial is conducted for new ships and for ships that have undergone modification or overhaul of their combat systems. Radar cross signature testing of surface ships is conducted on new vessels and periodically throughout a ship's life to measure how detectable the ship is by radar. Electromagnetic measurements of off-board electromagnetic signature are also conducted for submarines, ships, and surface craft periodically.

Other Weapon Systems Development and Testing—Numerous test activities and technical evaluations, in support of NAVSEA's systems development mission, often occur with fleet activities within the Study Area. Tests within this category include, but are not limited to, anti-surface, anti-submarine, and mine warfare, using torpedoes, sonobuoys, and mine detection and neutralization systems.

Space and Naval Warfare Systems Command Testing (SPAWAR)

The mission of SPAWAR is to acquire, develop, deliver, and sustain decision superiority for the warfighter at the right time and for the right cost. SPAWAR Systems Center Pacific is the research and development part of SPAWAR focused on developing and transitioning technologies in the area of command, control, communications, computers, intelligence, surveillance, and reconnaissance. SPAWAR Systems Center Pacific conducts research, development, test, and evaluation projects to support emerging technologies for intelligence, surveillance, and reconnaissance; anti-terrorism and force protection; mine countermeasures; anti-submarine warfare; oceanographic research; remote sensing; and communications. These activities include, but are not limited to, the testing of unmanned undersea and surface vehicles, a wide variety of intelligence, surveillance, and reconnaissance sensor systems, underwater surveillance technologies, and underwater communications.

Office of Naval Research and Naval Research Laboratory Testing (ONR and NRL)

As the Navy's science and technology provider, ONR and NRL provide technology solutions for Navy and Marine Corps needs. ONR's mission is to plan, foster, and encourage scientific research in recognition of its paramount importance as related to the maintenance of future naval power, and the preservation of national security. Further, ONR manages the Navy's basic, applied, and advanced research to foster transition from science and technology to higher levels of research, development, test, and evaluation. The Ocean Battlespace Sensing Department explores science and technology in the areas of oceanographic and meteorological observations, modeling, and prediction in the battlespace environment; submarine detection and classification (anti-submarine warfare); and mine warfare applications for detecting and neutralizing mines in both the ocean and littoral environment. ONR events include research, development, test, and evaluation activities; surface processes acoustic communications experiments; shallow water acoustic communications experiments; sediment acoustics experiments; shallow water acoustic propagation experiments; and long range acoustic propagation experiments.

Sonar, Ordnance, Targets, and Other Systems

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

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

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

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

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

- Towed or hull-mounted mine detection systems. These detection systems use acoustic and laser or video sensors to locate and classify suspect mines. Fixed and rotary wing platforms, ships, and unmanned vehicles are used for towed systems, which can rapidly assess large areas.

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

• Marine mammal systems. The Navy deploys trained Atlantic bottlenose dolphins (*Tursiops truncatus*) and California sea lions (*Zalopus californianus*) for integrated training involving two primary mission areas: to find objects such as inert mine shapes, and to detect swimmers or other intruders around Navy facilities such as piers. These systems also include one or more motorized small boats and several crew members for each trained marine mammal. When not engaged in training, Navy marine mammals are housed in temporary enclosures either on land or aboard ships.

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

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

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

• Airborne projectile-based mine clearance systems. These systems neutralize mines by firing a small or medium-caliber non-explosive, supercavitating projectile from a hovering helicopter.

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

Classification of Non-Impulsive and Impulsive Sources Analyzed

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

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

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

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

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

• Provides a framework to support the reallocation of source usage (hours/explosives) between different source bins, as long as the total number and severity of marine mammal takes remain within the overall analyzed and authorized limits. This flexibility is required to support evolving Navy training and testing requirements, which are linked to real world events.

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

• Frequency of the non-impulsive source:

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

  ○ Mid-frequency sources operate at or above 1 kHz, up to and including 10 kHz

  ○ High-frequency sources operate above 10 kHz, up to and including 100 kHz

  ○ Very high-frequency sources operate above 100, but below 200 kHz

• Source level of the non-impulsive source:

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

  ○ Equal to 180 dB and up to 200 dB

  ○ Greater than 200 dB

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

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

TABLE 1—IMPULSIVE TRAINING AND TESTING SOURCE CLASSES ANALYZED

Source class	Representative munitions	Net explosive weight (lbs)
E1	Medium-caliber projectiles	0.1–0.25 (45.4–113.4 g)
E2	Medium-caliber projectiles	0.26–0.5 (117.9–226.8 g)
E3	Large-caliber projectiles	>0.5–2.5 (>226.8 g–1.1 kg)
E4	Improved Extended Echo Ranging Sonobuoy	>2.5–5.0 (1.1–2.3 kg)
E5	5 in. (12.7 cm) projectiles	>5–10 (>2.3–4.5 kg)
E6	15 lb. (6.8 kg) shaped charge	>10–20 (>4.5–9.1 kg)
E7	40 lb. (18.1 kg) demo block/shaped charge	>20–60 (>9.1–27.2 kg)
E8	250 lb. (113.4 kg) bomb	>60–100 (>27.2–45.4 kg)
E9	500 lb. (226.8 kg) bomb	>100–250 (>45.4–113.4 kg)
E10	1,000 lb. (453.6 kg) bomb	>250–500 (>113.4–226.8 kg)
E11	650 lb. (294.8 kg) mine	>500–650 (>226.8–294.8 kg)
E12	2,000 lb. (907.2 kg) bomb	>650–1,000 (>294.8–453.6 kg)
E13	1,200 lb. (544.3 kg) HBX charge	>1,000–1,740 (>453.6–789.3 kg)

TABLE 2—NON-IMPULSIVE TRAINING SOURCE CLASSES ANALYZED

Source class category	Source class	Description
Mid-Frequency (MF): Tactical and non-tactical sources that produce mid-frequency (1 to 10 kHz) signals.	MF1	Active hull-mounted surface ship sonar (e.g., AN/SQS–53C and AN/SQS–60).
	MF1K	Kingfisher object avoidance mode associated with MF1 sonar.
	MF2	Active hull-mounted surface ship sonar (e.g., AN/SQS–56).
	MF2K	Kingfisher mode associated with MF2 sonar.
	MF3	Active hull-mounted submarine sonar (e.g., AN/BQQ–10).
	MF4	Active helicopter-deployed dipping sonar (e.g., AN/AQS–22 and AN/AQS–13).
	MF5	Active acoustic sonobuoys (e.g., AN/SSQ–62 DICASS).
	MF6	Active underwater sound signal devices (e.g., MK–84).
	MF11	Hull-mounted surface ship sonar with an active duty cycle greater than 80%.
	MF12	High duty cycle—variable depth sonar.
High-Frequency (HF) and Very High-Frequency (VHF): Tactical and non-tactical sources that produce high-frequency (greater than 10 kHz but less than 200 kHz) signals.	HF1	Active hull-mounted submarine sonar (e.g., AN/BQQ–15).
	HF4	Active mine detection, classification, and neutralization sonar (e.g., AN/SQS–20).
Anti-Submarine Warfare (ASW): Tactical sources such as active sonobuoys and acoustic countermeasures systems used during ASW training activities.	ASW1	MF active Deep Water Active Distributed System (DWADS).
	ASW2	MF active Multistatic Active Coherent (MAC) sonobuoy (e.g., AN/SSQ–125).
	ASW3	MF active towed active acoustic countermeasure systems (e.g., AN/SLQ–25 NIXIE).
	ASW4	MF active expendable active acoustic device countermeasures (e.g., MK–3).
Torpedoes (TORP): Source classes associated with active acoustic signals produced by torpedoes.	TORP1	HF active lightweight torpedo sonar (e.g., MK–46, MK–54, or Anti-Torpedo Torpedo).
	TORP2	HF active heavyweight torpedo sonar (e.g., MK–48).

TABLE 3—NON-IMPULSIVE TESTING SOURCE CLASSES ANALYZED

Source class category	Source class	Description
Low-Frequency (LF): Sources that produce low-frequency (less than 1 kilohertz [kHz]) signals.	LF4	Low-frequency sources equal to 180 dB and up to 200 dB.
	LF5	Low-frequency sources less than 180 dB.
	LF6	Low-frequency sonar currently in development (e.g., anti-submarine warfare sonar associated with the Littoral Combat Ship).
Mid-Frequency (MF): Tactical and non-tactical sources that produce mid-frequency (1 to 10 kHz) signals.	MF1	Hull-mounted surface ship sonar (e.g., AN/SQS–53C and AN/SQS–60).
	MF1K	Kingfisher mode associated with MF1 sonar (Sound Navigation and Ranging).
	MF2	Hull-mounted surface ship sonar (e.g., AN/SQS–56).
	MF3	Hull-mounted submarine sonar (e.g., AN/BQQ–10).
	MF4	Helicopter-deployed dipping sonar (e.g., AN/AQS–22 and AN/AQS–13).
	MF5	Active acoustic sonobuoys (e.g., DICASS).
	MF6	Active underwater sound signal devices (e.g., MK–84).
	MF8	Active sources (greater than 200 dB).
	MF9	Active sources (equal to 180 dB and up to 200 dB).
	MF10	Active sources (greater than 160 dB, but less than 180 dB) not otherwise binned.
	MF12	High duty cycle—variable depth sonar.
High-Frequency (HF) and Very High-Frequency (VHF): Tactical and non-tactical sources that produce high-frequency (greater than 10 kHz but less than 200 kHz) signals.	HF1	Hull-mounted submarine sonar (e.g., AN/BQQ–10).
	HF3	Hull-mounted submarine sonar (classified).
	HF4	Mine detection, classification, and neutralization sonar (e.g., AN/SQS–20).
	HF5	Active sources (greater than 200 dB).
	HF6	Active sources (equal to 180 dB and up to 200 dB).
Anti-Submarine Warfare (ASW): Tactical sources such as active sonobuoys and acoustic countermeasures systems used during the conduct of anti-submarine warfare testing activities.	ASW1	Mid-frequency Deep Water Active Distributed System (DWADS).
	ASW2	Mid-frequency Multistatic Active Coherent sonobuoy (e.g., AN/SSQ–125).
	ASW2H	Mid-frequency sonobuoy (e.g., high duty cycle)—Sources that are analyzed by hours.
	ASW3	Mid-frequency towed active acoustic countermeasure systems (e.g., AN/SLQ–25).
	ASW4	Mid-frequency expendable active acoustic device countermeasures (e.g., MK–3).

TABLE 3—NON-IMPULSIVE TESTING SOURCE CLASSES ANALYZED—Continued

Source class category	Source class	Description
Torpedoes (TORP): Source classes associated with the active acoustic signals produced by torpedoes.	TORP1	Lightweight torpedo (e.g., MK–46, MK–54, or Surface Ship Defense System).
	TORP2	Heavyweight torpedo (e.g., MK–48).
Acoustic Modems (M): Systems used to transmit data acoustically through water.	M3	Mid-frequency acoustic modems (greater than 190 dB).
Swimmer Detection Sonar (SD): Systems used to detect divers and submerged *swimmers*.	SD1–SD2	High-frequency sources with short pulse lengths, used for the detection of swimmers and other objects for the purpose of port security.
Airguns (AG): Underwater airguns are used during swimmer defense and diver deterrent training and testing activities.	AG	Up to 60 cubic inch airguns (e.g., Sercel Mini-G).
Synthetic Aperture Sonar (SAS): Sonar in which active acoustic signals are post-processed to form high-resolution images of the seafloor.	SAS1	MF SAS systems.
	SAS2	HF SAS systems.
	SAS3	VHF SAS systems.

Proposed Action

The Navy proposes to continue conducting training and testing activities within the HSTT Study Area. The Navy has been conducting military readiness training and testing activities in the HSTT Study Area since the 1940s. Recently, these activities were analyzed in three separate EISs completed between 2008 and 2011; the Hawaii Range Complex (HRC) EIS/OEIS (U.S. Department of the Navy 2008a), the SOCAL Range Complex EIS/OEIS (U.S. Department of the Navy 2008b), and the Silver Strand Training Complex (SSTC) EIS (U.S. Department of the Navy 2011a). These documents, among others, and their associated MMPA regulations and authorizations, describe the baseline of training and testing activities currently conducted in the Study Area.

The tempo and types of training and testing activities have fluctuated due to changing requirements; the introduction of new technologies; the dynamic nature of international events; advances in warfighting doctrine and procedures; and changes in basing locations for ships, aircraft, and personnel (force structure changes). Such developments have influenced the frequency, duration, intensity, and location of required training and testing.

Training

The Navy proposes to conduct training activities in the Study Area as described in Tables 4 and 5. Detailed information about each proposed activity (stressor, training event, description, sound source, duration, and geographic location) can be found in Appendix A of the HSTT DEIS/OEIS. NMFS used the detailed information in Appendix A of the HSTT DEIS/OEIS to analyze the potential impacts to marine mammals. Table 4 describes the annual number of impulsive source detonations during testing activities within the HSTT Study Area, and Table 5 describes the annual number of hours or items of non-impulsive sources used during training within the HSTT Study Area. The Navy's proposed action is an adjustment to existing baseline training activities to accommodate the following:

- Force structure changes including the relocation of ships, aircraft, and personnel;
- Planned new aircraft platforms, new vessel classes, and new weapons systems;
- Ongoing training activities that were not addressed in previous documentation; and
- New range capabilities, such as hydrophone modifications, upgrades, and replacement at instrumented Navy underwater tracking ranges.

TABLE 4—PROPOSED ANNUAL NUMBER OF IMPULSIVE SOURCE DETONATIONS DURING TRAINING IN THE HSTT STUDY AREA

Explosive class	Net explosive weight (NEW)	Annual in-water detonations (training)
E1	(0.1 lb.–0.25 lb.)	19,840
E2	(0.26 lb.–0.5 lb.)	1,044
E3	(0.6 lb.–2.5 lb.)	3,020
E4	(>2.5 lb.–5 lb.)	668
E5	(>5 lb.–10 lb.)	8,154
E6	(>10 lb.–20 lb.)	538
E7	(>20 lb.–60 lb.)	407
E8	(>60 lb.–100 lb.)	64
E9	(>100 lb.–250 lb.)	16
E10	(>250 lb.–500 lb.)	19
E11	(>500 lb.–650 lb.)	8
E12	(>650 lb.–1000 lb.)	224
E13	(>1000 lb.–1,740 lb.)	9

TABLE 5—ANNUAL HOURS AND ITEMS OF NON-IMPULSIVE SOURCES USED DURING TRAINING WITHIN THE HSTT STUDY AREA

Source class category	Source class	Annual use
Mid-Frequency (MF) Active sources from 1 to 10 kHz	MF1	11,588 hours.
	MF1K	88 hours.
	MF2	3,060 hours.
	MF2K	34 hours.
	MF3	2,336 hours.
	MF4	888 hours.
	MF5	13,718 items.
	MF11	1,120 hours.
	MF12	1,094 hours.
High-Frequency (HF) and Very High-Frequency (VHF) tactical and non-tactical sources that produce signals greater than 10kHz but less than 200 kHz.	HF1	1,754 hours.
	HF4	4,848 hours.
Anti-Submarine Warfare (ASW)	ASW1	224 hours.
Active ASW sources	ASW2	1,800 items.
	ASW3	16,561 hours.
	ASW4	1,540 items.
Torpedoes (TORP)	TORP1	170 items.
Active torpedo sonar	TORP2	400 items.

Testing

The Navy's proposed testing activities are described in Tables 6 and 7. Detailed information about each proposed activity (stressor, testing event, description, sound source, duration, and geographic location) can be found in Appendix A of the HSTT DEIS/OEIS. NMFS used the detailed information in Appendix A of the HSTT DEIS/OEIS to analyze the potential impacts from testing activities on marine mammals. Table 6 describes the annual number of impulsive source detonations during testing activities within the HSTT Study Area, and Table 7 describes the annual number of hours or items of non-impulsive sources used during testing within the HSTT Study Area.

TABLE 6—PROPOSED ANNUAL NUMBER OF IMPULSIVE SOURCE DETONATIONS DURING TESTING ACTIVITIES WITHIN THE HSTT STUDY AREA

Explosive class	Net explosive weight (NEW)	Annual in-water detonations (testing)
E1	(0.1 lb.–0.25 lb.)	14,501
E2	(0.26 lb.–0.5 lb.)	0
E3	(0.6 lb.–2.5 lb.)	2,990
E4	(>2.5 lb.–5 lb.)	753
E5	(>5 lb.–10 lb.)	202
E6	(>10 lb.–20 lb.)	37
E7	(>20 lb.–60 lb.)	21
E8	(>60 lb.–100 lb.)	12
E9	(>100 lb.–250 lb.)	0
E10	(>250 lb.–500 lb.)	31
E11	(>500 lb.–650 lb.)	14
E12	(>650 lb.–1000 lb.)	0
E13	(>1000 lb.–1,740 lb.)	0

TABLE 7—ANNUAL HOURS AND ITEMS OF NON-IMPULSIVE SOURCES USED DURING TESTING WITHIN THE HSTT STUDY AREA

Source class category	Source class	Annual use
Low-Frequency (LF) Sources that produce signals less than 1 kHz.	LF4	52 hours.
	LF5	2,160 hours.
	LF6	192 hours.
Mid-Frequency (MF) Tactical and non-tactical sources that produce signals from 1 to 10 kHz.	MF1	180 hours.
	MF1K	18 hours.
	MF2	84 hours.
	MF3	392 hours.
	MF4	693 hours.
	MF5	5,024 items.

TABLE 7—ANNUAL HOURS AND ITEMS OF NON-IMPULSIVE SOURCES USED DURING TESTING WITHIN THE HSTT STUDY AREA—Continued

Source class category	Source class	Annual use
	MF6	540 items.
	MF8	2 hours.
	MF9	3,039 hours.
	MF10	35 hours.
	MF12	336 hours.
High-Frequency (HF) and Very High-Frequency (VHF): Tactical and non-tactical sources that produce signals greater than 10kHz but less than 200kHz.	HF1	1,025 hours.
	HF3	273 hours.
	HF4	1,336 hours.
	HF5	1,094 hours.
	HF6	3,460 hours.
Anti-Submarine Warfare (ASW) Tactical sources used during anti-submarine warfare training and testing activities.	ASW1	224 hours.
	ASW2	2,260 items.
	ASW2H	255 hours.
	ASW3	1,278 hours.
	ASW4	477 items.
Torpedoes (TORP) Source classes associated with active acoustic signals produced by torpedoes.	TORP1	701 items.
	TORP2	732 items.
Acoustic Modems (M) Transmit data acoustically through the water.	M3	4,995 hours.
Swimmer Detection Sonar (SD) Used to detect divers and submerged swimmers.	SD1	38 hours.
Airguns (AG) Used during swimmer defense and diver deterrent training and testing activities.	AG	5 uses.
Synthetic Aperture Sonar (SAS): Sonar in which active acoustic signals are post-processed to form high-resolution images of the seafloor.	SAS1	2,700 hours.
	SAS2	4,956 hours.
	SAS3	3,360 hours.

Vessels

Vessels used as part of the proposed action include ships, submarines, boats, and Unmanned Undersea Vehicles (UUVs) ranging in size from small, 5-m Rigid Hull Inflatable Boats to 333-m long aircraft carriers. Representative Navy vessel types, lengths, and speeds used in both training and testing activities are shown in Table 8. While these speeds are representative, some vessels operate outside of these speeds due to unique training or safety requirements for a given event. Examples include increased speeds needed for flight operations, full speed runs to test engineering equipment, time critical positioning needs, etc. Examples of decreased speeds include speeds less than 5 knots or completely stopped for launching small boats, certain tactical maneuvers, target launch or retrievals, UUVs etc.

The number of Navy vessels in the HSTT Study Area varies based on training and testing schedules. Most activities include either one or two vessels, with an average of one vessel per activity, and last from a few hours up to two weeks. Multiple ships, however, can be involved with major training events. Vessel movement and the use of in-water devices as part of the proposed action would be concentrated in portions of the Study Area within SOCAL, naval installations at San Diego and Pearl Harbor, and on instrumented underwater ranges. Surface and sub-surface vessel operations in the Study Area may result in marine mammal strikes.

TABLE 8—TYPICAL NAVY BOAT AND VESSEL TYPES WITH LENGTH GREATER THAN 18 METERS USED WITHIN THE HSTT STUDY AREA

Vessel type (>18 m)	Example(s) (specifications in meters (m) for length, metric tons (mt) for mass, and knots for speed)	Typical operating speed (knots)
Aircraft Carrier	Aircraft Carrier (CVN) length: 333 m beam: 41 m draft: 12 m displacement: 81,284 mt max. speed: 30+ knots.	10 to 15.
Surface Combatants	Cruiser (CG) length: 173 m beam: 17 m draft: 10 m displacement: 9,754 mt max. speed: 30+ knots.	10 to 15.
	Destroyer (DDG) length: 155 m beam: 18 m draft: 9 m displacement: 9,648 mt max. speed: 30+ knots.	
	Frigate (FFG) length: 136 m beam: 14 m draft: 7 m displacement: 4,166 mt max. speed: 30+ knots.	
	Littoral Combat Ship (LCS) length: 115 m beam: 18 m draft: 4 m displacement: 3,000 mt max. speed: 40+ knots.	

TABLE 8—TYPICAL NAVY BOAT AND VESSEL TYPES WITH LENGTH GREATER THAN 18 METERS USED WITHIN THE HSTT STUDY AREA—Continued

Vessel type (>18 m)	Example(s) (specifications in meters (m) for length, metric tons (mt) for mass, and knots for speed)	Typical operating speed (knots)
Amphibious Warfare Ships	Amphibious Assault Ship (LHA, LHD) length: 253 m beam: 32 m draft: 8 m displacement: 42,442 mt max. speed: 20+ knots. Amphibious Transport Dock (LPD) length: 208 m beam: 32 m draft: 7 m displacement: 25,997 mt max. speed: 20+ knots. Dock Landing Ship (LSD) length: 186 m beam: 26 m draft: 6 m displacement: 16,976 mt max. speed: 20+ knots.	10 to 15.
Mine Warship Ship	Mine Countermeasures Ship (MCM) length: 68 m beam: 12 m draft: 4 m displacement: 1,333 max. speed: 14 knots.	5 to 8.
Submarines	Attack Submarine (SSN) length: 115 m beam: 12 m draft: 9 m displacement: 12,353 mt max. speed: 20+ knots. Guided Missile Submarine (SSGN) length: 171 m beam: 13 m draft: 12 m displacement: 19,000 mt max. speed: 20+ knots.	8 to 13.
Combat Logistics Force Ships*	Fast Combat Support Ship (T–AOE) length: 230 m beam: 33 m draft: 12 m displacement: 49,583 mt max. speed: 25 knots. Dry Cargo/Ammunition Ship (T–AKE) length: 210 m beam: 32 m draft: 9 m displacement: 41,658 mt max speed: 20 knots. Fleet Replenishment Oilers (T–AO) length: 206 m beam: 30 m draft: 11 displacement: 42,674 mt max. speed: 20 knots. Fleet Ocean Tugs (T–ATF) length: 69 m beam: 13 m draft: 5 m displacement: 2,297 max. speed: 14 knots.	8 to 12.
Support Craft/Other	Landing Craft, Utility (LCU) length: 41m beam: 9 m draft: 2 m displacement: 381 mt max. speed: 11 knots. Landing Craft, Mechanized (LCM) length: 23 m beam: 6 m draft: 1 m displacement: 107 mt max. speed: 11 knots.	3 to 5.
Support Craft/Other Specialized High Speed	MK V Special Operations Craft length: 25 m beam: 5 m displacement: 52 mt max. speed: 50 knots.	Variable.

*CLF vessels are not homeported in Pearl Harbor or San Diego, but are frequently used for various fleet support and training support events in the HSTT Study Area.

Duration and Location

Training and testing activities would be conducted in the HSTT Study Area from January 2014 through January 2019. The HSTT Study Area is comprised of established operating and warning areas across the north-central Pacific Ocean, from Southern California to Hawaii and the International Date Line. The defined Study Area has expanded beyond the areas included in previous Navy authorizations to include transit routes and pierside locations. This expansion is not an increase in the Navy's training and testing area, but rather an increase in the area to be analyzed (i.e., not previously analyzed) under an incidental take authorization in support of the HSTT EIS/OEIS. The Study Area includes three existing range complexes: the Hawaii Range Complex (HRC), the Southern California (SOCAL) Range Complex, and the Silver Strand Training Complex (SSTC). Each range complex is an organized and designated set of specifically bounded geographic areas, which includes a water component (above and below the surface), airspace, and sometimes a land component. Operating areas (OPAREAs) and special use airspace are established within each range complex. These designations are further described in Chapter 2 of the Navy's LOA application. In addition to Navy range complexes, the Study Area includes Navy pierside locations where sonar maintenance and testing activities occur (San Diego Bay, Pearl Harbor) and transit corridors on the high seas where training and sonar testing may occur during vessel transit.

Hawaii Range Complex (HRC)—The HRC geographically encompasses ocean areas located around the Hawaiian Islands chain. The largest component of the HRC is the temporary operating area, which extends north and west from the island of Kauai and totals over 2 million square nautical miles (nm^2) of air and sea space. This area is used for Navy ship transit throughout the year and for missile defense testing activities as required to support missile defense testing activities. Nearly all of the training and testing activities within the HRC take place within the smaller Hawaii OPAREA, which consists of 235,000 nm^2 of special use airspace, and sea and undersea space. The Hawaii OPAREA is the portion of the range complex immediately surrounding the island chain of Hawaii. Military activities and exercises were excluded from the list of prohibitions triggered when the Monument was established in 2006, so long as the activities are "carried out in a manner that avoids, to the extent practicable and consistent with operational requirements, adverse impacts on monument resources and qualities." More detailed information on the HRC, including maps, is provided in Chapter 2 of the Navy's LOA application (*http://www.nmfs.noaa.gov/pr/permits/incidental.htm#applications*).

Southern California (SOCAL) Range Complex—The SOCAL Range Complex is situated between Dana Point and San Diego, and extends more than 600 nm southwest into the Pacific Ocean. The two primary components of the SOCAL Range Complex are the ocean operating areas and the special use airspace. The SOCAL Range Complex includes San Diego Bay and a small portion of the Point Mugu Sea Range. The Silver Strand Training Complex is also included as part of the Southern California portion for this application. More detailed information on the SOCAL Range Complex, including maps, is provided in Chapter 2 of the Navy's LOA application (*http://www.nmfs.noaa.gov/pr/permits/incidental.htm#applications*).

Transit Corridor—In addition to the three range complexes, a transit corridor outside the bounds of existing range complexes is included in the Navy's request. This transit corridor is important to the Navy in that it provides adequate air, sea, and undersea space in which ships and aircraft can conduct training and some sonar maintenance and testing while en route between Southern California and Hawaii. The transit corridor is an area encompassing the shortest distance from San Diego to the center of the HRC. While in transit, ships and aircraft would, at times, conduct basic and routine unit level training as long as the training does not interfere with the primary objective of reaching their intended destination. Ships would also conduct sonar maintenance, which includes active sonar transmissions. The portion of the transit corridor to the east of 140° west longitude is included in the analysis of SOCAL activities and the area to the west of that meridian is included in the analysis of HRC activities since these portions of the corridor correspond with the marine mammal stocks in those range complexes.

Pierside Locations—The Study Area also includes select pierside locations where Navy surface ship and submarine sonar maintenance testing occur. These pierside locations include channels and transit routes in ports, and facilities associated with ports and shipyards at Navy piers in San Diego, California, and Navy piers, shipyards, and the Intermediate Maintenance Facility in Pearl Harbor, Hawaii.

Description of Marine Mammals in the Area of the Specified Activities

Thirty-nine marine mammal species are known to occur in the Study Area, including seven mysticetes (baleen whales), 25 odontocetes (dolphins and toothed whales), six pinnipeds (seals and sea lions), and the Southern sea otter. Among these species, there are 72 stocks managed by NMFS or the U.S. Fish and Wildlife Service (USFWS) in the U.S. Exclusive Economic Zone (EEZ). These species and their numbers are presented in Table 9 and relevant information on their status, distribution, and seasonal distribution (when applicable) is presented in Chapter 4 of the Navy's LOA application (*http://www.nmfs.noaa.gov/pr/permits/incidental.htm#applications*). Consistent with NMFS most recent Pacific Stock Assessment Report, a single species may include multiple stocks recognized for management purposes (e.g., spinner dolphin), while other species are grouped into a single stock due to limited species-specific information (e.g., beaked whales belonging to the genus *Mesoplodon*).

Species that may have once inhabited and transited the Study Area, but have not been sighted in recent years, include the North Pacific right whale (*Eubalaena japonica*), harbor porpoise (*Phocoena phocoena*), and Steller sea lion (*Eumetopias jubatus*). These species are not expected to be exposed to or affected by any project activities and, therefore, are not discussed further.

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

Common name	Scientific name	Study area	Stock	Stock abundance CV	Study area abundance (CV)	Occurrence in study area	ESA/MMPA Status
Order Cetacea Suborder Mysticeti (Baleen Whales)							
Family Balaenopteridae (Rorquals)							
Humpback whale	*Megaptera novaeangliae.*	SOCAL	California, Oregon, & Washington.	2,043 −0.1	36 −0.51	Seasonal; More sightings around the northern Channel Islands.	Endangered/Depleted.
		HRC	Central North Pacific.	10,103 (N/A)	4,491 (N/A)	Seasonal; Throughout known breeding grounds during winter and spring (most common November through April).	Endangered/Depleted.
Blue whale	*Balaenoptera musculus.*	SOCAL	Eastern North Pacific.	2,497 −0.24	842 −0.2	Seasonal; arrive April–May; more common late summer to fall.	Endangered/Depleted.
		HRC	Central North Pacific.	No data.	No data.	Seasonal; infrequent winter migrant; few sightings.	Endangered/Depleted.
Fin whale	*Balaenoptera physalus.*	SOCAL	California, Oregon, & Washington.	3,044 −0.18	359 −0.4	Year-round presence.	Endangered/Depleted.
		HRC	Hawaiian	174 −0.72	174 −0.72	Seasonal; mainly fall and winter although considered rare in HRC.	Endangered/Depleted.
Sei whale	*Balaenoptera borealis.*	SOCAL	Eastern North Pacific.	126 −0.53	7 −1.07	Rare; infrequently sighted in California. Only nine confirmed sightings on WA/OR/CA surveys from 1991–2008.	Endangered/Depleted.

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

Common name	Scientific name	Study area	Stock	Stock abundance CV	Study area abundance (CV)	Occurrence in study area	ESA/MMPA Status
		HRC	Hawaiian	77 −1.06	77 −1.06	Rare; limited sightings of seasonal migrants that feed at higher latitudes.	Endangered/Depleted.
Bryde's whale	*Balaenoptera edeni*.	SOCAL	Eastern Tropical Pacific.	13,000 −0.2	7 −1.07	Limited summer occurrence.	
		HRC	Hawaiian	469 −0.45	469 −0.45	Uncommon; distributed throughout the Hawaii Exclusive Economic Zone.	
Minke whale	*Balaenoptera acutorostrata*.	SOCAL	California, Oregon, & Washington.	478 −1.36	226 −1.02	Less common in summer; small numbers around northern Channel Islands.	
		HRC	Hawaiian	No data.	No data.	Regular but seasonal occurrence (November–March).	
Family Eschrichtiidae (Gray Whale)							
Gray whale	*Eschrichtius robustus*.	SOCAL	Eastern North Pacific.	18,813 −0.07	Population migrates through SOCAL	Transient during seasonal migrations.	
		HRC	No known occurrence				
Suborder Odontoceti (Toothed Whales)							
Family Physeteridae (Sperm Whale)							
Sperm whale	*Physeter macrocephalus*.	SOCAL	California, Oregon, & Washington.	971 −0.31	607 −0.57	Common year round; more likely in waters > 1,000 m, most often > 2,000 m.	Endangered/Depleted.
		HRC	Hawaiian	6,919 −0.81	6,919 −0.81	Widely distributed year round; more likely in waters > 1,000 m, most often > 2,000 m.	Endangered/Depleted.
Family Kogiidae (Pygmy and Dwarf Sperm Whale)							
Pygmy sperm whale.	*Kogia breviceps*	SOCAL	California, Oregon, & Washington.	579 −1.02		Seaward of 500–1000 m; limited sightings over entire Southern Cal. Bight.	
	HRC	Hawaiian	7,138 −1.12	7,138 −1.12	Stranding numbers suggest this species is more common than infrequent sightings during survey (Barlow 2006) indicated.		
Dwarf sperm whale.	*Kogia sima*	SOCAL	California, Oregon, & Washington.	Unknown		Seaward of 500–1000 m; no confirmed sightings over entire Southern Cal. Bight (all Kogia spp. or Kogia breviceps).	

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

Common name	Scientific name	Study area	Stock	Stock abundance CV	Study area abundance (CV)	Occurrence in study area	ESA/MMPA Status
		HRC	Hawaiian	17,519 −0.74	17,519 −0.74	Stranding numbers suggest this species is more common than infrequent sightings during survey (Barlow 2006) indicated.	
Family Delphinidae (Dolphins)							
Killer whale	*Orcinus orca*	SOCAL	Eastern North Pacific Offshore.	240 −0.49	30 −0.73	Uncommon; occurs infrequently; more likely in winter.	
		SOCAL	Eastern North Pacific Transient.	451 −0.49		Uncommon; occurs infrequently; more likely in winter.	
		HRC	Hawaiian	349 −0.98	349 −0.98	Uncommon; infrequent sightings.	
False killer whale	*Pseudorca crassidens*.	SOCAL	Eastern Tropical Pacific.	Unknown		Uncommon; warm water species; although stranding records from the Channel Islands.	
		HRC	Hawaii Insular [7],[8].	151 −0.2	151 −0.2	Regular	Endangered.
		HRC	Hawaii Pelagic [7]	1,503 −0.66	1,503 −0.66	Regular	
		HRC	Northwest Hawaiian Islands [7].	522 −1.09	522 −1.09	Regular	
Pygmy killer whale.	*Feresa attenuata*	SOCAL	Tropical	Unknown	Extralimital.	Extralimital within the south-west boundary of the SOCAL Range Complex.	
		HRC	Hawaiian	956 −0.83	956 −0.83	Year-round resident; abundance based on 3 sightings (Barlow 2006)..	
Short-finned pilot whale.	*Globicephala macrorhynchus*.	SOCAL	California, Oregon, & Washington.	760 −0.64	118 −1.04	Uncommon; more common before 1982.	
		HRC	Hawaiian	8,870 −0.38	8,870 −0.38	Commonly observed around main Hawaiian Islands and Northwestern Hawaiian Islands.	
Melon-headed whale.	*Peponocephala electra*.	SOCAL	No known occurrence				
		HRC	Hawaiian	2,950 −1.17	2,950 −1.17	Regular..	
Long-beaked common dolphin.	*Delphinus capensis*.	SOCAL	California	27,046 −0.59	17,530 −0.57	Common; more inshore distribution (within 50 nm of coast).	
		HRC	No known occurrence				
Short-beaked common dolphin.	*Delphinus delphis*.	SOCAL	California, Oregon, & Washington.	411,211 −0.21	165,400 −0.19	Common; one of the most abundant SOCAL dolphins; higher summer densities.	
		HRC	No known occurrence				

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

Common name	Scientific name	Study area	Stock	Stock abundance CV	Study area abundance (CV)	Occurrence in study area	ESA/MMPA Status
Bottlenose dolphin.	*Tursiops truncatus*.	SOCAL	California Coastal.	323 −0.13	323 −0.13	Limited, small population within 1 km of shore.	
		SOCAL	California, Oregon, & Washington Offshore.	1,006 −0.48	1,831 −0.47	Common	
		HRC	Hawaii Pelagic	3,178 −0.59	3,178 −0.59	Common in deep offshore waters.	
		HRC	Kauai and Niihau.	147 −0.11	147 −0.11	Common in shallow nearshore waters (1000 m or less).	
		HRC	Oahu	594 −0.54	594 −0.54	Common in shallow nearshore waters (1000 m or less).	
		HRC	4-Islands Region	153 −0.24	153 −0.24	Common in shallow nearshore waters (1000 m or less).	
		HRC	Hawaii Island	102 −0.13	102 −0.13	Common in shallow nearshore waters (1000 m or less).	
Pantropical spotted dolphin.	*Stenella attenuata*.	SOCAL	Eastern Tropical Pacific.	Unknown.		Rare; associated with warm tropical surface waters.	
		HRC	Hawaiian	8,978 −0.48	8,978 −0.48	Common; primary occurrence between 100 and 4,000 meters depth.	
Striped dolphin	*Stenella coeruleoalba*.	SOCAL	California, Oregon, & Washington.	10,908 −0.34	8,697 −0.34	Occasional visitor; warm water oceanic species.	
		HRC	Hawaiian	13,143 −0.46	13,143 −0.46	Occurs regularly year round but infrequent sighting data.	
Spinner dolphin	*Stenella longirostris*.	SOCAL	No known occurrence				
		HRC	Hawaii Pelagic	Unknown.	3,351 −0.74 for entire Hawaiian Islands Stock Complex	Common year round in offshore waters.	
		HRC	Hawaii Island	Unknown.	3,351 −0.74 for entire Hawaiian Islands Stock Complex	Common year round; rest in nearshore waters during the day and move offshore to feed at night.	
		HRC	Oahu/4-Islands	Unknown.	3,351 −0.74 for entire Hawaiian Islands Stock Complex	Common year round; rest in nearshore waters during the day and move offshore to feed at night.	
		HRC	Kauai/Niihau	Unknown.	3,351 −0.74 for entire Hawaiian Islands Stock Complex	Common year round; rest in nearshore waters during the day and move offshore to feed at night.	

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

Common name	Scientific name	Study area	Stock	Stock abundance CV	Study area abundance (CV)	Occurrence in study area	ESA/MMPA Status
		HRC	Pearl and Hermes Reef.	Unknown.	3,351 −0.74 for entire Hawaiian Islands Stock Complex	Common year round; rest in nearshore waters during the day and move offshore to feed at night.	
		HRC	Kure/Midway	Unknown.	3,351 −0.74 for entire Hawaiian Islands Stock Complex	Common year round; rest in nearshore waters during the day and move offshore to feed at night.	
Rough-toothed dolphin.	*Steno bredanensis*.	SOCAL	Tropical and warm temperate.	Unknown.		Rare; more tropical offshore species.	
		HRC	Hawaiian	8,709 −0.45	8,709 −0.45	Common throughout the main Hawaiian Islands and Hawaii Exclusive Economic Zone.	
Pacific white-sided dolphin.	*Lagenorhynchus obliquidens*.	SOCAL	California, Oregon, & Washington.	26,930 −0.28	2,196 −0.71	Common; year-round cool water species; more abundant November–April.	
		HRC	No known occurrence				
Northern right whale dolphin.	*Lissodelphis borealis*.	SOCAL	California, Oregon, & Washington.	8,334 −0.4	1,172 −0.52	Common; cool water species; more abundant November–April.	
		HRC	No known occurrence				
Fraser's dolphin	*Lagenodelphis hosei*.	SOCAL	No known occurrence				
		HRC	Hawaiian	10,226 −1.16	10,226 −1.16	Tropical species only recently documented within Hawaii Exclusive Economic Zone (2002 survey).	
Risso's dolphins	*Grampus griseus*	SOCAL	California, Oregon, & Washington.	6,272 −0.3	3,418 −0.31	Common; present in summer, but higher densities November–April.	
		HRC	Hawaiian	2,372 −0.97	2,372 −0.97	Have been considered rare but six sightings in Hawaii Exclusive Economic Zone during 2002 survey.	
Family Phocoenidae (Porpoises)							
Dall's porpoise ...	*Phocoenoidea dalli*.	SOCAL	California, Oregon, & Washington.	42,000 −0.33	727 −0.99	Common in cold water periods; more abundant November–April.	
		HRC	No known occurrence				

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

Common name	Scientific name	Study area	Stock	Stock abundance CV	Study area abundance (CV)	Occurrence in study area	ESA/MMPA Status
Family Ziphiidae (Beaked Whales)							
Cuvier's beaked whale.	*Ziphius cavirostris*.	SOCAL	California, Oregon, & Washington.	2,143 −0.65	911 −0.68	Possible year-round occurrence but difficult to detect due to diving behavior.	
		HRC	Hawaiian	15,242 −1.43	15,242 −1.43	Year-round occurrence but difficult to detect due to diving behavior.	
Baird's beaked whale.	*Berardius bairdii*	SOCAL	California, Oregon, & Washington.	907 −0.49	127 −1.14	Primarily along continental slope from late spring to early fall.	
		HRC	No known occurrence				
Longman's beaked whale.	*Indopacetus pacificus*.	SOCAL	No known occurrence				
		HRC	Hawaiian	1,007 −1.26	1,007 −1.26	One of the rarest and least known cetacean species; abundance based on Barlow 2006 with 3 sightings, however, multiple sightings during 2010 HICEAS.	
Blainville's beaked whale.	*Mesoplodon densirostris*.	SOCAL	California, Oregon, & Washington.	603 −1.16	132 (0.96; for Mesoplodon spp.).	Distributed throughout deep waters and continental slope regions; difficult to detect given diving behavior.	
		HRC	Hawaiian	2,872 −1.25	2,872 −1.25	Year-round occurrence but difficult to detect due to diving behavior.	
Mesoplodont beaked whales (SOCAL estimates also include Blainville's beaked whale listed separately above).	*Mesoplodon spp.*	SOCAL	California, Oregon, & Washington.	1,024 −0.77	132 −0.96	Distributed throughout deep waters and continental slope regions; difficult to detect given diving behavior. Limited sightings; generally seaward of 500–1000 m.	
		HRC	No known occurrence of five Mesoplodon species (M. carlhubbsi, M. ginkgodens, M. perrini, M. peruvianus, M. stejnegeri)				
Suborder Pinnipedia [9, 10]							
Family Otariidae (Fur Seals and Sea Lions)							
California sea lion.	*Zalophus californianus*.	SOCAL	U.S. Stock	238,000		Most common pinniped, Channel Islands breeding sites in summer.	
		HRC	No known occurrence				

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

Common name	Scientific name	Study area	Stock	Stock abundance CV	Study area abundance (CV)	Occurrence in study area	ESA/MMPA Status
Northern fur seal	*Callorhinus ursinus.*	SOCAL	San Miguel Island.	9,968	Stock is outside of SOCAL.	Common; small population breeds on San Miguel Island. May–October.	
		HRC	No known occurrence				
Guadalupe fur seal.	*Arctocephalus townsendi.*	SOCAL	Mexico	7,408		Rare; Occasional visitor to northern Channel Islands; mainly breeds on Guadalupe Island, Mexico, May–July.	Threatened/Depleted.
		HRC	No known occurrence				
Family Phocidae (True Seals)							
Hawaiian monk seal.	*Monachus schauinslandi.*	SOCAL	No known occurrence				
		HRC	Hawaiian	1,161	1,161	Predominantly occur at Northwestern Hawaiian Islands; approximately 150 in Main Hawaiian Islands.	Endangered/Depleted.
Northern elephant seal.	*Mirounga angustirostris.*	SOCAL	California Breeding.	124,000	SNI 9,794 pups in 2000. SCI up to 16 through 2000	Common; Channel Island haul-outs of different age classes; including SCI December–March and April–August; spend 8–10 months at sea.	
		HRC				Extralimital.	
Harbor seal	*Phoca vitulina*	SOCAL	California	34,233	5,271 (All age classes from aerial counts).	Common; Channel Islands haul-outs including SCI and La Jolla; bulk of stock found north of Pt. Conception.	
		HRC	No known occurrence				

Information on the status, distribution, abundance, and vocalizations of marine mammal species in the Study Area may be viewed in Chapter 4 of their LOA application (*http://www.nmfs.noaa.gov/pr/permits/incidental.htm#applications*). Further information on the general biology and ecology of marine mammals is included in the HSTT Draft EIS/OEIS. In addition, NMFS publishes annual stock assessment reports for marine mammals, including stocks that occur within the Study Area (*http://www.nmfs.noaa.gov/pr/species/mammals*).

Marine Mammal Hearing and Vocalizations

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

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

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

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

Marine Mammal Density Estimates

A quantitative analysis of impacts on a species requires data on the abundance and distribution of the species population in the potentially impacted area. One metric for performing this type of analysis is density, which is the number of animals present per unit area. The Navy compiled existing, publically available density data for use in the quantitative acoustic impact analysis. There is no single source of density data for every area of the world, species, and season because of the costs, resources, and effort required to provide adequate survey coverage to sufficiently estimate density. Therefore, to estimate marine mammal densities for large areas like the HSTT Study Area, the Navy compiled data from several sources. The Navy developed a hierarchy of density data sources to select the best available data based on species, area, and time (season). The resulting Geographic Information System database, called the Navy Marine Species Density Database, includes seasonal density values for every marine mammal species present within the HSTT Study Area (Navy, 2012).

The Navy Marine Species Density Database includes a compilation of the best available density data from several primary sources and published works including survey data from NMFS within the U.S. Exclusive Economic Zone. The Navy ranked their modeling methods as follows:

1. Density spatial model based estimates will be used when available (e.g., NMFS' Southwest Fisheries Science Center models for the California Current Ecosystem and the Central Pacific).

2. If no density spatial model based estimates are available, the following can be used in order of preference:

a. Density estimates using designed-based methods incorporating line-transect survey data and involving spatial stratification (i.e., estimates split by depth strata or arbitrary survey sub-regions).

b. Density estimates using designed-based methods incorporating only line-transect survey data (i.e., regional density estimate, stock assessment report).

c. Density estimates derived using a Relative Environmental Suitability (RES) model in conjunction with survey data from Sea Mammal Research Unit (SMRU) Ltd or in conjunction with a global population estimate from Kaschner *et al.'*s (2006) density data.

In some cases, extrapolation from neighboring regional density estimates or population/stock assessments is appropriate based on expert opinion. This is often preferred over using RES models because of discrepancies identified by local expert knowledge. This includes an extrapolation of no occurrence based on other sources of data such as the NMFS stock assessment reports or expert judgment. Additional information on the density data sources and how the database was applied to the HSTT Study Area is detailed in the Navy Marine Species Density Database Technical Report (*hstteis.com/DocumentsandReferences/HSTTDocuments/SupportingTechnicalDocuments.aspx*).

Brief Background on Sound

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

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

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

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

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

When considering the influence of various kinds of sound on the marine environment, it is necessary to understand that different kinds of marine life are sensitive to different frequencies of sound. Based on available behavioral data, audiograms derived using behavioral protocols or auditory evoked potential (AEP) techniques, anatomical modeling, and other data, Southall *et al.* (2007) designate ''functional hearing groups'' for marine mammals and estimate the lower and upper frequencies of functional hearing of the groups. Further, the frequency range in which each group's hearing is estimated as being most sensitive is represented in the flat part of the M-weighting functions (which are derived from the audiograms described above; see Figure 1 in Southall *et al.,* 2007) developed for each broad group. The functional groups and the associated frequencies are indicated below (though, again, animals are less sensitive to sounds at the outer edge of their functional range and most sensitive to sounds of frequencies within a smaller range somewhere in the middle of their functional hearing range):

- Low-frequency cetaceans—functional hearing is estimated to occur between approximately 7 Hz and 30 kHz;
- Mid-frequency cetaceans—functional hearing is estimated to occur between approximately 150 Hz and 160 kHz;
- High-frequency cetaceans—functional hearing is estimated to occur between approximately 200 Hz and 180 kHz;
- Pinnipeds in water—functional hearing is estimated to occur between approximately 75 Hz and 75 kHz.

The estimated hearing range for low-frequency cetaceans has been extended slightly from previous analyses (from 22 to 30 kHz). This decision is based on data from Watkins *et al.* (1986) for numerous mysticete species, Au *et al.* (2006) for humpback whales, an abstract from Frankel (2005) and paper from Lucifredi and Stein (2007) on gray whales, and an unpublished report (Ketten and Mountain, 2009) and abstract (Tubelli *et al.,* 2012) for minke whales. As more data from more species and/or individuals become available, these estimated hearing ranges may require modification.

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

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

Metrics Used in This Document

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

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

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

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

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

SEL = SPL + 10log(duration in seconds)

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

Potential Effects of Specified Activities on Marine Mammals

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

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

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

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

Non-Impulsive Sources

Direct Physiological Effects

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

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

The following physiological mechanisms are thought to play a role in inducing auditory TS: Effects to sensory hair cells in the inner ear that reduce their sensitivity, modification of the chemical environment within the sensory cells, residual muscular activity in the middle ear, displacement of certain inner ear membranes, increased blood flow, and post-stimulatory reduction in both efferent and sensory neural output (Southall *et al.,* 2007). The amplitude, duration, frequency, temporal pattern, and energy distribution of sound exposure all can affect the amount of associated TS and the frequency range in which it occurs. As amplitude and duration of sound exposure increase, so, generally, does the amount of TS, along with the recovery time. For intermittent sounds, less TS could occur than compared to a continuous exposure with the same energy (some recovery could occur between intermittent exposures depending on the duty cycle between sounds) (Kryter *et al.,* 1966; Ward, 1997). For example, one short but loud (higher SPL) sound exposure may induce the same impairment as one longer but softer sound, which in turn may cause more impairment than a series of several intermittent softer sounds with the same total energy (Ward, 1997). Additionally, though TTS is temporary, prolonged exposure to sounds strong enough to elicit TTS, or shorter-term exposure to sound levels well above the TTS threshold, can cause PTS, at least in terrestrial mammals (Kryter, 1985). Although in the case of mid- and high-frequency active sonar (MFAS/HFAS), animals are not expected to be exposed to levels high enough or durations long enough to result in PTS.

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

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

Marine mammal hearing plays a critical role in communication with conspecifics, and interpretation of environmental cues for purposes such as predator avoidance and prey capture. Depending on the degree (elevation of threshold in dB), duration (i.e., recovery time), and frequency range of TTS, and the context in which it is experienced, TTS can have effects on marine mammals ranging from discountable to serious (similar to those discussed in auditory masking, below). For example, a marine mammal may be able to readily compensate for a brief, relatively small amount of TTS in a non-critical frequency range that occurs during a time where ambient noise is lower and there are not as many competing sounds present. Alternatively, a larger amount and longer duration of TTS sustained during time when communication is critical for successful mother/calf interactions could have more serious impacts. Also, depending on the degree and frequency range, the effects of PTS on an animal could range in severity, although it is considered generally more serious because it is a permanent condition. Of note, reduced hearing sensitivity as a simple function of aging has been observed in marine mammals, as well as humans and other taxa (Southall *et al.,* 2007), so we can infer that strategies exist for coping with this condition to some degree, though likely not without cost.

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

It is unlikely that the short duration of sonar pings or explosion sounds would be long enough to drive bubble growth to any substantial size, if such a phenomenon occurs. However, an alternative but related hypothesis has also been suggested: Stable bubbles could be destabilized by high-level sound exposures such that bubble growth then occurs through static diffusion of gas out of the tissues. In such a scenario the marine mammal would need to be in a gas-supersaturated state for a long enough period of time for bubbles to become of a problematic size.

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

Although theoretical predictions suggest the possibility for acoustically mediated bubble growth, there is considerable disagreement among scientists as to its likelihood (Piantadosi and Thalmann, 2004; Evans and Miller, 2003). Crum and Mao (1996) hypothesized that received levels would have to exceed 190 dB in order for there to be the possibility of significant bubble growth due to supersaturation of gases in the blood (i.e., rectified diffusion). More recent work conducted by Crum *et al.* (2005) demonstrated the possibility of rectified diffusion for short duration signals, but at SELs and tissue saturation levels that are highly improbable to occur in diving marine mammals. To date, energy levels (ELs) predicted to cause in vivo bubble formation within diving cetaceans have not been evaluated (NOAA, 2002b). Although it has been argued that traumas from some recent beaked whale strandings are consistent with gas emboli and bubble-induced tissue separations (Jepson *et al.,* 2003), there is no conclusive evidence of this. However, Jepson *et al.* (2003, 2005) and Fernandez *et al.* (2004, 2005) concluded that in vivo bubble formation, which may be exacerbated by deep, long-duration, repetitive dives may explain why beaked whales appear to be particularly vulnerable to sonar exposures. Further investigation is needed to further assess the potential validity of these hypotheses. More information regarding hypotheses that attempt to explain how behavioral responses to non-impulsive sources can lead to strandings is included in the Stranding and Mortality section.

Acoustic Masking

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

The extent of the masking interference depends on the spectral, temporal, and spatial relationships between the signals an animal is trying to receive and the masking noise, in addition to other factors. In humans, significant masking of tonal signals occurs as a result of exposure to noise in a narrow band of similar frequencies. As the sound level increases, though, the detection of frequencies above those of the masking stimulus decreases also. This principle is expected to apply to marine mammals as well because of common biomechanical cochlear properties across taxa.

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

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

As mentioned previously, the functional hearing ranges of mysticetes, odontocetes, and pinnipeds underwater all encompass the frequencies of the sonar sources used in the Navy's MFAS/HFAS training exercises. Additionally, almost all species' vocal repertoires span across the frequencies of these sonar sources used by the Navy. The closer the characteristics of the masking signal to the signal of interest, the more likely masking is to occur. For hull-mounted sonar, which accounts for the largest takes of marine mammals (because of the source strength and number of hours it's conducted), the pulse length and low duty cycle of the MFAS/HFAS signal makes it less likely that masking would occur as a result.

Impaired Communication

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

Many animals will combine several of these strategies to compensate for high levels of background noise. Anthropogenic sounds that reduce the signal-to-noise ratio of animal vocalizations, increase the masked auditory thresholds of animals listening for such vocalizations, or reduce the active space of an animal's vocalizations impair communication between animals. Most animals that vocalize have evolved strategies to compensate for the effects of short-term or temporary increases in background or ambient noise on their songs or calls. Although the fitness consequences of these vocal adjustments remain unknown, like most other trade-offs animals must make, some of these strategies probably come at a cost (Patricelli *et al.,* 2006). For example, vocalizing more loudly in noisy environments may have energetic costs that decrease the net benefits of vocal adjustment and alter a bird's energy budget (Brumm, 2004; Wood and Yezerinac, 2006). Shifting songs and calls to higher frequencies may also impose energetic costs (Lambrechts, 1996).

Stress Responses

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

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

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

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

Relationships between these physiological mechanisms, animal behavior, and the costs of stress responses have also been documented fairly well through controlled experiments; because this physiology exists in every vertebrate that has been studied, it is not surprising that stress responses and their costs have been documented in both laboratory and free-living animals (for examples see, Holberton *et al.,* 1996; Hood *et al.,* 1998; Jessop *et al.,* 2003; Krausman *et al.,* 2004; Lankford *et al.,* 2005; Reneerkens *et al.,* 2002; Thompson and Hamer, 2000). Information has also been collected on the physiological responses of marine mammals to exposure to anthropogenic sounds (Fair and Becker, 2000; Romano *et al.,* 2002; Wright *et al.,* 2008). For example, Rolland *et al.* (2012) found that noise reduction from reduced ship traffic in the Bay of Fundy was associated with decreased stress in North Atlantic right whales. In a conceptual model developed by the Population Consequences of Acoustic Disturbance (PCAD) working group, serum hormones were identified as possible indicators of behavioral effects that are translated into altered rates of reproduction and mortality. The Office of Naval Research hosted a workshop (Effects of Stress on Marine Mammals Exposed to Sound) in 2009 that focused on this very topic (ONR, 2009).

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

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

Behavioral Disturbance

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

Exposure of marine mammals to sound sources can result in no response or responses including, but not limited to: increased alertness; orientation or attraction to a sound source; vocal modifications; cessation of feeding;

cessation of social interaction; alteration of movement or diving behavior; habitat abandonment (temporary or permanent); and, in severe cases, panic, flight, stampede, or stranding, potentially resulting in death (Southall *et al.,* 2007). A review of marine mammal responses to anthropogenic sound was first conducted by Richardson and others in 1995. A more recent review (Nowacek *et al.,* 2007) addresses studies conducted since 1995 and focuses on observations where the received sound level of the exposed marine mammal(s) was known or could be estimated. The following sub-sections provide examples of behavioral responses that provide an idea of the variability in behavioral responses that would be expected given the differential sensitivities of marine mammal species to sound and the wide range of potential acoustic sources to which a marine mammal may be exposed. Estimates of the types of behavioral responses that could occur for a given sound exposure should be determined from the literature that is available for each species, or extrapolated from closely related species when no information exists.

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

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

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

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

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

Foraging—Disruption of feeding behavior can be difficult to correlate with anthropogenic sound exposure, so it is usually inferred by observed displacement from known foraging areas, the appearance of secondary indicators (e.g., bubble nets or sediment plumes), or changes in dive behavior. Noise from seismic surveys was not found to impact the feeding behavior in western grey whales off the coast of Russia (Yazvenko *et al.,* 2007) and sperm whales engaged in foraging dives did not abandon dives when exposed to distant signatures of seismic airguns (Madsen *et al.,* 2006). Balaenopterid whales exposed to moderate low-frequency signals similar to the ATOC sound source demonstrated no variation in foraging activity (Croll *et al.,* 2001), whereas five out of six North Atlantic right whales exposed to an acoustic alarm interrupted their foraging dives (Nowacek *et al.,* 2004). Although the received sound pressure levels were similar in the latter two studies, the frequency, duration, and temporal pattern of signal presentation were different. These factors, as well as differences in species sensitivity, are likely contributing factors to the differential response. A determination of whether foraging disruptions incur fitness consequences will require information on or estimates of the energetic requirements of the individuals and the relationship between prey availability, foraging effort and success, and the life history stage of the animal.

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

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

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

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

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

Kvadsheim *et al.,* (2007) conducted a controlled exposure experiment in which killer whales fitted with D-tags were exposed to mid-frequency active sonar (Source A: a 1.0 second upsweep 209 dB @ 1–2 kHz every 10 seconds for 10 minutes; Source B: with a 1.0 second upsweep 197 dB @ 6–7 kHz every 10 seconds for 10 minutes). When exposed to Source A, a tagged whale and the group it was traveling with did not appear to avoid the source. When exposed to Source B, the tagged whales along with other whales that had been carousel feeding, ceased feeding during the approach of the sonar and moved rapidly away from the source. When exposed to Source B, Kvadsheim and his co-workers reported that a tagged killer whale seemed to try to avoid further exposure to the sound field by the following behaviors: immediately swimming away (horizontally) from the source of the sound; engaging in a series of erratic and frequently deep dives that seemed to take it below the sound field; or swimming away while engaged in a series of erratic and frequently deep dives. Although the sample sizes in this study are too small to support statistical analysis, the behavioral responses of the orcas were consistent with the results of other studies.

In 2007, the first in a series of behavioral response studies, a collaboration by the Navy, NMFS, and other scientists showed one beaked whale (*Mesoplodon densirostris*) responding to an MFAS playback. Tyack *et al.* (2011) indicates that the playback began when the tagged beaked whale was vocalizing at depth (at the deepest part of a typical feeding dive), following a previous control with no sound exposure. The whale appeared to stop clicking significantly earlier than usual, when exposed to mid-frequency signals in the 130–140 dB (rms) received level range. After a few more minutes of the playback, when the received level reached a maximum of 140–150 dB, the whale ascended on the slow side of normal ascent rates with a longer than normal ascent, at which point the exposure was terminated. The results are from a single experiment and a greater sample size is needed before robust and definitive conclusions can be drawn.

Tyack *et al.* (2011) also indicates that Blainville's beaked whales—a resident species within the study area—appear to be sensitive to noise at levels well below expected TTS (~160 dB re1μPa). This sensitivity is manifest by an adaptive movement away from a sound source. This response was observed irrespective of whether the signal transmitted was within the band width of MFAS, which suggests that beaked whales may not respond to the specific sound signatures. Instead, they may be sensitive to any pulsed sound from a point source in this frequency range. The response to such stimuli appears to involve maximizing the distance from the sound source.

Results from a 2007–2008 study conducted near the Bahamas showed a change in diving behavior of an adult Blainville's beaked whale to playback of mid-frequency source and predator sounds (Boyd *et al.,* 2008; Tyack *et al.,* 2011). Reaction to mid-frequency sounds included premature cessation of clicking and termination of a foraging dive, and a slower ascent rate to the surface. Preliminary results from a similar behavioral response study in southern California waters have been presented for the 2010–2011 field season (Southall *et al.,* 2011). Cuvier's beaked whale responses suggested particular sensitivity to sound exposure as consistent with results for Blainville's beaked whale. Similarly, beaked whales exposed to sonar during British training exercises stopped foraging (DSTL 2007), and preliminary results of controlled playback of sonar may indicate feeding/foraging disruption of killer whales and sperm whales (Miller *et al.,* 2011).

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

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

Behavioral Responses

Southall *et al.* (2007) reports the results of the efforts of a panel of experts in acoustic research from behavioral, physiological, and physical disciplines that convened and reviewed the available literature on marine mammal hearing and physiological and behavioral responses to human-made sound with the goal of proposing exposure criteria for certain effects. This peer-reviewed compilation of literature is very valuable, though Southall *et al.* (2007) note that not all data are equal, some have poor statistical power, insufficient controls, and/or limited information on received levels, background noise, and other potentially important contextual variables—such data were reviewed and sometimes used for qualitative illustration but were not included in the quantitative analysis for the criteria recommendations. All of the studies considered, however, contain an estimate of the received sound level when the animal exhibited the indicated response.

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

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

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

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

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

In addition to summarizing the available data, the authors of Southall *et al.* (2007) developed a severity scaling system with the intent of ultimately being able to assign some level of biological significance to a response. Following is a summary of their scoring system; a comprehensive list of the behaviors associated with each score, along with the assigned scores, may be found in the report:

• 0–3 (Minor and/or brief behaviors) includes, but is not limited to: no response; minor changes in speed or locomotion (but with no avoidance); individual alert behavior; minor cessation in vocal behavior; minor changes in response to trained behaviors (in laboratory)

- 4–6 (Behaviors with higher potential to affect foraging, reproduction, or survival) includes, but is not limited to: moderate changes in speed, direction, or dive profile; brief shift in group distribution; prolonged cessation or modification of vocal behavior (duration > duration of sound), minor or moderate individual and/or group avoidance of sound; brief cessation of reproductive behavior; or refusal to initiate trained tasks (in laboratory)
- 7–9 (Behaviors considered likely to affect the aforementioned vital rates) includes, but is not limited to: extensive or prolonged aggressive behavior; moderate, prolonged or significant separation of females and dependent offspring with disruption of acoustic reunion mechanisms; long-term avoidance of an area; outright panic, stampede, stranding; threatening or attacking sound source (in laboratory)

Potential Effects of Behavioral Disturbance

The different ways that marine mammals respond to sound are sometimes indicators of the ultimate effect that exposure to a given stimulus will have on the well-being (survival, reproduction, etc.) of an animal. There is little marine mammal data quantitatively relating the exposure of marine mammals to sound to effects on reproduction or survival, though data exists for terrestrial species to which we can draw comparisons for marine mammals.

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

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

Several authors have established that long-term and intense disturbance stimuli can cause population declines by reducing the body condition of individuals that have been disturbed, followed by reduced reproductive success, reduced survival, or both (Daan *et al.,* 1996; Madsen, 1994; White, 1983). For example, Madsen (1994) reported that pink-footed geese in undisturbed habitat gained body mass and had about a 46-percent reproductive success rate compared with geese in disturbed habitat (being consistently scared off the fields on which they were foraging) which did not gain mass and had a 17-percent reproductive success rate. Similar reductions in reproductive success have been reported for mule deer disturbed by all-terrain vehicles (Yarmoloy *et al.,* 1988), caribou disturbed by seismic exploration blasts (Bradshaw *et al.,* 1998), caribou disturbed by low-elevation military jet-fights (Luick *et al.,* 1996), and caribou disturbed by low-elevation jet flights (Harrington and Veitch, 1992). Similarly, a study of elk that were disturbed experimentally by pedestrians concluded that the ratio of young to mothers was inversely related to disturbance rate (Phillips and Alldredge, 2000).

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

On a related note, many animals perform vital functions, such as feeding, resting, traveling, and socializing, on a diel cycle (24-hour cycle). Substantive behavioral reactions to noise exposure (such as disruption of critical life functions, displacement, or avoidance of important habitat) are more likely to be significant if they last more than one diel cycle or recur on subsequent days (Southall *et al.,* 2007). Consequently, a behavioral response lasting less than 1 day and not recurring on subsequent days is not considered particularly severe unless it could directly affect reproduction or survival (Southall *et al.,* 2007).

In response to the National Research Council of the National Academies (2005) review, the Office of Naval Research founded a working group to formalize the Population Consequences of Acoustic Disturbance (PCAD) framework. The PCAD model connects observable data through a series of transfer functions using a case study approach. The long-term goal is to improve the understanding of how effects of sound on marine mammals transfer between behavior and life functions and between life functions and vital rates of individuals. Then, this understanding of how disturbance can affect the vital rates of individuals will facilitate the further assessment of the population level effects of anthropogenic sound on marine mammals by providing a quantitative approach to evaluate effects and the relationship between takes and possible changes to adult survival and/or annual recruitment.

Stranding and Mortality

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

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

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

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

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

Strandings Associated With Impulse Sound

During a Navy training event on March 4, 2011 at the Silver Strand Training Complex in San Diego, California, three or possibly four dolphins were killed in an explosion. During an underwater detonation training event, a pod of 100 to 150 long-beaked common dolphins were observed moving toward the 700-yd (640.1-m) exclusion zone around the explosive charge, monitored by personnel in a safety boat and participants in a dive boat. Approximately 5 minutes remained on a time-delay fuse connected to a single 8.76 lb (3.97 kg) explosive charge (C–4 and detonation cord). Although the dive boat was placed between the pod and the explosive in an effort to guide the dolphins away from the area, that effort was unsuccessful and three long-beaked common dolphins near the explosion died. In addition to the three dolphins found dead on March 4, the remains of a fourth dolphin were discovered on March 7, 2011 near Ocean Beach, California (3 days later and approximately 11.8 mi. [19 km] from Silver Strand where the training event occurred), which might also have been related to this event. Association of the fourth stranding with the training event is uncertain because dolphins strand on a regular basis in the San Diego area. Details such as the dolphins' depth and distance from the explosive at the time of the detonation could not be estimated from the 250 yd (228.6 m) standoff point of the observers in the dive boat or the safety boat.

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

Strandings Associated With MFAS

Over the past 16 years, there have been five stranding events coincident with military mid-frequency sonar use in which exposure to sonar is believed to have been a contributing factor: Greece (1996); the Bahamas (2000); Madeira (2000); Canary Islands (2002); and Spain (2006). Additionally, in 2004, during the Rim of the Pacific (RIMPAC) exercises, between 150 and 200 usually pelagic melon-headed whales occupied the shallow waters of Hanalei Bay, Kauai, Hawaii for over 28 hours. NMFS determined that MFAS was a plausible, if not likely, contributing factor in what may have been a confluence of events that led to the stranding. A number of other stranding events coincident with the operation of mid-frequency sonar, including the death of beaked whales or other species (minke whales, dwarf sperm whales, pilot whales), have been reported; however, the majority have not been investigated to the degree necessary to determine the cause of the stranding and only one of these stranding events, the Bahamas (2000), was associated with exercises conducted by the U.S. Navy.

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

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

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

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

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

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

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

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

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

The cranial sinuses and airways were found to be clear with little or no fluid deposition, which may indicate good preservation of tissues (Woods Hole Oceanographic Institution, 2005).

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

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

Canary Islands, Spain (2002)—The southeastern area within the Canary Islands is well known for aggregations of beaked whales due to its ocean depths of greater than 547 fathoms (1,000 m) within a few hundred meters of the coastline (Fernandez *et al.,* 2005). On September 24, 2002, 14 beaked whales were found stranded on Fuerteventura and Lanzarote Islands in the Canary Islands (International Council for Exploration of the Sea, 2005a). Seven whales died, while the remaining seven live whales were returned to deeper waters (Fernandez *et al.,* 2005). Four beaked whales were found stranded dead over the next three days either on the coast or floating offshore. These strandings occurred within near proximity of an international naval exercise that utilized MFAS and involved numerous surface warships and several submarines. Strandings began about 4 hours after the onset of MFAS activity (International Council for Exploration of the Sea, 2005a; Fernandez *et al.,* 2005).

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

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

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

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

Environmental factors, abiotic and biotic, were analyzed for any anomalous occurrences that would have contributed to the animals entering and remaining in Hanalei Bay. The Bay's bathymetry is similar to many other sites within the Hawaiian Island chain and dissimilar to sites that have been associated with mass strandings in other parts of the U.S. The weather conditions appeared to be normal for that time of year with no fronts or other significant features noted. There was no evidence of unusual distribution, occurrence of predator or prey species, or unusual harmful algal blooms, although Mobley *et al.,* 2007 suggested that the full moon cycle that occurred at that time may have influenced a run of squid into the Bay. Weather patterns and bathymetry that have been associated with mass strandings elsewhere were not found to occur in this instance.

The Hanalei event was spatially and temporally correlated with RIMPAC. Official sonar training and tracking exercises in the Pacific Missile Range Facility (PMRF) warning area did not commence until approximately 8 a.m. on July 3 and were thus ruled out as a possible trigger for the initial movement into the Bay. However, six naval surface vessels transiting to the operational area on July 2 intermittently transmitted active sonar (for approximately 9 hours total from 1:15 p.m. to 12:30 a.m.) as they approached from the south. The potential for these transmissions to have triggered the whales' movement into Hanalei Bay was investigated. Analyses with the information available indicated that animals to the south and east of Kaua'i could have detected active sonar transmissions on July 2, and reached Hanalei Bay on or before 7 a.m. on July 3. However, data limitations regarding the position of the whales prior to their arrival in the Bay, the magnitude of sonar exposure, behavioral responses of melon-headed whales to acoustic stimuli, and other possible relevant factors preclude a conclusive finding regarding the role of sonar in triggering this event. Propagation modeling suggests that transmissions from sonar use during the July 3 exercise in the PMRF warning area may have been detectable at the mouth of the Bay. If the animals responded negatively to these signals, it may have contributed to their continued presence in the Bay. The U.S. Navy ceased all active sonar transmissions during exercises in this range on the afternoon of July 3. Subsequent to the cessation of sonar use, the animals were herded out of the Bay.

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

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

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

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

Association Between Mass Stranding Events and Exposure to MFAS

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

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

Behaviorally Mediated Responses to MFAS That May Lead to Stranding

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

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

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

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

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

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

Impulsive Sources

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

Injuries resulting from a shock wave take place at boundaries between tissues of different densities. Different velocities are imparted to tissues of different densities, and this can lead to their physical disruption. Blast effects are greatest at the gas-liquid interface (Landsberg, 2000). Gas-containing organs, particularly the lungs and gastrointestinal tract, are especially susceptible (Goertner, 1982; Hill, 1978; Yelverton *et al.,* 1973). In addition, gas-containing organs including the nasal sacs, larynx, pharynx, trachea, and lungs may be damaged by compression/expansion caused by the oscillations of the blast gas bubble (Reidenberg and Laitman, 2003). Intestinal walls can bruise or rupture, with subsequent hemorrhage and escape of gut contents into the body cavity. Less severe gastrointestinal tract injuries include contusions, petechiae (small red or purple spots caused by bleeding in the skin), and slight hemorrhaging (Yelverton *et al.,* 1973).

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

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

Vessel Strike

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

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

Jensen and Silber (2003) detailed 292 records of known or probable ship strikes of all large whale species from 1975 to 2002. Of these, vessel speed at the time of collision was reported for 58 cases. Of these cases, 39 (or 67 percent) resulted in serious injury or death (19 of those resulted in serious injury as determined by blood in the water, propeller gashes or severed tailstock, and fractured skull, jaw, vertebrae, hemorrhaging, massive bruising or other injuries noted during necropsy and 20 resulted in death). Operating speeds of vessels that struck various species of large whales ranged from 2 to 51 knots. The majority (79 percent) of these strikes occurred at speeds of 13 knots or greater. The average speed that resulted in serious injury or death was 18.6 knots. Pace and Silber (2005) found that the probability of death or serious injury increased rapidly with increasing vessel speed. Specifically, the predicted probability of serious injury or death increased from 45 to 75 percent as vessel speed increased from 10 to 14 knots, and exceeded 90 percent at 17 knots. Higher speeds during collisions result in greater force of impact, but higher speeds also appear to increase the chance of severe injuries or death by pulling whales toward the vessel. Computer simulation modeling showed that hydrodynamic forces pulling whales toward the vessel hull increase with increasing speed (Clyne, 1999; Knowlton *et al.,* 1995).

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

Over a period of 20 years from 1991 to 2010 there have been a total of 16 Navy vessel strikes in SOCAL, and five Navy vessel strikes in HRC. Two of the five HRC Navy strikes were by smaller workboats (less than 12 m in length), versus larger Navy ships. In terms of the 16 consecutive 5-year periods in the last 20 years, no single 5-year period exceeded ten whales struck within SOCAL and HRC (periods from 2000–2004 and 2001–2005). For Navy vessel strikes in SOCAL, there were six consecutive 5-year periods with six or more whales struck (1997–2001, 1998–2002, 1999–2003, 2000–2004, 2001–2005, and 2002–2006), and no more than three whales struck in the last 5-year period from 2006–2010. No whales have been struck by Navy vessels in SOCAL since 2009. For Navy vessel strikes in the HRC for the same time period, there was one 5-year period when three whales were struck (2003–2007), seven periods when two whales were struck, five periods when one whale was struck, and three periods when no whales were struck. Within the data set analyzed for HRC through 2010, no whales have been struck by a Navy vessel since 2008.

Mitigation

In order to issue an incidental take authorization under section 101(a)(5)(A) of the MMPA, NMFS must set forth the ''permissible methods of taking pursuant to such activity, and other means of effecting the least practicable adverse impact on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance.'' The NDAA of 2004 amended the MMPA as it relates to military-readiness activities and the ITA process such that ''least practicable adverse impact'' shall include consideration of personnel safety, practicality of implementation, and impact on the effectiveness of the ''military readiness activity''. The training and testing activities described in the Navy's LOA application are considered military readiness activities.

NMFS reviewed the proposed activities and the proposed mitigation measures as described in the Navy's LOA application to determine if they would result in the least practicable adverse effect on marine mammals, which includes a careful balancing of the likely benefit of any particular measure to the marine mammals with the likely effect of that measure on personnel safety, practicality of implementation, and impact on the effectiveness of the ''military-readiness activity.'' Included below are the mitigation measures the Navy proposed in their LOA application.

Proposed Mitigation Measures

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

Lookouts

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

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

Due to aircraft and boat manning and space restrictions, lookouts positioned in aircraft or on boats would consist of the aircraft crew, pilot, or boat crew. Lookouts positioned in aircraft and boats may necessarily be responsible for tasks in addition to observing the air or surface of the water (for example, navigation of a helicopter or rigid hull inflatable boat). However, aircraft and boat lookouts would, to the maximum extent practicable and consistent with aircraft and boat safety and training and testing requirements, comply with the observation objectives described above for lookouts positioned on surface ships.

The Navy proposes to use at least one lookout during the training and testing activities provided in Table 10. Additional details on lookout procedures and implementation are provided in Chapter 11 of the Navy's LOA application (*http://www.nmfs.noaa.gov/pr/permits/incidental.htm#applications*).

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

Number of lookouts	Training and testing activities	Benefit
4	Mine countermeasure and neutralization activities using time delay would use 4, depending on the explosives being used. If applicable, aircrew and divers would report sightings of marine mammals.	Lookouts can visually detect marine mammals so that potentially harmful impacts from explosives use can be avoided.
		Lookouts dedicated to observations can more quickly and effectively relay sighting information so that corrective action can be taken. Support from aircrew and divers, if they have are involved, would increase the probability of sightings, reducing the potential for impacts.
1 to 2	Vessels using low-frequency active sonar or hull-mounted mid-frequency active sonar associated with ASW activities would have either one or two lookouts, depending on the size and status/location of the vessel.	Lookouts can visually detect marine mammals so that potentially harmful impacts from Navy sonar and explosives use can be avoided. Dedicated lookouts can more quickly and effectively relay sighting information so that corrective action can be taken. Support from aircrew and divers, if they are involved, would increase the probability of sightings, reducing the potential for impacts.
	Mine countermeasure and neutralization activities with positive control would use one or two lookouts (depending on net explosive weight), with at least one on each support vessel. If applicable, aircrew and divers would also report the presence of marine mammals.	
	Mine neutralization activities involving diver placed charges of up to 100 lb (45 kg) net explosive weight detonation would use two lookouts.	
	Sinking exercises would use two lookouts (one in an aircraft and one on a vessel).	
	At sea explosives testing would have at least one lookout.	
1	Surface ships and aircraft conducting ASW, ASUW, or MIW activities using high-frequency active sonar; non-hull mounted mid-frequency active sonar; helicopter dipping mid-frequency active sonar; anti-swimmer grenades; IEER sonobuoys; line charge testing; surface gunnery activities; surface missile activities; bombing activities; explosive torpedo testing; elevated causeway system pile driving; towed in-water devices; full power propulsion testing of surface vessels; and activities using non-explosive practice munitions, would have one lookout.	Lookouts can visually detect marine mammals so that potentially harmful impacts from Navy sonar; explosives; sonobuoys; gunnery rounds; missiles; explosive torpedoes; pile driving; towed systems; surface vessel propulsion; and non-explosive munitions can be avoided.

Personnel standing watch on the bridge, Commanding Officers, Executive Officers, maritime patrol aircraft aircrews, anti-submarine warfare helicopter crews, civilian equivalents, and lookouts would complete the NMFS-approved Marine Species Awareness Training (MSAT) prior to standing watch or serving as a lookout. Additional details on the Navy's MSAT program are provided in Chapter 5 of the HSTT DEIS/OEIS.

Mitigation Zones

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

Most of the current mitigation zones for activities that involve the use of impulsive and non-impulsive sources were originally designed to reduce the potential for onset of TTS. The Navy updated their acoustic propagation modeling to incorporate new hearing threshold metrics (i.e., upper and lower frequency limits), new marine mammal density data, and factors such as an animal's likely presence at various depths. An explanation of the acoustic propagation modeling process can be found in the Marine Species Modeling Team Technical Report (U.S. Department of the Navy 2012a).

As a result of updates to the acoustic propagation modeling, some of the ranges to effects are larger than previous model outputs. Due to the ineffectiveness of mitigating such large areas, the Navy is unable to mitigate for onset of TTS during every activity. However, some ranges to effects are smaller than previous models estimated, and the mitigation zones were adjusted accordingly to provide consistency across the measures. The Navy developed each proposed mitigation zone to avoid or reduce the potential for onset of the lowest level of injury, PTS, out to the predicted maximum range. Mitigating to the predicted maximum range to PTS also mitigates to the predicted maximum range to onset mortality (1 percent mortality), onset slight lung injury, and onset slight gastrointestinal tract injury, since the maximum range to effects for these criteria are shorter than for PTS. Furthermore, in most cases, the predicted maximum range to PTS also covers the predicted average range to TTS. Tables 11 and 12 summarize the predicted average range to TTS, average range to PTS, maximum range to PTS, and recommended mitigation zone for each activity category, based on the Navy's acoustic propagation modeling results. It is important for the Navy to have standardized mitigation zones wherever training and testing may be conducted. The information in Tables 11 and 12 was developed in consideration of both Atlantic and Pacific Ocean conditions, marine mammal species, environmental factors, effectiveness, and operational assessments. Therefore, the ranges to effects in Tables 11 and 12 provide effective values that ensure appropriate mitigation ranges for both Atlantic Fleet and Pacific Fleet activities, and may not align with range to effects values found in other tables of the Navy's LOA application.

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

TABLE 11—PREDICTED RANGES TO TTS, PTS, AND RECOMMENDED MITIGATION ZONES

Activity category	Bin (representative source)*	Predicted average range to TTS	Predicted average range to PTS	Predicted maximum range to PTS	Recommended mitigation zone
Non-Impulsive Sound					
Low-Frequency and Hull-Mounted Mid-Frequency Active Sonar [1].	MF1 (SQS–53 ASW hull-mounted sonar).	4,251 yd. (3,887 m)	281 yd. (257 m)	<292 yd. (<267 m)	6 dB power down at 1,000 yd. (914 m); 4 dB power down at 500 yd. (457 m); and shutdown at 200 yd. (183 m).
High-Frequency and Non-Hull Mounted Mid-Frequency Active Sonar.	MF4 (AQS–22 ASW dipping sonar).	226 yd. (207 m)	<55 yd. (<50 m)	<55 yd. (<50 m)	200 yd. (183 m).
Explosive and Impulsive Sound					
Improved Extended Echo Ranging Sonobuoys.	E4 (Explosive sonobuoy).	434 yd. (397 m)	156 yd. (143 m)	563 yd. (515 m)	600 yd. (549 m).
Explosive Sonobuoys using 0.6–2.5 lb. NEW.	E3 (Explosive sonobuoy).	290 yd. (265 m)	113 yd. (103 m)	309 yd. (283 m)	350 yd. (320 m).
Anti-Swimmer Grenades	E2 (Up to 0.5 lb. NEW).	190 yd. (174 m)	83 yd. (76 m)	182 yd. (167 m)	200 yd. (183 m).
Mine Countermeasure and Neutralization Activities Using Positive Control Firing Devices.	NEW dependent (see Table 12).				
Mine Neutralization Diver-Placed Mines Using Time-Delay Firing Devices.	E6 (Up to 20 lb. NEW).	647 yd. (592 m)	232 yd. (212 m)	469 yd. (429 m)	1,000 yd. (915 m).
Ordnance Testing (Line Charge Testing).	E4 (Numerous 5 lb. charges).	434 yd. (397 m)	156 yd. (143 m)	563 yd. (515 m)	900 yd. (823 m).**
Gunnery Exercises—Small- and Medium-Caliber (Surface Target).	E2 (40 mm projectile).	190 yd. (174 m)	83 yd. (76 m)	182 yd. (167 m)	200 yd. (183 m).
Gunnery Exercises—Large-Caliber (Surface Target).	E5 (5 in. projectiles at the surface***).	453 yd. (414 m)	186 yd. (170 m)	526 yd. (481 m)	600 yd. (549 m).
Missile Exercises up to 250 lb. NEW (Surface Target).	E9 (Maverick missile).	949 yd. (868 m)	398 yd. (364 m)	699 yd. (639 m)	900 yd. (823 m).
Missile Exercises up to 500 lb. NEW (Surface Target).	E10 (Harpoon missile).	1,832 yd. (1,675 m)	731 yd. (668 m)	1,883 yd. (1,721 m)	2,000 yd. (1.8 km).
Bombing Exercises	E12 (MK–84 2,000 lb. bomb).	2,513 yd. (2.3 km)	991 yd. (906 m)	2,474 yd. (2.3 km)	2,500 yd. (2.3 km).**
Torpedo (Explosive) Testing	E11 (MK–48 torpedo).	1,632 yd. (1.5 km)	697 yd. (637 m)	2,021 yd. (1.8 km)	2,100 yd. (1.9 km).
Sinking Exercises	E12 (Various sources up to the MK–84 2,000 lb. bomb).	2,513 yd. (2.3 km)	991 yd. (906 m)	2,474 yd. (2.3 km)	2.5 nm.

TABLE 11—PREDICTED RANGES TO TTS, PTS, AND RECOMMENDED MITIGATION ZONES—Continued

Activity category	Bin (representative source)*	Predicted average range to TTS	Predicted average range to PTS	Predicted maximum range to PTS	Recommended mitigation zone
At-Sea Explosive Testing	E5 (Various sources less than 10 lb. NEW at various depths***).	525 yd. (480 m)	204 yd. (187 m)	649 yd. (593 m)	1,600 yd. (1.4 km).**
Elevated Causeway System—Pile Driving.	24 in. steel impact hammer.	1,094 yd. (1,000 m)	51 yd. (46 m)	51 yd. (46 m)	60 yd. (55 m).

ASW: anti-submarine warfare; JAX: Jacksonville; NEW: net explosive weight; PTS: permanent threshold shift; TTS: temporary threshold shift.
[1] The mitigation zone would be 200 yd for bin LF4 testing sources.
* This table does not provide an inclusive list of source bins; bins presented here represent the source bin with the largest range to effects within the given activity category.
** Recommended mitigation zones are larger than the modeled injury zones to account for multiple types of sources or charges being used.
*** The representative source bin E5 has different range to effects depending on the depth of activity occurrence (at the surface or at various depths).

TABLE 12—PREDICTED RANGES TO EFFECTS AND MITIGATION ZONE RADIUS FOR MINE COUNTERMEASURE AND NEUTRALIZATION ACTIVITIES USING POSITIVE CONTROL FIRING DEVICES

Charge size net explosive weight (bins)	General mine countermeasure and neutralization activities using positive control firing devices *				Mine countermeasure and neutralization activities using diver placed charges under positive control **			
	Predicted average range to TTS	Predicted average range to PTS	Predicted maximum range to PTS	Recommended mitigation zone	Predicted average range to TTS	Predicted average range to PTS	Predicted maximum range to PTS	Recommended mitigation zone
2.6–5 lb. (1.2–2.3 kg) (E4).	434 yd. (474 m)	197 yd. (180 m)	563 yd. (515 m)	600 yd. (549 m)	545 yd. (498 m)	169 yd. (155 m)	301 yd. (275 m)	350 yd. (320 m).
6–10 lb. (2.7–4.5 kg) (E5).	525 yd. (480 m)	204 yd. (187 m)	649 yd. (593 m)	800 yd. (732 m)	587 yd. (537 m)	203 yd. (185 m)	464 yd. (424 m)	500 yd. (457 m).
11–20 lb. (5–9.1 kg) (E6).	766 yd. (700 m)	288 yd. (263 m)	648 yd. (593 m)	800 yd. (732 m)	647 yd. (592 m)	232 yd. (212 m)	469 yd. (429 m)	500 yd. (457 m).
21–60 lb. (9.5–27.2 kg) (E7) ***.	1,670 yd. (1,527 m).	581 yd. (531 m)	964 yd. (882 m)	1,200 yd. (1.1 km).	1,532 yd. (1,401 m).	473 yd. (432 m)	789 yd. (721 m)	800 yd. (732 m).
61–100 lb. (27.7–45.4 kg) (E8) ****.	878 yd. (802 m)	383 yd. (351 m)	996 yd. (911 m)	1,600 yd. (1.4 m).	969 yd. (886 m)	438 yd. (400 m)	850 yd. (777 m)	850 yd. (777 m).
250–500 lb. (113.4–226.8 kg) (E10).	1,832 yd. (1,675 m).	731 yd. (668 m)	1,883 yd. (1,721 m).	2,000 yd. (1.8 km).				Not Applicable.
501–650 lb. (227.3–294.8) (E11).	1,632 yd. (1,492 m).	697 yd. (637 m)	2,021 yd. (1,848 m).	2,100 yd. (1.9 km).				Not Applicable.

PTS: permanent threshold shift; TTS: temporary threshold shift
* These mitigation zones are applicable to all mine countermeasure and neutralization activities conducted in all locations that Tables 2.8–1 through 2.8–5 specifies.
** These mitigation zones are only applicable to mine countermeasure and neutralization activities involving the use of diver placed charges. These activities are conducted in shallow water and the mitigation zones are based only on the functional hearing groups with species that occur in these areas (mid-frequency cetaceans and sea turtles).
*** The E7 bin was only modeled in shallow-water locations so there is no difference for the diver placed charges category.
**** The E8 bin was only modeled for surface explosions, so some of the ranges are shorter than for sources modeled in the E7 bin which occur at depth.

When mine neutralization activities using diver placed charges (up to a 20 lb. NEW) are conducted with a time-delay firing device, the detonation is fused with a specified time-delay by the personnel conducting the activity and is not authorized until the area is clear at the time the fuse is initiated. During these activities, the detonation cannot be terminated once the fuse is initiated due to human safety concerns. The Navy is proposing to modify the number of lookouts currently used for mine neutralization activities using diver-placed time-delay firing devices. As a reference, the current mitigation involves the use of six lookouts and three small rigid hull inflatable boats (two lookouts positioned in each of the three boats) for mitigation zones equal to or larger than 1,400 yd. (1,280 m), or four lookouts and two boats for mitigation zones smaller than 1,400 yd. (1,280 m), which was incorporated into the current Silver Strand Training Complex IHA to minimize the possibility of take by serious injury or mortality (which is not authorized under an IHA). The Navy has determined that using six lookouts and three boats in the long term is impracticable to implement from an operational standpoint due to the impact that it is causing on resource requirements (i.e., limited personnel resources and boat availability). During activities using up to a 20 lb. NEW (bin E6) detonation, the Navy is proposing to have four lookouts and two small rigid hull inflatable boats (two lookouts positioned in each of the two boats) monitoring a 1,000-yd (915-m) mitigation zone. In addition, when aircraft are used, the pilot or member of the aircrew will serve as an additional lookout.

NMFS believes that the Navy's proposed modification to this mitigation measure will still reduce the potential for injury or mortality for a few reasons: (1) The Navy's acoustic propagation modeling results show that the predicted ranges to TTS and PTS for mine neutralization diver-placed mines using time-delay firing devices do not exceed 647 yd (592 m), which is well within the proposed 1,000-yd (915-m) mitigation zone; (2) the number of lookouts for a 1,000-yd (915-m) mitigation zone would not change; (3)

the maximum net explosive weight would decrease from 29 lb (currently) to 20 lb (proposed); (4) the Navy would continue to monitor the mitigation zone for 30 minutes before, during, and 30 after the activity to ensure that the area is clear of marine mammals; and (5) time-delay firing device activities are only conducted during daylight hours.

Vessels and In-Water Devices

Vessel Movement—Ships would avoid approaching marine mammals head on and would maneuver to maintain a mitigation zone of 457 m around observed whales, and 183 m around all other marine mammals (except bow riding dolphins), providing it is safe to do so.

Towed In-water Devices—The Navy would ensure towed in-water devices avoid coming within a mitigation zone of 229 m around any observed marine mammal, providing it is safe to do so.

Non-Explosive Practice Munitions

Gunnery Exercises (small, medium, and large caliber using a surface target)—Mitigation would include visual observation immediately before and during the exercise within a mitigation zone of 183 m around the intended impact location. The exercise would not commence if concentrations of floating vegetation (*Sargassum* or kelp patties) are observed in the mitigation zone. Firing would cease if a marine mammal is visually detected within the mitigation zone. Firing would recommence if any one of the following conditions are met: (1) The animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, (3) the mitigation zone has been clear from any additional sightings for a period of 30 minutes, or (4) the intended target location has been repositioned more than 366 m away from the location of the last sighting.

Bombing Exercises—Mitigation would include visual observation from the aircraft immediately before the exercise and during target approach within a mitigation zone of 914 m around the intended impact location. The exercise would not commence if concentrations of floating vegetation (*Sargassum* or kelp patties) are observed in the mitigation zone. Bombing would cease if a marine mammal is visually detected within the mitigation zone. Bombing would recommence if any one of the following conditions are met: (1) The animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, or (3) the mitigation zone has been clear from any additional sightings for a period of 30 minutes.

Other Mitigation

The Navy Marine Mammal Program utilizes the following standard operating procedures to help to limit the low risk of disease transmission from Navy marine mammals to indigenous marine mammals, including the Hawaiian monk seals, while training in the HRC:

- Waste from Navy sea lions would be collected and disposed of in an approved sewer system;
- During operations, all onsite personnel would be made aware of the potential for disease transfer, and asked to report any sightings of monk seals immediately to other training participants;
- Sea lion handlers would visually scan for indigenous marine animals, especially monk seals, for at least 5 minutes before a Navy sea lion enters the water and would continue monitoring while the sea lion is in the water. If a monk seal is seen approaching or within 100 m of the Navy sea lion, the handler would hold the Navy sea lion in the boat or recall the Navy sea lion immediately if it has already been released; and
- The Navy would obtain an import permit from the State of Hawaii Department of Agriculture and would adhere to the conditions of that permit.

Humpback Whale Cautionary Area

The Navy is proposing to continue their designation of a humpback whale cautionary area in Hawaiian waters. Humpback whales migrate to the Hawaiian Islands each winter to rear their calves and mate. Data indicate that, historically, humpback whales have concentrated in high densities in certain areas around the Hawaiian Islands. NMFS has reviewed the Navy's data on MFAS training in these dense humpback whale areas since June 2006 and found it to be rare and infrequent. While past data is no guarantee of future activity, it documents a history of low level MFAS activity in dense humpback areas. In order to be successful at operational missions and against the threat of quiet, diesel-electric submarines, the Navy has, for more than 40 years, routinely conducted Anti-Submarine Warfare (ASW) training in the waters off the Hawaiian Islands, including the Humpback Whale National Marine Sanctuary. During this period, no reported cases of harmful effects to humpback whales attributed to MFAS use have occurred. Coincident with this use of MFAS, abundance estimates reflect an annual increase in the humpback whale stock (Mobley 2001a, 2004). A recent long-term study of humpback whales in Hawaiian waters shows long-term fidelity to the Hawaiian winter grounds, with many showing sighting spans ranging from 10 to 32 years (Herman *et al.,* 2011).

NMFS and the Navy have explored ways of effecting the least practicable impact (which includes a consideration of practicality of implementation and impacts to training fidelity) to humpback whales from exposure to MFAS. Proficiency in ASW requires that Sailors gain and maintain expert skills and experience in operating MFAS in myriad marine environments. The Hawaiian Islands, including areas in which humpback whales concentrate, contain unique bathymetric features the Navy needs to ensure sailors gain critical skills and unique experience by training in coastal waters. Sound propagates differently in shallow water and no two shallow water areas are the same. So as not to negatively affect military readiness, the Navy contends that it is necessary to maintain the possibility of using all shallow water training areas. Crew members will be working in similar areas during real world events and these are the types of environments where enemy submarines may be operating.

The Navy recognizes the significance of the Hawaiian Islands for humpback whales. The Navy has designated a humpback whale cautionary area, which consists of a 5-km (3.1-mi) buffer zone having one of the highest concentrations of humpback whales during winter months. Similar to the previous HRC rulemaking, conducting exercises in the humpback whale cautionary area would continue to require a much higher level of clearance than typically required for MFAS activities. Should national security needs require MFAS training and testing in the humpback whale cautionary area between December 15 and April 15, it shall be personally authorized by the Commander, U.S. Pacific Fleet (CPF). The CPF shall base such authorization on the unique characteristics of the area from a military readiness perspective, taking into account the importance of the area for humpback whales and the need to minimize adverse impacts on humpback whales from MFAS whenever practicable. Approval at this level for this type of activity is extraordinary. CPF is a four-star Admiral and the highest ranking officer in the U.S. Pacific Fleet. This case-by-case authorization cannot be delegated and represents the Navy's commitment to fully consider and balance mission requirements with environmental stewardship. Further, CPF would provide specific direction on required mitigation prior to operational units transiting to and training in the humpback whale cautionary area. This process would ensure the decisions to train in this area are made at the highest level in the Pacific Fleet, heighten awareness of humpback whale activities in the cautionary area, and serve to reemphasize that mitigation measures are to be scrupulously followed. The Navy would provide NMFS with advance notification of any MFAS training and testing activities in the humpback whale cautionary area.

Data from several sources, which are summarized and cited on NOAA's Cetacean and Sound Mapping Web site (cetsound.noaa.gov) indicate that there are several resident populations of odontocetes off the western side of the Big Island of Hawaii (e.g., beaked whales, melon-headed whales, dwarf sperm whales, pilot whales). Generally, we highlight the presence of resident populations in the interest of helping to support decisions that ensure that these small populations, limited to a small area of preferred habitat, are not exposed to concentrations of activities within their ranges that have the potential to impact a large portion of the stock/species over longer amounts of time that could have detrimental consequences to the stock/species. However, NMFS has reviewed the Navy's exercise reports and considered/discussed their historical level of activity in the area where these resident populations are concentrated, which is very low, and concluded that time/area restrictions would not afford much reduction of impacts in this location and are not necessary at this point. If future monitoring and exercise reports suggest that increased operations overlap with these resident populations, NMFS would revisit the consideration of time/area limitations around these populations.

Cetacean and Sound Mapping

NMFS Office of Protected Resources standardly considers available information about marine mammal habitat use to inform discussions with applicants regarding potential spatio-temporal limitations of their activities that might help effect the least practicable adverse impact (e.g., Humpback Whale Cautionary Area). Through the Cetacean and Sound Mapping effort (*www.cetsound.noaa.gov*), NOAA's Cetacean Density and Distribution Mapping Working Group (CetMap) is currently involved in a process to compile available literature and solicit expert review to identify areas and times where species are known to concentrate for specific behaviors (e.g., feeding, breeding/calving, or migration) or be range-limited (e.g., small resident populations). These areas, called Biologically Important Areas (BIAs), are useful tools for planning and impact assessments and are being provided to the public via the CetSound Web site, along with a summary of the supporting information. While these BIAs are useful tools for analysts, any decisions regarding protective measures based on these areas must go through the normal MMPA evaluation process (or any other statutory process that the BIAs are used to inform)—the designation of a BIA does not pre-suppose any specific management decision associated with those areas. Additionally, the BIA process is iterative and the areas will be updated as new information becomes available. Currently, NMFS has published BIAs for the Arctic Slope and some in Hawaii (which were considered in the Mitigation Section for HSTT). The BIAs in other regions, such as the Atlantic and West Coast of the continental U.S. are still in development. We have indicated to the Navy that once these BIAs are complete and put on the Web site, we may need to discuss whether (in the context of the nature and scope of any Navy activities planned in and around the BIAs, what impacts might be anticipated, and practicability) additional protective measures might be appropriate.

Stranding Response Plan

NMFS and the Navy developed a Stranding Response Plan for the HRC and SOCAL Range Complex in 2009 as part of the incidental take authorization process. The Stranding Response Plans are specifically intended to outline the applicable requirements the authorizations are conditioned upon in the event that a marine mammal stranding is reported in the HRC or SOCAL Range Complex during a major training exercise. NMFS considers all plausible causes within the course of a stranding investigation and these plans in no way presume that any strandings in a Navy range complex are related to, or caused by, Navy training and testing activities, absent a determination made during investigation. The plans are designed to address mitigation, monitoring, and compliance. The Navy is currently working with NMFS to refine these plans for the new HSTT Study Area (to include regionally specific plans that include more logistical detail). The current Stranding Response Plans for the HRC and SOCAL Range Complex are available for review here: *http://www.nmfs.noaa.gov/pr/permits/incidental.htm#applications.*

Mitigation Conclusions

NMFS has carefully evaluated the Navy's proposed mitigation measures and considered a broad range of other measures in the context of ensuring that NMFS prescribes the means of effecting the least practicable adverse impact on the affected marine mammal species and stocks and their habitat. Our evaluation of potential measures included consideration of the following factors in relation to one another: the manner in which, and the degree to which, the successful implementation of the measure is expected to minimize adverse impacts to marine mammals; the proven or likely efficacy of the specific measure to minimize adverse impacts as planned; and the practicability of the measure for applicant implementation, including consideration of personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity.

In some cases, additional mitigation measures are required beyond those that the applicant proposes. Any mitigation measure(s) prescribed by NMFS should be able to accomplish, have a reasonable likelihood of accomplishing (based on current science), or contribute to the accomplishment of one or more of the general goals listed below:

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

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

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

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

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

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

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

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

Monitoring

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

Monitoring measures prescribed by NMFS should accomplish one or more of the following general goals:

- An increase in the probability of detecting marine mammals, both within the safety zone (thus allowing for more effective implementation of the mitigation) and in general to generate more data to contribute to the analyses mentioned below
- An increase in our understanding of how many marine mammals are likely to be exposed to levels of MFAS/HFAS (or explosives or other stimuli) that we associate with specific adverse effects, such as behavioral harassment, TTS, or PTS.
- An increase in our understanding of how marine mammals respond to MFAS/HFAS (at specific received levels), explosives, or other stimuli expected to result in take and how anticipated adverse effects on individuals (in different ways and to varying degrees) may impact the population, species, or stock (specifically through effects on annual rates of recruitment or survival) through any of the following methods:
  - Behavioral observations in the presence of MFAS/HFAS compared to observations in the absence of sonar (need to be able to accurately predict received level and report bathymetric conditions, distance from source, and other pertinent information)
  - Physiological measurements in the presence of MFAS/HFAS compared to observations in the absence of tactical sonar (need to be able to accurately predict received level and report bathymetric conditions, distance from source, and other pertinent information)
  - Pre-planned and thorough investigation of stranding events that occur coincident to naval activities
  - Distribution and/or abundance comparisons in times or areas with concentrated MFAS/HFAS versus times or areas without MFAS/HFAS
- An increased knowledge of the affected species
- An increase in our understanding of the effectiveness of certain mitigation and monitoring measures.

Overview of Navy Monitoring

The current Navy Fleet monitoring program is composed of a collection of ''range-specific'' monitoring plans, each developed individually as part of the MMPA/ESA authorization processes. These individual plans establish specific monitoring requirements for each range complex based on a set of effort-based metrics (e.g., 20 days of aerial survey). Concurrent with implementation of the initial range-specific monitoring plans, the Navy and NMFS began development of the Integrated Comprehensive Monitoring Program (ICMP). The ICMP has been developed in direct response to Navy permitting requirements established in various MMPA final rules, ESA consultations, Biological Opinions, and applicable regulations. The ICMP is intended to coordinate monitoring efforts across all regions and to allocate the most appropriate level and type of effort for each range complex based on a set of standardized objectives, and in acknowledgement of regional expertise and resource availability. The ICMP is designed to be a flexible, scalable, and adaptable through the adaptive management and strategic planning processes to periodically assess progress and reevaluate objectives. Although the ICMP does not specify actual monitoring field work or projects, it does establish top-level goals that have been developed in coordination with NMFS. As the ICMP is implemented, detailed and specific studies will be developed which support the Navy's top-level monitoring goals. In essence, the ICMP directs that monitoring activities relating to the effects of Navy training and testing activities on marine species should be designed to accomplish one or more of the following top-level goals:

- An increase in our understanding of the likely occurrence of marine mammals and/or ESA-listed marine species in the vicinity of the action (i.e., presence, abundance, distribution, and/or density of species);
- An increase in our understanding of the nature, scope, or context of the likely exposure of marine mammals and/or ESA-listed species to any of the potential stressor(s) associated with the action (e.g., tonal and impulsive sound), through better understanding of one or more of the following: (1) The action and the environment in which it occurs (e.g., sound source characterization, propagation, and ambient noise levels); (2) the affected species (e.g., life history or dive patterns); (3) the likely co-occurrence of marine mammals and/or ESA-listed marine species with the action (in whole or part) associated with specific adverse effects, and/or; (4) the likely biological or behavioral context of exposure to the stressor for the marine mammal and/or ESA-listed marine species (e.g., age class of exposed animals or known pupping, calving or feeding areas);
- An increase in our understanding of how individual marine mammals or ESA-listed marine species respond

(behaviorally or physiologically) to the specific stressors associated with the action (in specific contexts, where possible, e.g., at what distance or received level);

• An increase in our understanding of how anticipated individual responses, to individual stressors or anticipated combinations of stressors, may impact either: (1) the long-term fitness and survival of an individual; or (2) the population, species, or stock (e.g., through effects on annual rates of recruitment or survival);

• An increase in our understanding of the effectiveness of mitigation and monitoring measures;

• A better understanding and record of the manner in which the authorized entity complies with the ITA and Incidental Take Statement;

• An increase in the probability of detecting marine mammals (through improved technology or methods), both specifically within the safety zone (thus allowing for more effective implementation of the mitigation) and in general, to better achieve the above goals; and

• A reduction in the adverse impact of activities to the least practicable level, as defined in the MMPA.

While the ICMP only directly applies to monitoring activities under applicable MMPA and ESA authorizations, it also serves to facilitate coordination among the Navy's marine species monitoring program and the basic and applied research programs discussed in the Ongoing Navy-funded Research section of this document.

An October 2010 Navy monitoring meeting initiated a process to critically evaluate current Navy monitoring plans and begin development of revisions to existing range-specific monitoring plans and associated updates to the ICMP. Discussions at that meeting and through the Navy/NMFS adaptive management process established a way ahead for continued refinement of the Navy's monitoring program. This process included establishing a Scientific Advisory Group (SAG) composed of technical experts to provide objective scientific guidance for Navy consideration. The Navy established the SAG in early 2011 with the initial task of evaluating current Navy monitoring approaches under the ICMP and existing LOAs and developing objective scientific recommendations that would serve as the basis for a Strategic Planning Process for Navy monitoring to be incorporated as a major component of the ICMP. The SAG convened in March 2011, composed of leading academic and civilian scientists with significant expertise in marine species monitoring, acoustics, ecology, and modeling. The SAG's final report laid out both over-arching and range-specific recommendations for the Navy's Marine Species Monitoring program and is available through the Navy's Marine Species Monitoring web portal: *http://www.navymarinespeciesmonitoring.us.*

Adaptive management discussions between the Navy and NMFS established a way ahead for continued refinement of the Navy's monitoring program. Consensus was that the ICMP and associated implementation components would continue the evolution of Navy marine species monitoring towards a single integrated program, incorporate SAG recommendations when appropriate and logistically feasible, and establish a more collaborative framework for evaluating, selecting, and implementing future monitoring across all the Navy range complexes through the adaptive management and strategic planning process.

Past and Current Monitoring in the HSTT Study Area

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

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

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

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

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

5. Visual surveys generally provide suitable data for addressing questions of distribution and abundance of marine mammals, but are much less effective at providing information on movements and behavior, with a few notable exceptions where sightings are most frequent. For example, Navy-funded focal follows of marine mammals during aerial visual surveys in SOCAL have provided unique new science on regional at-sea marine mammal behavior including group size, travel direction, spatial occurrence within SOCAL, maximum inter-animal dispersal, and behavioral state.

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

7. NMFS and the Navy should more carefully consider what and how information should be gathered by watchstanders during training exercises and monitoring events, as some reports contain different information, making cross-report comparisons difficult.

Navy-funded monitoring accomplishments in the HRC and SOCAL portions of HSTT from 2009 to 2012 are provided in the Navy's draft 5-year Comprehensive Report, as required by the 2009 rulemakings and available here: *http://www.nmfs.noaa.gov/pr/permits/incidental.htm#applications.* Following is a summary of the work conducted:

• Conducted over 4,000 hours of visual survey effort;

• Covered over 64,800 nautical miles of ocean;

• Sighted over 256,000 individual marine mammals;

• Taken over 45,500 digital photos and 32 hours of digital video;

• Attached 70 satellite tracking tags to individual marine mammals; and

• Collected over 25,000 hours of passive acoustic recordings.

Some recent highlights of findings include:

• Increased understanding of Hawaiian monk seal habitat use and behavior throughout the Main Hawaiian Islands;

• Estimated received levels and reconstructions of animal movements during an ASW training event from the bottom-mounted hydrophone arrays at the Pacific Missile Range Facility;

• Increased knowledge of baseline marine mammal behavior information in SOCAL from focal follows of priority cetacean species; and

• Observed northern right whale dolphin mother-calf pairs for the first time since SOCAL aerial monitoring surveys began in fall 2008.

Data collection and analysis within these range complexes is ongoing. From 2009 to 2011, Navy lookouts aboard Navy ships reported 1,262 sightings for an estimated 12,875 marine mammals within the HSTT Study Area. These observations were mainly during major at-sea training events and there were no reported observations of adverse reactions by marine mammals and no dead or injured animals reported associated with Navy training activities.

Proposed Monitoring for the HSTT Study Area

Based on discussions between the Navy and NMFS, future monitoring would address the ICMP top-level goals through a collection of specific regional and ocean basin studies based on scientific objectives. Quantitative metrics of monitoring effort (e.g., 20 days of aerial survey) would not be a specific requirement. The adaptive management process and reporting requirements would serve as the basis for evaluating performance and compliance, primarily considering the quality of the work and results produced, as well as peer review and publications, and public dissemination of information, reports, and data. The strategic planning process would be used to set intermediate scientific objectives, identify potential species of interest at a regional scale, and evaluate and select specific monitoring projects to fund or continue supporting for a given fiscal year. The strategic planning process would also address relative investments to different range complexes based on goals across all range complexes, and monitoring would leverage multiple techniques for data acquisition and analysis whenever possible.

Ongoing Navy Research

Overview

The Navy is one of the world's leading organizations in assessing the effects of human activities on the marine environment, and provides a significant amount of funding and support to marine research, outside of the monitoring required by their incidental take authorizations. They also develop approaches to ensure that these resources are minimally impacted by current and future Navy operations. Navy scientists work cooperatively with other government researchers and scientists, universities, industry, and non-governmental conservation organizations in collecting, evaluating, and modeling information on marine resources, including working towards a better understanding of marine mammals and sound. From 2004 to 2012, the Navy has provided over $230 million for marine species research. The Navy sponsors 70 percent of all U.S. research concerning the effects of human-generated sound on marine mammals and 50 percent of such research conducted worldwide. Major topics of Navy-supported marine species research directly applicable to proposed activities within the HSTT Study Area include the following:

• Better understanding of marine species distribution and important habitat areas;

• Developing methods to detect and monitor marine species before and during training and testing activities;

• Better understanding the impacts of sound on marine mammals, sea turtles, fish, and birds; and

• Developing tools to model and estimate potential impacts of sound.

It is imperative that the Navy's research and development (R&D) efforts related to marine mammals are conducted in an open, transparent manner with validated study needs and requirements. The goal of the Navy's R&D program is to enable collection and publication of scientifically valid research as well as development of techniques and tools for Navy, academic, and commercial use. The two Navy organizations that account for most funding and oversight of the Navy marine mammal research program are the Office of Naval Research (ONR) Marine Mammals and Biology Program, and the Office of the Chief of Naval Operations (CNO) Energy and Environmental Readiness Division (N45) Living Marine Resources (LMR) Program. The primary focus of these programs has been on understanding the effects of sound on marine mammals, including physiological, behavioral and ecological effects.

The ONR Marine Mammals and Biology Program supports basic and applied research and technology development related to understanding the effects of sound on marine mammals, including physiological, behavioral, ecological, and population-level effects. Current program thrusts include, but are not limited to:

• Monitoring and detection;

• Integrated ecosystem research including sensor and tag development;

• Effects of sound on marine life including hearing, behavioral response studies, diving and stress physiology, and Population Consequences of Acoustic Disturbance (PCAD); and

• Models and databases for environmental compliance.

To manage some of the Navy's marine mammal research programmatic elements, OPNAV N45 developed in 2011 a new Living Marine Resources (LMR) Research and Development Program. The mission of the LMR program is to develop, demonstrate, and assess information and technology solutions to protect living marine resources by minimizing the environmental risks of Navy at-sea training and testing activities while preserving core Navy readiness capabilities. This mission is accomplished by:

• Improving knowledge of the status and trends of marine species of concern and the ecosystems of which they are a part;

• Developing the scientific basis for the criteria and thresholds to measure the effects of Navy generated sound;

• Improving understanding of underwater sound and sound field characterization unique to assessing the biological consequences resulting from underwater sound (as opposed to tactical applications of underwater sound or propagation loss modeling for military communications or tactical applications); and

• Developing technologies and methods to monitor and, where possible, mitigate biologically significant consequences to living marine resources resulting from naval activities, emphasizing those consequences that are most likely to be biologically significant.

The program is focused on three primary objectives that influence program management priorities and directly affect the program's success in accomplishing its mission:

1. Collect, Validate, and Rank R&D Needs: Expand awareness of R&D program opportunities within the Navy marine resource community to encourage and facilitate the submittal of well-defined and appropriate needs statements.

2. Address High Priority Needs: Ensure that program investments and the resulting projects maintain a direct and consistent link to the defined user needs.

3. Transition Solutions and Validate Benefits: Maximize the number of program-derived solutions that are successfully transitioned to the Fleet and system commands.

The LMR program primarily invests in the following areas:

• Developing Data to Support Risk Threshold Criteria;

• Improved Data Collection on Protected Species, Critical Habitat within Navy Ranges;

• New Monitoring and Mitigation Technology Demonstrations;

• Database and Model Development; and

• Education and Outreach, Emergent Opportunities.

The Navy has also developed the technical reports and supporting data used for analysis in the HSTT DEIS/OEIS and this proposed rule, which include the Navy Marine Species Density Database, Acoustic Criteria and Thresholds, and Determination of Acoustic Effects on Marine Mammals and Sea Turtles. Furthermore, research cruises by NMFS and by academic institutions have received funding from the Navy. For instance, LMR currently supports the Marine Mammal Monitoring on Ranges program at Pacific Missile Range Facility on Kauai and, along with ONR, the multi-year Southern California Behavioral Response Study (*http://www.socal-brs.org*). All of this research helps in understanding the marine environment and the effects that may arise from underwater noise in oceans. Further, NMFS is working on a long-term stranding study that will be supported by the Navy by way of a funding and information sharing component (see below).

Navy Research and Development

Navy Funded—Both OPNAV N45 and ONR R&D programs have projects ongoing within the HSTT Study Area. Some data and results from these R&D projects are summarized in the Navy's annual range complex monitoring reports, and available on NMFS' Web site (*http://www.nmfs.noaa.gov/pr/permits/incidental.htm#applications*) and the Fleet's new marine species monitoring Web site (*http://www.navymarinespeciesmonitoring.us*). In addition, the Navy's Fleet monitoring is coordinated with R&D monitoring in a given region to leverage research objectives, assets, and studies where possible under the Navy's Integrated Comprehensive Monitoring Program.

Below are some current Navy R&D funded projects or joint Navy-NMFS/academic funded projects through 2012 in the HSTT Study Area. Southern California:

• Behavioral Response Study (multiple academic, NMFS, contract scientists, Navy science organizations, and other collaborators; $1.8M funded by OPNAV N45 and ONR)

• Small Boat Based Marine Mammal Surveys in Southern California (Scripps Institute of Oceanography, University of California San Diego; $400K funded by OPNAV N45)

• Distribution and Demographics of Marine Mammals in SOCAL Through Photo-Identification, Genetics, and Satellite Telemetry (Cascadia Research Collective; $260K funded by OPNAV N45)

• Blue and Humpback Acoustic Survey Methods (Southwest Fisheries Science Center, National Marine Fisheries Service Fisheries Science Center, $160K funded by OPNAV N45)

• Tracking Marine Mammals on Southern California Offshore ASW Range (SOAR) using Marine Mammal Monitoring on Navy Ranges (M3R) (Naval Undersea Warfare Center Newport; $500K funded by OPNAV N45)

Hawaii:

• Passive Acoustic Methods for Tracking Marine Mammals Using Widely-Spaced Bottom Mounted Hydrophones (University of Hawaii; funded by ONR)

• Satellite Tagging Odontocetes in the Navy's Pacific Missile Range Facility (PMRF) and Kauai (Cascadia Research Collective; $150K funded by OPNAV N45)

• Tracking Marine Mammals on PMRF using Marine Mammal Monitoring on Navy Ranges (M3R) System (Naval Undersea Warfare Center Newport; $290K funded by OPNAV N45)

• Remote Monitoring of Dolphins and Whales in the High Naval Activity Areas in Hawaiian Waters (Hawaii Institute of Marine Biology, funded by ONR)

The integration between the Navy's new LMR R&D program and related fleet and Systems Command HSTT monitoring would continue and improve over the 5-year period with applicable R&D results presented in HSTT annual monitoring reports.

Other National Department of Defense Funded Initiatives—The Strategic Environmental Research and Development Program (SERDP) and Environmental Security Technology Certification Program (ESTCP) are the Department of Defense's environmental research programs, harnessing the latest science and technology to improve environmental performance, reduce costs, and enhance and sustain mission capabilities. The programs respond to environmental technology requirements common to all military services, complementing the services' research programs. SERDP and ESTCP promote partnerships and collaboration among academia, industry, the military services, and other federal agencies. They are independent programs managed from a joint office to coordinate the full spectrum of efforts, from basic and applied research to field demonstration and validation. Beginning in March 2012, an ESTCP project that might eventually be applicable to future Navy training and testing is the Biodegradable Sonobuoy Decelerators. More information about this project can be found at: *http://www.serdp.org/Program-Areas/Weapons-Systems-and-Platforms/Waste-Reduction-and-Treatment-in-DoD-Operations/WP-201222/WP-201222/(language)/eng-US).*

Adaptive Management

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

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

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

The Navy is currently establishing a strategic planning process under the ICMP in coordination with NMFS. The objective of the strategic planning process is to guide the continued evolution of Navy marine species monitoring towards a single integrated program, incorporating expert review and recommendations, and establishing a more structured and collaborative framework for evaluating, selecting, and implementing future monitoring across the all Navy range complexes. The Strategic Plan is intended to be a primary component of the ICMP and provide a ''vision'' for navy monitoring across geographic regions—serving as guidance for determining how to most efficiently and effectively invest the marine species monitoring resources to address ICMP top-level goals and satisfy MMPA monitoring requirements. This process is being designed to integrate various elements including:

- ICMP top-level goals;
- SAG recommendations;
- Integration of regional scientific expert input;
- Ongoing adaptive management review dialogue between NMFS and the Navy;
- Lessons learned from past and future monitoring at Navy training and testing ranges; and
- Leveraged research and lessons learned from other Navy funded marine science programs.

Reporting

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

General Notification of Injured or Dead Marine Mammals

Navy personnel would ensure that NMFS (the appropriate Regional Stranding Coordinator) is notified immediately (or as soon as clearance procedures allow) if an injured or dead marine mammal is found during or shortly after, and in the vicinity of, any Navy training exercise utilizing MFAS, HFAS, or underwater explosive detonations. The Navy would provide NMFS with species identification or a description of the animal(s), the condition of the animal(s) (including carcass condition if the animal is dead), location, time of first discovery, observed behaviors (if alive), and photographs or video (if available). The HSTT Stranding Response Plan contains further reporting requirements for specific circumstances (*http://www.nmfs.noaa.gov/pr/permits/incidental.htm#applications*).

Annual Monitoring and Exercise Reports

As noted above, reports from individual monitoring events, results of analyses, publications, and periodic progress reports for specific monitoring projects would be posted to the Navy's Marine Species Monitoring web portal as they become available. Progress and results from all monitoring activity conducted within the HSTT Study Area, as well as required Major Training Event exercise activity, would be summarized in an annual report. A draft of this report would be submitted to NMFS for review by April 15 of each year. NMFS would review the report and provide comments for incorporation within 3 months.

Comprehensive Monitoring and Exercise Summary Report

The Navy would submit to NMFS a draft report that analyzes and summarizes all of the multi-year marine mammal monitoring and Major Training Event exercise information gathered during training and testing exercises for which individual annual reports are required under the proposed regulations. This report would be submitted at the end of the fourth year of the rule (December 2018), covering activities that have occurred through June 1, 2018. The Navy will respond to NMFS comments on the draft comprehensive report if submitted within 3 months of receipt. The report will be considered final after the Navy has addressed NMFS' comments, or three months after the submittal of the draft if NMFS does not provide comments.

Estimated Take of Marine Mammals

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

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

Definition of Harassment

As mentioned previously, with respect to military readiness activities, section 3(18)(B) of the MMPA defines ''harassment'' as: (i) Any act that injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild [Level A Harassment]; or (ii) any act that disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns, including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering, to a point where such behavioral patterns are abandoned or significantly altered [Level B Harassment].

Level B Harassment

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

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

Earlier in this document, we described the Southall *et al.,* (2007) severity scaling system and listed some examples of the three broad categories of behaviors: 0–3 (Minor and/or brief behaviors); 4–6 (Behaviors with higher potential to affect foraging, reproduction, or survival); 7–9 (Behaviors considered likely to affect the aforementioned vital rates). Generally speaking, MMPA Level B Harassment, as defined in this document, would include the behaviors described in the 7–9 category, and a subset, dependent on context and other considerations, of the behaviors described in the 4–6 category. Behavioral harassment does not generally include behaviors ranked 0–3 in Southall *et al.,* (2007).

Acoustic Masking and Communication Impairment—Acoustic masking is considered Level B Harassment as it can disrupt natural behavioral patterns by interrupting or limiting the marine mammal's receipt or transmittal of important information or environmental cues.

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

Level A Harassment

Of the potential effects that were described earlier, following are the types of effects that fall into the Level A Harassment category:

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

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

Tissue Damage due to Behaviorally Mediated Bubble Growth—Several authors suggest mechanisms in which marine mammals could behaviorally respond to exposure to MFAS/HFAS by altering their dive patterns (unusually rapid ascent, unusually long series of surface dives, etc.) in a manner that might result in unusual bubble formation or growth ultimately resulting in tissue damage. In this scenario, the rate of ascent would need to be sufficiently rapid to compromise behavioral or physiological protections against nitrogen bubble formation. There is considerable disagreement among scientists as to the likelihood of this phenomenon (Piantadosi and Thalmann, 2004; Evans and Miller, 2003). Although it has been argued that traumas from recent beaked whale strandings are consistent with gas emboli and bubble-induced tissue separations (Jepson *et al.,* 2003; Fernandez *et al.,* 2005), nitrogen bubble formation as the cause of the traumas has not been verified. If tissue damage does occur by this phenomenon, it would be considered an injury.

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

Vessel or Ordnance Strike—Vessel strike or ordnance strike associated with the specified activities would be considered Level A Harassment, serious injury, or mortality.

Take Criteria

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

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

Level B Harassment Threshold (TTS)—Behavioral disturbance, acoustic masking, and TTS are all considered Level B Harassment. Marine mammals would usually be behaviorally disturbed at lower received levels than those at which they would likely sustain TTS, so the levels at which behavioral disturbance are likely to occur is considered the onset of Level B Harassment. The behavioral responses of marine mammals to sound are variable, context specific, and, therefore, difficult to quantify (see Risk Function section, below). Alternately, TTS is a physiological effect that has been studied and quantified in laboratory conditions. Because data exist to support an estimate of the received levels at which marine mammals will incur TTS, NMFS uses an acoustic criteria to estimate the number of marine mammals that might sustain TTS. TTS is a subset of Level B Harassment (along with sub-TTS behavioral harassment) and we are not specifically required to estimate those numbers; however, the more specifically we can estimate the affected marine mammal responses, the better the analysis.

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

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

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

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

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

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

TABLE 14—IMPULSIVE SOUND EXPLOSIVE CRITERIA AND THRESHOLDS FOR PREDICTING INJURY AND MORTALITY

Group	Species	Slight injury			Mortality
		PTS	GI Tract	Lung	
Low-frequency Cetaceans	All mysticetes	187 dB SEL (LF_{II}) or 230 dB Peak SPL.	237 dB SPL or 104 psi.	Equation 1	Equation 2.
Mid-frequency Cetaceans	Most delphinids, medium and large toothed whales.	187 dB SEL (MF_{II}) or 230 dB Peak SPL.			
High-frequency Cetaceans	Porpoises and *Kogia* spp	161 dB SEL (HF_{II}) or 201 dB Peak SPL.			
Phocidae	Hawaiian monk, elephant, and harbor seal.	192 dB SEL (P_{WI}) or 218 dB Peak SPL.			
Otariidae	Sea lions and fur seals	215 dB SEL (O_{WI}) or 218 dB Peak SPL.			
Mustelidae	Sea otters.				

Equation 1:

$= 39.1M^{1/3} (1+[D_{Rm}/10.081])^{1/2}$ Pa − sec

Equation 2:

$= 91.4M^{1/3} (1+[D_{Rm}/10.081])^{1/2}$ Pa − sec

Where: M = mass of the animals in kg.

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

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

Unlike step functions, acoustic risk continuum functions (which are also called ''exposure-response functions'' or ''dose-response functions'' in other risk assessment contexts) allow for probability of a response that NMFS would classify as harassment to occur over a range of possible received levels (instead of one number) and assume that the probability of a response depends first on the ''dose'' (in this case, the received level of sound) and that the probability of a response increases as the ''dose'' increases (see Figure 1a). In January 2009, NMFS issued three final rules governing the incidental take of marine mammals (within Navy's HRC, SOCAL, and Atlantic Fleet Active Sonar Training (AFAST)) that used a risk continuum to estimate the percent of marine mammals exposed to various levels of MFAS that would respond in a manner NMFS considers harassment.

The Navy and NMFS have previously used acoustic risk functions to estimate the probable responses of marine mammals to acoustic exposures for other training and research programs. Examples of previous application include the Navy FEISs on the SURTASS LFA sonar (U.S. Department of the Navy, 2001c); the North Pacific Acoustic Laboratory experiments conducted off the Island of Kauai (Office of Naval Research, 2001); and the Supplemental EIS for SURTASS LFA sonar (U.S. Department of the Navy, 2007d). As discussed earlier, factors other than received level (such as distance from or bearing to the sound source, context of animal at time of exposure) can affect the way that marine mammals respond; however, data to support a quantitative analysis of those (and other factors) do not currently exist. NMFS will continue to modify these criteria as new data become available and can be appropriately and effectively incorporated.

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

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

Where:

R = Risk (0 − 1.0)

L = Received level (dB re: 1 μPa).

B = Basement received level = 120 dB re: 1 μPa.

K = Received level increment above B where 50-percent risk = 45 dB re: 1 μPa.

A = Risk transition sharpness parameter = 10 (odontocetes and pinnipeds) or 8 (mysticetes).

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

The inclusion of a special behavioral response criterion for beaked whales of the family Ziphiidae is new to these criteria. It has been speculated that beaked whales might have unusual sensitivities to sonar sound due to their likelihood of stranding in conjunction with MFAS use, even in areas where other species were more abundant (D'Amico *et al.* 2009), but there were not sufficient data to support a separate treatment for beaked whales until recently. With the recent publication of results from Blainville's beaked whale monitoring and experimental exposure studies on the instrumented Atlantic Undersea Test and Evaluation Center range in the Bahamas (McCarthy *et al.* 2011; Tyack *et al.* 2011), there are now statistically strong data suggesting that beaked whales tend to avoid both actual naval MFAS in real anti-submarine training scenarios as well as sonar-like signals and other signals used during controlled sound exposure studies in the same area. An unweighted 140 dB re 1 μPa sound pressure level threshold has been adopted by the Navy for significant behavioral effects for all beaked whales (family: Ziphiidae).

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

Since impulse events can be quite short, it may be possible to accumulate multiple received impulses at sound pressure levels considerably above the energy-based criterion and still not be considered a behavioral take. The Navy treats all individual received impulses as if they were one second long for the purposes of calculating cumulative sound exposure level for multiple impulse events. For example, five air gun impulses, each 0.1 second long, received at 178 dB sound pressure level would equal a 175 dB sound exposure level, and would not be predicted as leading to a take. However, if the five 0.1 second pulses are treated as a 5 second exposure, it would yield an adjusted value of approximately 180 dB, exceeding the threshold. For impulses associated with explosions that have durations of a few microseconds, this assumption greatly overestimates effects based on sound exposure level metrics such as TTS and PTS and behavioral responses. Appropriate weighting values will be applied to the received impulse in one-third octave bands and the energy summed to produce a total weighted sound exposure level value. For impulsive behavioral criteria, the Navy's new weighting functions (detailed in the LOA application) are applied to the received sound level before being compared to the threshold.

TABLE 15— EXPLOSIVE CRITERIA AND THRESHOLDS

Group	Species	Slight injury			Mortality
		PTS	GI Tract	Lung	
Low Frequency Cetaceans	All mysticetes	187 dB SEL (LF_{II}) or 230 dB Peak SPL.	237 dB SPL or 104 psi.	Equation 1	Equation 2.
Mid-Frequency Cetaceans	Most delphinids, medium and large toothed whales.	187 dB SEL (MF_{II}) or 230 dB Peak SPL.			
High Frequency Cetaceans	Porpoises and Kogia spp	161 dB SEL (HF_{II}) or 201dB Peak SPL.			
Phocidae	Hawaiian monk, elephant, and harbor seal.	192 dB SEL (P_{WI}) or 218 dB Peak SPL.			
Otariidae	Sea lions and Fur seals	215 dB SEL (O_{WI}) or 218 dB Peak SPL.			
Mustelidae	Sea Otters.				

$$= 39.1M^{1/3}\left(1+\frac{D_{Rm}}{10.081}\right)^{1/2} Pa-\sec$$

$$= 91.4M^{1/3}\left(1+\frac{D_{Rm}}{10.081}\right)^{1/2} Pa-\sec$$

Existing NMFS criteria was applied to sounds generated by pile driving and airguns (Table 16).

TABLE 16—THRESHOLDS FOR PILE DRIVING AND AIRGUNS

Species groups	Underwater vibratory pile driving criteria (sound pressure level, dB re 1 μPa)		Underwater impact pile driving and airgun criteria (sound pressure level, dB re 1 μPa)	
	Level A injury threshold	Level B disturbance threshold	Level A injury threshold	Level B disturbance threshold
Cetaceans (whales, dolphins, porpoises)	180 dB rms	120 dB rms	180 dB rms	160 dB rms.
Pinnipeds (seals)	190 dB rms	120 dB rms	190 dB rms	160 dB rms.

Quantitative Modeling for Impulsive and Non-Impulsive Sound

The Navy performed a quantitative analysis to estimate the number of marine mammals that could be harassed by acoustic sources or explosives used during Navy training and testing activities. Inputs to the quantitative analysis included marine mammal density estimates; marine mammal depth occurrence distributions; oceanographic and environmental data; marine mammal hearing data; and criteria and thresholds for levels of potential effects. The quantitative analysis consists of computer-modeled estimates and a post-model analysis to determine the number of potential mortalities and harassments. The model calculates sound energy propagation from sonars, other active acoustic sources, and explosives during naval activities; the sound or impulse received by animat dosimeters representing marine mammals distributed in the area around the modeled activity; and whether the sound or impulse received by a marine mammal exceeds the thresholds for effects. The model estimates are then further analyzed to consider animal avoidance and implementation of mitigation measures, resulting in final estimates of effects due to Navy training and testing. This process results in a reduction to take numbers and is detailed in Chapter 6 (section 6.3) of the Navy's application.

A number of computer models and mathematical equations can be used to predict how energy spreads from a sound source (e.g., sonar or underwater detonation) to a receiver (e.g., dolphin or sea turtle). Basic underwater sound models calculate the overlap of energy and marine life using assumptions that account for the many, variable, and often unknown factors that can greatly influence the result. Assumptions in previous Navy models have intentionally erred on the side of overestimation when there are unknowns or when the addition of other variables was not likely to substantively change the final analysis. For example, because the ocean environment is extremely dynamic and information is often limited to a synthesis of data gathered over wide areas and requiring many years of research, known information tends to be an average of a seasonal or annual variation. The Equatorial Pacific El Nino disruption of the ocean-atmosphere system is an example of dynamic change where unusually warm ocean temperatures are likely to redistribute marine life and alter the propagation of underwater sound energy. Previous Navy modeling therefore made some assumptions indicative of a maximum theoretical propagation for sound energy (such as a perfectly reflective ocean surface and a flat seafloor). More complex computer models build upon basic modeling by factoring in additional variables in an effort to be more accurate by accounting for such things as bathymetry and an animal's likely presence at various depths.

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

The quantified results of the marine mammal acoustic effects analysis presented in the Navy's LOA application differ from the quantified results presented in the HSTT DEIS/OEIS. Presentation of the results in this new manner for MMPA, ESA, and other regulatory analyses is well within the framework of the previous NEPA analyses presented in the DEIS. The differences are due to three main factors: (1) Administrative corrections to the modeling inputs for training and testing; (2) use of a more accurate seasonal density for the species (short-beaked common dolphins) having the highest abundance of any marine mammal in the Study Area; and (3) additional post-model quantification to further refine the numerical analysis of acoustic effects so as to include animal avoidance of sound sources, avoidance of areas of activity before use of a sound source or explosive, and implementation of mitigation. This additional quantification was in direct response to public comments received on the HSTT DEIS/OEIS with regard to a somewhat universal misunderstanding of the numbers presented as modeling results. These comments indicated that many readers believed the modeling effects numbers presented in the tables were the entire acoustic impact analysis. Furthermore, it was clear that these same readers had missed the critical subsequent qualitative analysis required to accurately interpret those numbers since the model does not account for animal avoidance of repeated explosive exposures, movement, or standard Navy mitigations. In response to these comments, the numbers presented in Navy's LOA application will be reflected in the HSTT FEIS/OEIS to more fully quantify the analyzed effects to marine mammals. The differences between the HSTT DEIS/OEIS and the Navy's LOA application reflect reductions in the analyzed mortality takes, Level A takes, and Level B takes. The Navy has advised NMFS that all comments received on the proposed rule that address (1) Administrative corrections to the modeling inputs for training and testing; (2) use of more accurate seasonal density data; and (3) post-model quantification based on animal avoidance of sound sources and mitigation will be reviewed and addressed by the Navy in the HSTT FEIS/OEIS.

The steps of the quantitative analysis of acoustic effects, the values that went into the Navy's model, and the resulting ranges to effects are detailed in Chapter 6 of the Navy's LOA application (*http://www.nmfs.noaa.gov/pr/permits/incidental.htm#applications*).

Take Request

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

- Acoustic (sonar and other active non-impulse sources, explosives, pile driving, swimmer defense airguns, weapons firing, launch and impact noise, vessel noise, aircraft noise);
- Energy (electromagnetic devices);
- Physical disturbance or strikes (vessels, in-water devices, military expended materials, seafloor devices);
- Entanglement (fiber optic cables, guidance wires, parachutes);
- Ingestion (munitions, military expended materials other than munitions); and
- Indirect stressors (risk to monk seals from Navy California sea lions from the transmission of disease or parasites).

The Navy determined, and NMFS agrees, that three stressors could potentially result in the incidental taking of marine mammals from training and testing activities within the Study Area: (1) Non-impulsive stressors (sonar and other active acoustic sources), (2) impulsive stressors (explosives, pile driving and removal), and (3) vessel strikes. Non-impulsive and impulsive stressors have the potential to result in incidental takes of marine mammals by harassment, injury, or mortality. Vessel strikes have the potential to result in incidental take from direct injury and/or mortality.

Training Activities—Based on the Navy's model and post-model analysis (described in detail in Chapter 6 of their LOA application), Table 18 summarizes the Navy's take request for training activities for an annual maximum year (a notional 12-month period when all annual and non-annual events could occur) and the summation over a 5-year period (annual events occurring five times and non-annual events occurring three times). Table 19 summarizes the Navy's take request for training activities by species from the modeling estimates.

While the Navy does not anticipate any marine mammal strandings or that the mortalities predicted by the acoustic modeling would occur, the Navy requests annual authorization for take by mortality of up to seven small odontocetes (i.e., dolphins) and pinnipeds to include any combination of such species that may be present in the Study Area. While the Navy does not anticipate any beaked whale strandings or mortalities from sonar and other active sources, in order to account for unforeseen circumstances that could lead to such effects the Navy requests the annual take, by mortality, of two beaked whales as part of training activities.

Vessel strike to marine mammals is not associated with any specific training activity but rather a limited, sporadic, and accidental result of Navy vessel movement within the Study Area. In order to account for the accidental nature of vessel strikes to large whales in general, and the potential risk from any vessel movement within the Study Area, the Navy is seeking take authorization in the event a Navy vessel strike does occur while conducting training. The Navy's take authorization request is based on the probabilities of whale strikes suggested by the data from NMFS Southwest Regional Office, NMFS Pacific Islands Regional Office, the Navy, and the calculations detailed in Chapter 6 of the Navy's LOA application. The number of Navy and commercial whale strikes for which the species has been positively identified suggests that the probability of striking a gray whale in the SOCAL Range Complex and humpback whale in the HRC is greater than striking other species. However, since species identification has not been possible in most vessel strike cases, the Navy cannot quantifiably predict what species may be taken. Therefore, the Navy seeks take authorization by vessel strike for any combined number of large whale species to include gray whale, fin whale, blue whale, humpback whale, Bryde's whale, sei whale, minke whale, or sperm whale. The Navy requests takes of large marine mammals over the course of the 5-year regulations from training activities as discussed below:

- The take by vessel strike during training activities in any given year of no more than four large whales total of any combination of species including gray whale, fin whale, blue whale, humpback whale, Bryde's whale, sei whale, minke whale, or sperm whale. The four takes per year requested would be no more than two of any one species of blue whale, fin whale, humpback whale, sei whale, or sperm whale in any given year.
- The take by vessel strike of no more than 12 large whales from training activities over the course of the five years of the HSTT regulations.

Over a period of 20 years from 1991 to 2010 there have been a total of 16 Navy vessel strikes in SOCAL, and five Navy vessel strikes in HRC. It should be noted that two of the five HRC Navy strikes were by <12-meter workboats vice larger Navy ships. In terms of the 16 consecutive 5-year periods in the last 20 years, no single 5-year period exceeded ten whales struck within SOCAL and HRC (periods from 2000–2004 and 2001–2005). For Navy vessel strikes in SOCAL, there were six consecutive 5-year periods with six or more whales struck (1997–2001, 1998–2002, 1999–2003, 2000–2004, 2001–2005, and 2002–2006), and no more than three whales struck in the last 5-year period from 2006–2010. No whales have been struck by Navy vessels in SOCAL since 2009. For Navy vessel strikes in the HRC for the same time period, there was one 5-year period when three whales were struck (2003–2007), seven periods when two whales were struck, five periods when one whale was struck, and three periods when no whales were struck. Within the data set analyzed for HRC through 2010, no whales have been struck by a Navy vessel since 2008. Also as discussed in Chapter 6 of the Navy's LOA application, the Poisson probability of striking as many as two large whales in the SOCAL portion of the HSTT is only 14 percent per year, and the probability of striking two large whales in the HRC portion of the HSTT is only 2 percent.

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

MMPA Category	Source	Training activities	
		Annual authorization sought [1]	5-Year authorization sought [2]
Mortality	Impulse	7 mortalities applicable to any small odontocete or pinniped species.	35 mortalities applicable to any small odontocete or pinniped species over five years.
	Unspecified [3]	2 mortalities to beaked whales [3]	10 mortalities to beaked whales over five years.[3]
	Vessel strike	No more than 4 large whale mortalities in any given year [4].	No more than 12 large whale mortalities over five years.[4]
Level A	Impulse and Non-Impulse.	266—Species specific data shown in Table 19.	1,314—Species specific data shown in Table 19.
Level B	Impulse and Non-Impulse.	1,691,123—Species specific data shown in Table 19.	8,398,931—Species specific data shown in Table 19.

[1] These numbers constitute the total for an annual maximum year (a notional 12-month period when all annual and non-annual events could occur) in which a RIMPAC exercise and Civilian Port Defense events would occur in Hawaii and SOCAL.
[2] These numbers constitute the summation over a 5-year period with annual events occurring five times and non-annual events occurring three times.
[3] The Navy's NAEMO model did not quantitatively predict these mortalities. Navy, however, is seeking this particular authorization given sensitivities these species may have to anthropogenic activities. Request includes 2 Ziphidae beaked whale annually to include any combination of Cuvier's beaked whale, Baird's beaked whale, Longman's beaked whale, and unspecified Mesoplodon sp. (not to exceed 10 beaked whales total over the 5-year length of requested authorization).
[4] The Navy cannot quantifiably predict that proposed takes from training will be of any particular species, and therefore seeks take authorization for any combination of large whale species (gray whale, fin whale, blue whale, humpback whale, Bryde's whale, sei whale, minke whale, or sperm whale), but of the four takes per year no more than two of any one species of blue whale, fin whale, humpback whale, sei whale, or sperm whale is requested.

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

Species	Stock	Annually [1]			Total over 5-year rule [2]		
		Level B	Level A	Mortality	Level B	Level A	Mortality
Blue whale	Eastern North Pacific	4,145	0	0	20,725	0	0
	Central North Pacific	180	0	0	834	0	0
Fin whale	California, Oregon, & Washington.	1,528	0	0	7,640	0	0
	Hawaiian	191	0	0	891	0	0
Humpback whale	California, Oregon, & Washington.	1,081	0	0	5,405	0	0
	Central North Pacific	8,192	0	0	40,960	0	0

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

Species	Stock	Annually [1]			Total over 5-year rule [2]		
		Level B	Level A	Mortality	Level B	Level A	Mortality
Sei whale	Eastern North Pacific	146	0	0	730	0	0
	Hawaiian	484	0	0	2,266	0	0
Sperm whale	California, Oregon, & Washington.	1,958	0	0	9,790	0	0
	Hawaiian	1,374	0	0	6,130	0	0
Guadalupe fur seal	Mexico	2,603	0	0	13,015	0	0
Hawaiian monk seal	Hawaiian	1,292	0	0	6,334	0	0
Bryde's whale	Eastern Tropical Pacific	112	0	0	560	0	0
	Hawaiian	137	0	0	637	0	0
Gray whale	Eastern North Pacific	9,560	2	0	47,800	10	0
Minke whale	California, Oregon, & Washington.	359	0	0	1,795	0	0
	Hawaiian	447	0	0	2,235	0	0
Baird's beaked whale	California, Oregon, & Washington.	4,420	0	0	22,100	0	0
Blainville's beaked whale	Hawaiian	10,316	0	0	48,172	0	0
Bottlenose dolphin	California coastal	521	0	0	2,605	0	0
	California, Oregon & Washington offshore.	26,618	0	0	133,090	0	0
	Hawaii Stock Complex	5,163	0	0	22,895	0	0
Cuvier's beaked whale	California, Oregon, & Washington.	13,353	0	0	66,765	0	0
	Hawaiian	52,893	0	0	248,025	0	0
Dwarf sperm whale	Hawaiian	22,359	46	0	101,291	214	0
Dall's porpoise	California, Oregon, & Washington.	36,891	47	0	184,455	235	0
False killer whale	Hawaii Insular	49	0	0	220	0	0
	Hawaii Pelagic	480	0	0	2,116	0	0
	Northwest Hawaiian Islands	177	0	0	776	0	0
Fraser's dolphin	Hawaiian	2,009	0	0	8,809	0	0
Killer whale	Eastern North Pacific offshore/transient.	321	0	0	1,605	0	0
	Hawaiian	182	0	0	822	0	0
Kogia spp	California	12,943	33	0	64,715	165	0
Long-beaked common dolphin	California	73,113	2	0	365,565	10	0
Longman's beaked whale	Hawaiian	3,666	0	0	17,296	0	0
Melon-headed whale	Hawaiian	1,511	0	0	6,733	0	0
Mesoplodon beaked whales [3]	California, Oregon, & Washington.	1,994	0	0	9,970	0	0
Northern right whale dolphin	California, Oregon, & Washington.	51,596	1	0	257,980	5	0
Pacific white-sided dolphin	California, Oregon, & Washington.	38,467	1	0	192,335	5	0
Pantropical spotted dolphin	Hawaiian	10,887	0	0	48,429	0	0
Pygmy killer whale	Hawaiian	571	0	0	2,603	0	0
Pygmy sperm whale	Hawaiian	229	0	0	1,093	0	0
Risso's dolphin	California, Oregon, & Washington.	86,564	1	0	432,820	5	0
	Hawaiian	1,085	0	0	4,887	0	0
Rough-toothed dolphin	Hawaiian	5,131	0	0	22,765	0	0
Short-beaked common dolphin	California, Oregon, & Washington.	999,282	70	*3	4,996,410	350	*15
Short-finned pilot whale	California, Oregon, & Washington.	308	0	0	1,540	0	0
	Hawaiian	9,150	0	0	40,760	0	0
Spinner dolphin	Hawaii Stock Complex	2,576	0	0	11,060	0	0
Striped dolphin	California, Oregon, & Washington.	3,545	0	0	17,725	0	0
	Hawaiian	3,498	0	0	15,422	0	0
California sea lion	U.S. Stock	126,961	25	*4	634,805	125	*20
Northern fur seal	San Miguel Island	20,083	5	0	100,415	25	0
Harbor seal	California	5,906	11	0	29,530	55	0
Northern elephant seal	California Breeding	22,516	22	0	112,580	110	0

[1] These numbers constitute the total for an annual maximum year (a notional 12-month period when all annual and non-annual events could occur) in which a RIMPAC exercise and Civilian Port Defense events would occur in Hawaii and SOCAL.
[2] These numbers constitute the summation over a 5-year period with annual events occurring five times and non-annual events occurring three times.
[3] Mesoplodon spp. in SOCAL for the undifferentiated occurrence of five Mesoplodon species (M. carlhubbsi, M. ginkgodens, M. perrini, M. peruvianus, M. stejnegeri but does not include Blainville's beaked whale listed separately above.

* These mortalities are considered in Table 18 as an unspecified "any small odontocete and pinniped species."

Testing Activities—Table 19 summarizes the Navy's take request for testing activities and Table 20 specifies the Navy's take request for testing activities by species from the modeling estimates.

While the Navy does not anticipate any mortalities predicted for testing activities by the acoustic modeling would occur, the Navy requests annual authorization for take by mortality of up to 19 small odontocetes (i.e., dolphins) and pinnipeds to include any combination of such species with potential presence in the Study Area as part of testing activities using impulsive sources.

The Navy does not anticipate vessel strikes of marine mammals would occur during testing activities in the Study Area in any given year. Most testing conducted in the Study Area that involves surface ships is conducted on Navy ships. Therefore, the vessel strike take request for training activities covers those activities. For the smaller number of testing activities not conducted in conjunction with fleet training, the Navy requests a smaller number of takes resulting incidental to vessel strike. However, in order to account for the accidental nature of vessel strikes to large whales in general, and potential risk from any vessel movement within the Study Area, the Navy is seeking take authorization in the event a Navy vessel strike does occur while conducting testing during the five year period of NMFS' final authorization as follows:

- The take by vessel strike during testing activities in any given year of no more than two large whales total of any combination of species including gray whale, fin whale, blue whale, humpback whale, Bryde's whale, sei whale, minke whale, or sperm whale. The two takes per year requested would be no more than one of any species of blue whale, fin whale, humpback whale, sei whale, or sperm whale in any given year.
- The take by vessel strike of no more than three large whales from testing activities over the course of the 5-year regulations.

TABLE 19—SUMMARY OF ANNUAL AND 5-YEAR TAKE REQUEST FOR TESTING ACTIVITIES

MMPA Category	Source	Testing activities	
		Annual authorization sought	5-Year authorization sought
Mortality	Impulse	19 mortalities applicable to any small odontocete or pinniped species.	95 mortalities applicable to any small odontocete or pinniped species over five years.
	Vessel strike	No more than 2 large whale mortalities in any given year.[1]	No more than 3 large whale mortalities over five years.[1]
Level A	Impulse and Non-Impulse.	145—Species specific data shown in Table 21.	725—Species specific data shown in Table 21.
Level B	Impulse and Non-Impulse.	238,880—Species specific data shown in Table 21.	1,194,400—Species specific data shown in Table 21.

[1] Navy cannot quantifiably predict that the proposed takes from testing (a total of two in a given year or over the course of 5-years) will be of any particular species, and therefore seeks take authorization for any combination of large whale species (gray whale, fin whale, blue whale, humpback whale, Bryde's whale, sei whale, minke whale, or sperm whale), but of the two takes in any given year, no more than one of each species of blue whale, fin whale, humpback whale, sei whale, or sperm whale is requested.

TABLE 20—SPECIES-SPECIFIC TAKE REQUESTS FROM MODELING ESTIMATES OF IMPULSIVE AND NON-IMPULSIVE SOURCE EFFECTS FOR ALL TESTING ACTIVITIES

Species	Stock	Annually			Total over 5-year rule		
		Level B	Level A	Mortality	Level B	Level A	Mortality
Blue whale	Eastern North Pacific	413	0	0	2,065	0	0
	Central North Pacific	15	0	0	75	0	0
Fin whale	California, Oregon, & Washington.	202	0	0	1,010	0	0
	Hawaiian	23	0	0	115	0	0
Humpback whale	California, Oregon, & Washington.	101	0	0	505	0	0
	Central North Pacific	820	0	0	4,100	0	0
Sei whale	Eastern North Pacific	21	0	0	105	0	0
	Hawaiian	30	0	0	150	0	0
Sperm whale	California, Oregon, & Washington.	146	0	0	730	0	0
	Hawaiian	117	0	0	585	0	0
Guadalupe fur seal	Mexico	269	0	0	1,345	0	0
Hawaiian monk seal	Hawaiian	358	0	0	1,790	0	0
Bryde's whale	Eastern Tropical Pacific	5	0	0	25	0	0
	Hawaiian	13	0	0	65	0	0
Gray whale	Eastern North Pacific	2,570	1	0	12,850	5	0
Minke whale	California, Oregon, & Washington.	49	0	0	245	0	0
	Hawaiian	30	0	0	150	0	0
Baird's beaked whale	California, Oregon, & Washington.	1,045	0	0	5,225	0	0
Blainville's beaked whale	Hawaiian	960	0	0	4,800	0	0

TABLE 20—SPECIES-SPECIFIC TAKE REQUESTS FROM MODELING ESTIMATES OF IMPULSIVE AND NON-IMPULSIVE SOURCE EFFECTS FOR ALL TESTING ACTIVITIES—Continued

Species	Stock	Annually			Total over 5-year rule		
		Level B	Level A	Mortality	Level B	Level A	Mortality
Bottlenose dolphin	California coastal	769	0	0	3,845	0	0
	California, Oregon & Washington offshore.	2,407	0	0	12,035	0	0
	Hawaii Stock Complex	337	0	0	1,685	0	0
Cuvier's beaked whale	California, Oregon, & Washington.	2,319	0	0	11,595	0	0
	Hawaiian	4,549	0	0	22,745	0	0
Dwarf sperm whale	Hawaiian	2,376	28	0	11,880	140	0
Dall's porpoise	California, Oregon, & Washington.	5,215	32	0	26,075	160	0
False killer whale	Hawaii Insular	4	0	0	20	0	0
	Hawaii Pelagic	37	0	0	185	0	0
False killer whale	Northwest Hawaiian Islands	14	0	0	70	0	0
Fraser's dolphin	Hawaiian	45	0	0	225	0	0
Killer whale	Eastern North Pacific offshore/transient.	53	0	0	265	0	0
	Hawaiian	14	0	0	70	0	0
Kogia spp.	California	1,232	6	0	6,160	30	0
Long-beaked common dolphin	California	47,851	2	0	239,255	10	0
Longman's beaked whale	Hawaiian	436	0	0	2,180	0	0
Melon-headed whale	Hawaiian	124	0	0	620	0	0
Mesoplodon beaked whales [1]	California, Oregon, & Washington.	345	0	0	1,725	0	0
Northern right whale dolphin	California, Oregon, & Washington.	5,729	1	0	28,645	5	0
Pacific white-sided dolphin	California, Oregon, & Washington.	4,924	1	0	24,620	5	0
Pantropical spotted dolphin	Hawaiian	685	2	0	3,425	10	0
Pygmy killer whale	Hawaiian	61	0	0	305	0	0
Pygmy sperm whale	Hawaiian	117	1	0	585	5	0
Risso's dolphin	California, Oregon, & Washington.	8,739	1	0	43,695	5	0
	Hawaiian	113	0	0	565	0	0
Rough-toothed dolphin	Hawaiian	410	0	0	2,050	0	0
Short-beaked common dolphin	California, Oregon, & Washington.	122,748	40	* 13	613,740	200	* 65
Short-finned pilot whale	California, Oregon, & Washington.	79	0	0	395	0	0
	Hawaiian	797	0	0	3,985	0	0
Spinner dolphin	Hawaii Stock Complex	167	1	0	835	5	0
Striped dolphin	California, Oregon, & Washington.	998	0	0	4,990	0	0
	Hawaiian	269	1	0	1,345	5	0
California sea lion	U.S. Stock	13,038	17	* 6	65,190	85	* 30
Northern fur seal	San Miguel Island	1,088	3	0	5,440	15	0
Harbor seal	California	892	3	0	4,460	15	0
Northern elephant seal	California Breeding	2,712	5	0	13,560	25	0

[1] Mesoplodon spp. in SOCAL for the undifferentiated occurrence of five Mesoplodon species (M. carlhubbsi, M. ginkgodens, M. perrini, M. peruvianus, M. stejnegeri) but does not include Blainville's beaked whale listed separately above.

* These mortalities are considered in Table 20 as an unspecified ''any small odontocete and pinniped species.''

Marine Mammal Habitat

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

Important Marine Mammal Habitat

The only ESA-listed marine mammal with designated critical habitat within the HSTT Study Area is the Hawaiian monk seal. Critical habitat was first established for the Hawaiian monk seal in 1986 to include all beach areas, sand spits and islets, lagoon waters, inner reef waters, and ocean waters to a depth of 18.3 m around specified northwestern Hawaiian Islands. These areas were expanded in 1988 and in 2011, NMFS proposed that six new extensive areas in the main Hawaiian Islands be added. However, specific areas were excluded from critical habitat designation because it was determined that the national security benefits of exclusion outweighed the benefits of inclusion, and that their exclusion would not result in extinction of the species. The excluded areas include: Kingfisher

Underwater Training area in marine areas off the northeast coast of Niihau; Pacific Missile Range Facility Main Base at Barking Sands, Kauai; Pacific Missile Range Facility Offshore Areas in marine areas off the western coast of Kauai; the Naval Defensive Sea Area and Puuloa Underwater Training Range in marine areas outside Pearl Harbor, Oahu; and the Shallow Water Minefield Sonar Training Range off the western coast of Kahoolawe in the Maui Nui area.

The nearshore areas in and around the Hawaiian Humpback Whale National Marine Sanctuary contain very important breeding and calving habitat for the humpback whale; however, effects in this area have been analyzed previously in this document in the context of the whales themselves. There are no known specific breeding areas within the SOCAL Range Complex with the exception of pinnipeds. Much is unknown about the specifics of dolphin mating, but it is presumed that these species mate throughout their habitat and possibly throughout the year. Even less is known about the mating habits of beaked whales. Most of the offshore area within the SOCAL Range Complex could potentially be utilized for active sonar activities or underwater detonations. The Navy assumes that active sonar activities could take place within potential mating areas of these toothed whale species within SOCAL, although current state of knowledge is very limited and there may be seasonal components to distribution that could account for breeding activities outside of the SOCAL Range Complex. Baleen whales and sperm whales breed in deep tropical and subtropical waters south and west of the SOCAL Range Complex.

Expected Effects on Habitat

Unless the sound source or explosive detonation is stationary and/or continuous over a long duration in one area, the effects of the introduction of sound into the environment are generally considered to have a less severe impact on marine mammal habitat than the physical alteration of the habitat. Activities involving sound or energy from sonar and other active acoustic sources would not occur on shore in designated Hawaiian monk seal critical habitat where haul out and resting behavior occurs and would have no effect on critical habitat at sea. Acoustic exposures are not expected to result in long-term physical alteration of the water column or bottom topography, as the occurrences are of limited duration and are intermittent in time. Surface vessels associated with the activities are present in limited duration and are intermittent as they are continuously and relatively rapidly moving through any given area. Most of the high-explosive military expended materials would detonate at or near the water surface. Only bottom-laid explosives are likely to affect bottom substrate; habitat used for underwater detonations and seafloor device placement would primarily be soft-bottom sediment. Once on the seafloor, military expended material would likely be colonized by benthic organisms because the materials would serve as anchor points in the shifting bottom substrates, similar to a reef. The surface area of bottom substrate affected would make up a very small percentage of the total training area available in the HSTT Study Area.

Effects on Marine Mammal Prey

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

Marine invertebrates in the Hawaii Range Complex (HRC) portion of the HSTT Study Area inhabit coastal waters and seafloor habitats, including rocky intertidal zones, coral reefs, deep-water slopes, canyons, and seamounts. Corals are the primary living structural components of Hawaii's subtidal zone, with an average of about 20.3 percent coral coverage in the main Hawaiian Islands (Friedlander *et al.* 2005). Approximately 250 species of corals are found within the main Hawaiian Islands, but the area is dominated by six species (Maragos *et al.,* 2004; Friedlander *et al.,* 2005). The Northwestern Hawaiian Islands have at least 57 species of stony coral (Maragos *et al.* 2004). The coral reefs of the Northwestern Hawaiian Islands support diverse communities of bottom-dwelling invertebrates. Over 800 non-coral invertebrate species have been identified from the Northwestern Hawaiian Islands. Mollusks, echinoderms, and crustaceans dominate, representing 80 percent of the invertebrate species (Friedlander *et al.* 2005).

Marine invertebrates in the Southern California portion of the HSTT Study Area inhabit coastal waters and benthic habitats, including salt marshes, kelp forests, soft sediments, canyons, and the continental shelf. The diverse range of species include oysters, crabs, worms, ghost shrimp, California horn snails (Cerithidea californica), sponges, sea fans, isopods, and stony corals (Proctor *et al.,* 1980; Dugan *et al.,* 2000; Chess and Hobson, 1997). The Channel Islands, off the coast of Southern California, are situated in a transitional location between cold and warm water, making them host to over 5,000 invertebrate species (Tissot *et al.,* 2006). Soft-bottom communities of California estuaries, such as San Diego Bay, are home to mostly crustaceans, marine worms, and mollusks (Navy and San Diego Unified Port District, 2000).

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

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

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

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

Fish—Fish are not distributed uniformly throughout the HSTT Study Area, but are closely associated with a variety of habitats. Some species range across thousands of square miles while others have small home ranges and restricted distributions (Helfman *et al.,* 2009).

Currently 566 species of reef and shore fishes are known to occur around the Insular Pacific-Hawaiian Large Marine Ecosystem within the HSTT Study Area. The high number of species that are found only in Hawaii can be explained by its geographical and hydrographical isolation (Randall 1998). Migratory open ocean fishes, such as the larger tunas, the billfishes, and some sharks, are able to move across the great distance that separates the Hawaiian Islands from other islands or continents in the Pacific. Coral reef fish communities in the Hawaiian Islands (excluding Nihoa) show a consistent pattern of species throughout the year. Exceptions include the seasonal distributions of migratory, open ocean species. Several reef fish species also show seasonal fluctuations which are usually related to movements of juveniles into new areas or spawning activity (U. S. Navy Office of Naval Research, 2001).

The Southern California portion of the HSTT Study Area is in a region of highly productive fisheries (Leet *et al.,* 2001) within the California Current Large Marine Ecosystem. The portion of the California Bight in the HSTT Study Area is a transitional zone between cold and warm water masses, geographically separated by Point Conception. The cold-water California Current Large Marine Ecosystem is rich in microscopic plankton (diatoms, krill, and other organisms), which form the base of the food chain in the Southern California portion of the HSTT Study Area. Small coastal pelagic fishes depend on this plankton and in turn are fed on by larger species (such as highly migratory species). The high fish diversity found in the HSTT Study Area occurs for several reasons: (1) The ranges of many temperate and tropical species extend into Southern California; (2) the area has complex bottom features and physical oceanographic features that include several water masses and a changeable marine climate (Allen *et al.* 2006; Horn and Allen 1978); and (3) the islands and coastal areas provide a diversity of habitats that include soft bottom, rocky reefs, kelp beds, and estuaries, bays, and lagoons.

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

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

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

Marine Mammal Avoidance

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

Other Expected Effects

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

Analysis and Negligible Impact Determination

Pursuant to NMFS' regulations implementing the MMPA, an applicant is required to estimate the number of animals that will be ''taken'' by the specified activities (i.e., takes by harassment only, or takes by harassment, injury, and/or death). This estimate informs the analysis that NMFS must perform to determine whether the activity will have a ''negligible impact'' on the affected species or stock. Level B (behavioral) harassment occurs at the level of the individual(s) and does not assume any resulting population-level consequences, though there are known avenues through which behavioral disturbance of individuals can result in population-level effects (e.g., pink-footed geese (*Anser brachyrhynchus*) in undisturbed habitat gained body mass and had about a 46-percent reproductive success compared with geese in disturbed habitat (being consistently scared off the fields on which they were foraging) which did not gain mass and had a 17-percent reproductive success). 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 Level B harassment takes, alone, is not enough information on which to base an impact determination. In addition to considering estimates of the number of marine mammals that might be ''taken'' through behavioral harassment, NMFS must consider other factors, such as the likely nature of any responses (their intensity, duration, etc.), the context of any responses (critical reproductive time or location, migration, etc.), as well as the number and nature of estimated Level A harassment takes, the number of estimated mortalities, and effects on habitat. Generally speaking, and especially with other factors being equal, the Navy and NMFS anticipate more severe effects from takes resulting from exposure to higher received levels (though this is in no way a strictly linear relationship throughout species, individuals, or circumstances) and less severe effects from takes resulting from exposure to lower received levels.

The Navy's specified activities have been described based on best estimates of the maximum number of activity hours or detonations that the Navy would conduct. There may be some flexibility in the exact number of hours, items, or detonations may vary from year to year, but totals would not exceed the 5-year totals indicated in Tables 19 and 21. Furthermore the Navy's take request is based on their model and post-model analysis. The requested number of Level B takes does not equate to the number of individual animals the Navy expects to harass (which is lower), but rather to the instances of take (i.e., exposures) that will occur. Depending on the location, duration, and frequency of activities, along with the distribution and movement of marine mammals, individual animals may be exposed multiple times to impulse or non-impulse sounds at or above the Level B harassment threshold. However, the Navy is currently unable to estimate the number of individuals that may be taken during training and testing activities. The model results over estimate the overall number of takes that may occur to a smaller number of individuals. While the model shows that an increased number of exposures may take place (compared to the 2009 rulemakings for HRC and the SOCAL Range Complex), the types and severity of individual responses to training and testing activities are not expected to change.

Taking the above into account, considering the sections discussed below, and dependent upon the implementation of the proposed mitigation measures, NMFS has preliminarily determined that Navy's proposed training and testing exercises would have a negligible impact on the marine mammal species and stocks present in the Study Area.

Behavioral Harassment

As discussed previously in this document, marine mammals can respond to MFAS/HFAS in many different ways, a subset of which qualifies as harassment (see Behavioral Harassment Section). One thing that the take estimates do not take into account is the fact that most marine mammals will likely avoid strong sound sources to one extent or another. Although an animal that avoids the sound source will likely still be taken in some instances (such as if the avoidance results in a missed opportunity to feed, interruption of reproductive behaviors, etc.) in other cases avoidance may result in fewer instances of take than were estimated or in the takes resulting from exposure to a lower received level than was estimated, which could result in a less severe response. For MFAS/HFAS, the Navy provided information (Table 21) estimating the percentage of behavioral harassment that would occur within the 6-dB bins (without considering mitigation or avoidance). As mentioned above, an animal's exposure to a higher received level is more likely to result in a behavioral response that is more likely to adversely affect the health of the animal. As the table illustrates, the vast majority (about 83 percent, at least for hull-mounted sonar, which is responsible for most of the sonar takes) of calculated takes for MFAS result from exposures between 156 dB and 162 dB. Less than 0.5 percent of the takes are expected to result from exposures above 174 dB.

TABLE 21—NON-IMPULSIVE RANGES IN 6–dB BINS AND PPERCENTAGE OF BEHAVIORAL HARASSMENTS

Received level	Sonar bin MF1 (e.g., SQS–53; ASW hull mounted sonar)		Sonar bin MF4 (e.g., AQS–22; ASW dipping sonar)		Sonar Bin MF5 (e.g., SSQ–62; ASW sonobuoy)		Sonar Bin HF4 (e.g., SQQ–32; MIW sonar)	
	Distance at which levels occur within radius of source (m)	Percentage of behavioral harassments occurring at given levels	Distance at which levels occur within radius of source (m)	Percentage of behavioral harassments occurring at given levels	Distance at which levels occur within radius of source (m)	Percentage of behavioral harassments occurring at given levels	Distance at which levels occur within radius of source (m)	Percentage of behavioral harassments occurring at given levels
Low Frequency Cetaceans								
120 ≤SPL <126	172,558–162,925	0.00	40,000–40,000	0.00	23,880–17,330	0.00	3,100–2,683	0.00
126 ≤SPL <132	162,925–117,783	0.00	40,000–40,000	0.00	17,330–12,255	0.10	2,683–2,150	0.01
132 ≤SPL <138	117,783–108,733	0.04	40,000–12,975	3.03	12,255–7,072	4.12	2,150–1,600	0.48
138 ≤SPL <144	108,733–77,850	1.57	12,975–12,800	0.14	7,072–3,297	23.69	1,600–1,150	4.20
144 ≤SPL <150	77,850–58,400	5.32	12,800–6,525	27.86	3,297–1,113	42.90	1,150–575	24.79
150 ≤SPL <156	58,400–53,942	4.70	6,525–2,875	36.83	1,113–255	24.45	575–300	28.10
156 ≤SPL <162	53,942–8,733	83.14	2,875–1,088	23.78	255–105	3.52	300–150	24.66
162 ≤SPL <168	8,733–4,308	3.51	1,088–205	7.94	105–55	1.08	150–100	9.46
168 ≤SPL <174	4,308–1,950	1.31	205–105	0.32	55–55	0.00	100–<50	8.30
174 ≤SPL <180	1,950–850	0.33	105–55	0.10	55–55	0.00	<50	0.00
180 ≤SPL <186	850–400	0.06	55–<50	0.01	55–<50	0.13	<50	0.00
186 ≤SPL <192	400–200	0.01	<50	0.00	<50	0.00	<50	0.00
192 ≤ SPL <198	200–100	0.00	<50	0.00	<50	0.00	<50	0.00
Mid-Frequency Cetaceans								
120 ≤ SPL <126	172,592–162,933	0.00	40,000–40,000	0.00	24,205–18,872	0.00	4,133–3,600	0.00
126 ≤ SPL <132	162,933–124,867	0.00	40,000–40,000	0.00	18,872–12,697	0.10	3,600–3,075	0.00
132 ≤ SPL <138	124,867–108,742	0.07	40,000–12,975	2.88	12,697–7,605	3.03	3,075–2,525	0.01
138 ≤ SPL <144	108,742–78,433	1.54	12,975–12,800	0.02	7,605–4,080	17.79	2,525–1,988	0.33
144 ≤ SPL <150	78,433–58,650	5.41	12,800–6,525	26.73	4,080–1,383	46.83	1,988–1,500	2.83
150 ≤ SPL <156	58,650–53,950	4.94	6,525–2,875	36.71	1,383–300	27.08	1,500–1,000	14.92
156 ≤ SPL <162	53,950–8,925	82.62	2,875–1,088	25.65	300–155	3.06	1,000–500	40.11
162 ≤ SPL <168	8,925–4,375	3.66	1,088–205	7.39	155–55	2.02	500–300	22.18
168 ≤ SPL <174	4,375–1,992	1.34	205–105	0.52	55–55	0.00	300–150	14.55
174 ≤ SPL <180	1,992–858	0.34	105–55	0.09	55–55	0.00	150–<50	5.07
180 ≤ SPL <186	858–408	0.06	55–<50	0.01	55–<50	0.09	<50	0.00
186 ≤ SPL <192	408–200	0.01	<50	0.00	<50	0.00	<50	0.00
192 ≤ SPL <198	200–100	0.00	<50	0.00	<50	0.00	<50	0.00

ASW: anti-submarine warfare; MIW: mine warfare; m: meter; SPL: sound pressure level

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

Diel Cycle

As noted previously, many animals perform vital functions, such as feeding, resting, traveling, and socializing on a diel cycle (24-hour cycle). Behavioral reactions to noise exposure (when taking place in a biologically important context, such as disruption of critical life functions, displacement, or avoidance of important habitat) are more likely to be significant if they last more than one diel cycle or recur on subsequent days (Southall *et al.,* 2007). Consequently, a behavioral response lasting less than one day and not recurring on subsequent days is not considered severe unless it could directly affect reproduction or survival (Southall *et al.,* 2007).

In the previous section, we discussed that potential behavioral responses to MFAS/HFAS that fall into the category of harassment could range in severity. By definition, for military readiness activities, takes by behavioral harassment involve the disturbance or likely disturbance of a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns (such as migration, surfacing, nursing, breeding, feeding, or sheltering) to a point where such behavioral patterns are abandoned or significantly altered. These reactions would, however, be more of a concern if they were expected to last over 24 hrs or be repeated in subsequent days. However, vessels with hull-mounted active sonar are typically moving at speeds of 10–15 knots, 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. Animals may be exposed to MFAS/HFAS for more than one day or on successive days. However, because neither the vessels nor the animals are stationary, significant long-term effects are not expected.

Most planned explosive exercises are of a short duration (1–6 hours). Although explosive exercises may sometimes be conducted in the same general areas repeatedly, because of their short duration and the fact that they are in the open ocean and animals can easily move away, it is similarly unlikely that animals would be exposed for long, continuous amounts of time.

TTS

As mentioned previously, TTS can last from a few minutes to days, be of varying degree, and occur across various frequency bandwidths, all of which determine the severity of the impacts on the affected individual, which can range from minor to more severe. The TTS sustained by an animal is primarily classified by three characteristics:

1. Frequency—Available data (of mid-frequency hearing specialists exposed to mid- or high-frequency sounds; Southall *et al.,* 2007) suggest that most TTS occurs in the frequency range of the source up to one octave higher than the source (with the maximum TTS at ½ octave above). The more powerful MF sources used have center frequencies between 3.5 and 8 kHz and the other unidentified MF sources are, by definition, less than 10 kHz, which suggests that TTS induced by any of these MF sources would be in a frequency band somewhere between approximately 2 and 20 kHz. There are fewer hours of HF source use and the sounds would attenuate more quickly, plus they have lower source levels, but if an animal were to incur TTS from these sources, it would cover a higher frequency range (sources are between 20 and 100 kHz, which means that TTS could range up to 200 kHz; however, HF systems are typically used less frequently and for shorter time periods than surface ship and aircraft MF systems, so TTS from these sources is even less likely). TTS from explosives would be broadband. Vocalization data for each species was provided in the Navy's LOA application.

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

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

Based on the range of degree and duration of TTS reportedly induced by exposures to non-pulse sounds of energy higher than that to which free-swimming marine mammals in the field are likely to be exposed during MFAS/HFAS training exercises in the Study Area, it is unlikely that marine mammals would ever sustain a TTS from MFAS that alters their sensitivity by more than 20 dB for more than a few days (and any incident of TTS would likely be far less severe due to the short duration of the majority of the exercises and the speed of a typical vessel). Also, for the same reasons discussed in the Diel Cycle section, and because of the short distance within which animals would need to approach the sound source, it is unlikely that animals would be exposed to the levels necessary to induce TTS in subsequent time periods such that their recovery is impeded. Additionally, though the frequency range of TTS that marine mammals might sustain would overlap with some of the frequency ranges of their vocalization types, the frequency range of TTS from MFAS (the source from which TTS would most likely be sustained because the higher source level and slower attenuation make it more likely that an animal would be exposed to a higher received level) would not usually span the entire frequency range of one vocalization type, much less span all types of vocalizations. If impaired, marine mammals would typically be aware of their impairment and implement behaviors to compensate (see Acoustic Masking or Communication Impairment section), though these compensations may incur energetic costs.

Acoustic Masking or Communication Impairment

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

PTS, Injury, or Mortality

NMFS believes that many marine mammals would deliberately avoid exposing themselves to the received levels of active sonar necessary to induce injury by moving away from or at least modifying their path to avoid a close approach. Additionally, in the unlikely event that an animal approaches the sonar vessel at a close distance, NMFS believes that the mitigation measures (i.e., shutdown/powerdown zones for MFAS/HFAS) would typically ensure that animals would not be exposed to injurious levels of sound. As discussed previously, the Navy utilizes both aerial (when available) and passive acoustic monitoring (during all ASW exercises) in addition to watchstanders on vessels to detect marine mammals for mitigation implementation.

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

As discussed previously, marine mammals (especially beaked whales) could potentially respond to MFAS at a received level lower than the injury threshold in a manner that indirectly results in the animals stranding. The exact mechanism of this potential response, behavioral or physiological, is not known. When naval exercises have been associated with strandings in the past, it has typically been when three or more vessels are operating simultaneously, in the presence of a strong surface duct, and in areas of constricted channels, semi-enclosed areas, and/or steep bathymetry. Based on the number of occurrences where strandings have been definitively associated with military active sonar versus the number of hours of active sonar training that have been conducted, we believe that the probability is small that this will occur. Lastly, an active sonar shutdown protocol for strandings involving live animals milling in the water minimizes the chances that these types of events turn into mortalities.

While NMFS does not expect any mortalities from impulsive sources to occur, we are proposing to authorize takes by mortality of a limited number of small odontocetes and pinnipeds from training and testing activities. Based on previous vessel strikes in the Study Area, NMFS is also proposing to authorize takes by mortality of a limited number of large whales from vessel strike. As described previously, although we have a good sense of how many marine mammals the Navy may strike over the course of 5 years (and it is much smaller than the 15 large whale mortalities requested for all training and testing activities), the species distribution is unpredictable. Thus, we have analyzed the possibility that all large whale takes requested in one year may be of the same species. However, the number of takes authorized of a single species is limited (for example, no more than three takes of any one of the following species may occur in a single year: blue whale, fin whale, humpback whale, sei whale, and sperm whale). Over the first three years of the existing HRC and SOCAL rules, five mortalities have resulted from activities that would be covered by the HSTT rule: two mortalities from ship strike, and three confirmed mortalities from explosive exercises (which occurred before the monitoring was modified to its current form, which better protects animals when time-delay firing devices are used). The number of mortalities from vessel strikes are not expected to be an increase over the past decade, but rather they are being addressed under the incidental take authorization for the first time.

Species-Specific Analysis

In the discussions below, the ''acoustic analysis'' refers to the Navy's model results and post-model analysis. The Navy performed a quantitative analysis to estimate the number of marine mammals that could be harassed by acoustic sources or explosives used during Navy training and testing activities. Inputs to the quantitative analysis included marine mammal density estimates; marine mammal depth occurrence distributions; oceanographic and environmental data; marine mammal hearing data; and criteria and thresholds for levels of potential effects. Marine mammal densities used in the model may overestimate actual densities when species data is limited and for species with seasonal migrations (e.g., humpbacks, blue whales, Hawaiian stock of fin whales, sei whales, gray whales). The quantitative analysis consists of computer modeled estimates and a post-model analysis to determine the number of potential mortalities and harassments. The model calculates sound energy propagation from sonars, other active acoustic sources, and explosives during naval activities; the sound or impulse received by animat dosimeters representing marine mammals distributed in the area around the modeled activity; and whether the sound or impulse received by a marine mammal exceeds the thresholds for effects. The model estimates are then further analyzed to consider animal avoidance and implementation of mitigation measures, resulting in final estimates of effects due to Navy training and testing. It is important to note that the Navy's take estimates represent the total number of takes and not the number of individuals taken, as a single individual may be taken multiple times over the course of a year.

Although this more complex computer modeling approach accounts for various environmental factors affecting acoustic propagation, the current software tools do not consider the likelihood that a marine mammal would attempt to avoid repeated exposures to a sound or avoid an area of intense activity where a training or testing event may be focused. Additionally, the software tools do not consider the implementation of mitigation (e.g., stopping sonar transmissions when a marine mammal is within a certain distance of a ship or range clearance prior to detonations). In both of these situations, naval activities are modeled as though an activity would occur regardless of proximity to marine mammals and without any horizontal movement by the animal away from the sound source or human activities (e.g., without accounting for likely animal avoidance). The initial model results overestimate the number of takes (as described previously), primarily by behavioral disturbance. The final step of the quantitative analysis of acoustic effects is to consider the implementation of mitigation and the possibility that marine mammals would avoid continued or repeated sound exposures. NMFS provided input to the Navy on this process and the Navy's qualitative analysis is described in detail in section 6.3 of their LOA application (*http://www.nmfs.noaa.gov/pr/permits/incidental.htm#applications*).

Mysticetes—The Navy's acoustic analysis indicates that numerous exposures of mysticete species to sound levels likely to result in Level B harassment may occur, mostly from sonar and other active acoustic stressors associated with mostly training and some testing activities in the HSTT Study Area. Of these species, humpback, blue, fin, and sei whales are listed as endangered under the ESA. Level B takes are anticipated to be in the form of behavioral harassment and no injurious takes of humpback, blue, fin, or sei whales from sonar, or other active acoustic stressors are expected. The majority of acoustic effects to mysticetes from sonar and other active sound sources during training activities would be primarily from anti-submarine warfare events involving surface ships and hull mounted (mid-frequency) sonar. Most Level B harassments to mysticetes from sonar would result from received levels between 144 and 162 SPL. High-frequency systems are not within mysticetes' ideal hearing range and it is unlikely that they would cause a significant behavioral reaction. The only mysticete species that may be exposed to sound or energy from explosions resulting in the possibility of PTS is the gray whale. Exposures would occur in the SOCAL Range Complex during the cool season However, the Navy's proposed mitigation zones for explosive activities extend beyond the predicted maximum range to PTS. The implementation of mitigation and the sightability of mysticetes (due to their large size) reduces the potential for a significant behavioral reaction or a threshold shift to occur. Furthermore, gray whales in particular should be easier to sight because they would be migrating through the HSTT Study Area and there is often more than one whale in an area at the same time.

In addition to Level B takes, the Navy is requesting no more than 12 large whale mortalities over 5 years (no more than 4 large whale mortalities in a given year) due to vessel strike during training activities and no more than three large whale mortalities over 5 years (no more than 2 large whale mortalities in any given year) due to vessel strike during testing activities. However, no more than three mortalities of any of the following species would be authorized to occur in a given year: blue whale, fin whale, humpback whale, sei whale, and sperm whale. The Navy provided a detailed analysis of strike data in section 6.3.4 of their LOA application. Marine mammal mortalities were not previously analyzed by NMFS in the 2009 rulemakings for HRC and the SOCAL Range Complex. However, over a period of 20 years (1991 to 2010), there have been 16 Navy vessel strikes in the SOCAL Range Complex and five Navy vessel strikes in HRC. No single 5-year period exceeded ten whales struck within SOCAL and HRC. The number of mortalities from vessel strike are not expected to be an increase over the past decade, but rather NMFS is proposing to authorize these takes for the first time.

Areas of high humpback whale density in the HRC were discussed earlier in this document. Since humpback whales migrate to the north in the summer, impacts are predicted only for the cool season in the HSTT Study Area. While the humpback breeding areas around Hawaii are important, NMFS has determined that MFAS training in these areas is rare and infrequent and should not affect annual rates of recruitment or survival. As discussed in the Proposed Mitigation section of this document, the Navy has agreed that training exercises in the designated Humpback Whale Cautionary Area would require a much higher level of clearance than is normal practice in planning and conducting MFAS training. Furthermore, no reported cases of harmful effects to humpback whales attributed to MFAS use have occurred during the Navy's 40-plus years of training in the waters off the Hawaiian Islands. Coincident with this use of MFAS, abundance estimates reflect an annual increase in the humpback whale stock (Mobley 2001a, 2004). A recent long-term study of humpback whales in Hawaiian waters shows long-term fidelity to the Hawaiian winter grounds, with many showing sighting spans ranging from 10 to 32 years (Herman *et al.,* 2011). The overall abundance of humpback whales in the north Pacific has continued to increase and is now greater than some pre-whaling abundance estimates (Barlow *et al.,* 2011). The California, Oregon, Washington stock of humpback whales use the waters within the Southern California portion of the HSTT Study Area as a summer feeding ground. No areas of specific importance for reproduction or feeding for other mysticetes have been identified in the HSTT Study Area.

Sperm Whales—The Navy's acoustic analysis indicates that 3,595 exposures of sperm whales to sound levels likely to result in Level B harassment may occur in the HSTT Study Area from sonar or other active acoustic stressors during training and testing activities. These Level B takes are anticipated to be in the form of behavioral harassment and no injurious takes of sperm whales from sonar, other active acoustic stressors, or explosives are requested or proposed for authorization. Sperm whales have shown resilience to acoustic and human disturbance, although they may react to sound sources and activities within a few kilometers. Sperm whales that are exposed to activities that involve the use of sonar and other active acoustic sources may alert, ignore the stimulus, avoid the area by swimming away or diving, or display aggressive behavior. Some (but not all) sperm whale vocalizations might overlap with the MFAS/HFAS TTS frequency range, which could temporarily decrease an animal's sensitivity to the calls of conspecifics or returning echolocation signals. However, as noted previously, NMFS does not anticipate TTS of a long duration or severe degree to occur as a result of exposure to MFAS/HFAS. The majority of Level B takes are expected to be in the form of mild responses. No areas of specific importance for reproduction or feeding for sperm whales have been identified in the HSTT Study Area.

Pygmy and Dwarf Sperm Whales—The Navy's acoustic analysis indicates that 25,081 exposures of pygmy and dwarf sperm whales to sound levels likely to result in Level B harassment may occur from sonar and other active acoustic stressors and explosives associated with training and testing activities in the HRC. In SOCAL, the two *Kogia* species are managed as a single stock and management unit and up to 14,175 exposures to sound levels likely to result in Level B harassment may occur from sonar and other active acoustic stressors and explosives associated with training and testing activities. The Navy's acoustic analysis also indicates that 74 exposures of dwarf sperm whale and one exposure of pygmy sperm whale to sound levels likely to result in Level A harassment may occur from active acoustic stressors and explosions in HRC and 39 exposures of *Kogia* to sound levels likely to result in Level A harassment may occur from active acoustic stressors or explosions in SOCAL. Behavioral responses can range from a mild orienting response, or a shifting of attention, to flight and panic. These species tend to avoid human activity and presumably anthropogenic sounds. Pygmy and dwarm sperm whales may startle and leave the immediate area of activity, reducing the potential impacts. Significant behavioral reactions seem more likely than with most other odontocetes; however, it is unlikely that animals would receive multiple exposures over a short period of time, allowing animals to recover lost resources (e.g., food) or opportunities (e.g., mating). Therefore, long-term consequences for individual Kogia or their respective populations are not expected. Furthermore, many explosions actually occur upon impact with above-water targets. However, sources such as these were modeled as exploding at 1 meter depth, which overestimates the potential effects.

Data from several sources, which are summarized and cited on NOAA's Cetacean and Sound Mapping Web site (*cetsound.noaa.gov*) indicate that there are resident populations of dwarf sperm whales (among other species) off the western side of the Big Island of Hawaii. As discussed earlier, we highlight the presence of resident populations in the interest of helping to support decisions that ensure that these small populations, limited to a small area of preferred habitat, are not exposed to concentrations of activities within their ranges that have the potential to impact a large portion of the stock/species over longer amounts of time that could have detrimental consequences to the stock/species. However, NMFS has reviewed the Navy's exercise reports and considered/discussed their historical level of activity in the area where these resident populations are concentrated, which is very low, and concluded that time/area restrictions would not afford much reduction of impacts in this location and are not necessary at this point. If future monitoring and exercise reports suggest that increased operations are overlapping with these resident populations, NMFS would revisit the consideration of time/area limitations around these populations.

Dall's Porpoise—The Navy's acoustic analysis indicates that 42,106 exposures of Dall's porpoise to sound levels likely to result in Level B Harassment may occur from sonar and other active acoustic stressors and explosives associated with training and testing activities in the SOCAL Range Complex. The analysis also indicates that 79 exposures to sound levels likely to result in Level A Harassment may occur from sonar and other active acoustic stressors.

Predicted impacts to odontocetes from activities from sonar and other active acoustic sources are mostly from anti-submarine warfare events involving surface ships and hull mounted sonar. For high-frequency cetaceans, such as Dall's porpoise, ranges to TTS for multiple pings can, under certain conditions, reach over 10 km from a source. Activities involving ASW training often involve multiple participants and activities associated with the event. Sensitive species, such as Dall's porpoise, may avoid the area for the duration of the event and then return, allowing the animal to recover from any energy expenditure or missed resources. However, the Navy's proposed mitigation has a provision that allows the Navy to continue operation of MFAS if the animals are clearly bow-riding even after the Navy has initially maneuvered to try and avoid closing with the animals. Since these animals sometimes bow-ride, they could potentially be exposed to levels associated with TTS. Some dolphin vocalizations might overlap with the MFAS/HFAS TTS frequency range (2–20 kHz), which could potentially temporarily decrease an animal's sensitivity to the calls of conspecifics or returning echolocation signals. However, for the reasons described in the beginning of this section, NMFS does not anticipate TTS of a long duration or severe degree to occur as a result of exposure to MFA/HFAS.

Ranges to PTS are on average about 855 meters from the largest explosive (Bin E12) for a high-frequency cetacean such as Dall's porpoise, which is less than the proposed mitigation zone for most explosive source bins. The metrics used to estimate PTS are based on the animal's mass; the smaller an animal, the more susceptible that individual is to these effects. In the Navy's analysis, all individuals of a given species were assigned the weight of that species' newborn calf. Since many individual Dall's porpoise are obviously larger than a newborn calf, this assumption causes the acoustic model to overestimate the potential effects. Threshold shifts do not necessarily affect all hearing frequencies equally, so some threshold shifts may not interfere with an animal hearing biologically relevant sounds.

Odontocetes, such as Dall's porpoise, may further minimize sound exposure during avoidance due to directional hearing. No areas of specific importance for reproduction or feeding for Dall's porpoise have been identified in the HSTT Study Area.

Beaked Whales—The Navy's acoustic analysis indicates that numerous exposures of beaked whale species to sound levels likely to result in Level B Harassment may occur from sonar and other active acoustic stressors associated with training and testing activities. Research and observations show that if beaked whales are exposed to sonar or other active acoustic sources they may startle, break off feeding dives, and avoid the area of the sound source to levels of 157 dB (McCarthy *et al.,* 2011). Furthermore, in research done at the Navy's instrumented tracking range in the Bahamas, animals leave the immediate area of the anti-submarine warfare training exercise, but return within a few days after the event ends. At the Bahamas range and at Navy instrumented ranges in the HSTT Study Area that have been operating for decades (in Hawaii north of Kauai and in SOCAL west of San Clemente Island), populations of beaked whales appear to be stable. The analysis also indicates that no exposures to sound levels likely to result in Level A Harassment would occur. However, while the Navy's model did not quantitatively predict any mortalities of beaked whales, the Navy is requesting a limited number of takes by mortality given the sensitivities these species may have to anthropogenic activities. Almost 40 years of conducting similar exercises in the HSTT Study Area without observed incident indicates that injury or mortality are not expected to occur as a result of Navy activities.

Some beaked whale vocalizations might overlap with the MFAS/HFAS TTS frequency range (2–20 kHz), which could potentially temporarily decrease an animal's sensitivity to the calls of conspecifics or returning echolocation signals. However, NMFS does not anticipate TTS of a long duration or severe degree to occur as a result of exposure to MFA/HFAS. No beaked whales are predicted to be exposed to MFAS/HFAS sound levels associated with PTS or injury. No areas of specific importance for reproduction or feeding for beaked whales have been identified in the HSTT Study Area.

As discussed previously, scientific uncertainty exists regarding the potential contributing causes of beaked whale strandings and the exact behavioral or physiological mechanisms that can potentially lead to the ultimate physical effects (stranding and/or death) that have been documented in a few cases. Although NMFS does not expect injury or mortality of any of these species to occur as a result of the MFAS/HFAS training exercises, there remains the potential for the operation of MFAS to contribute to the mortality of beaked whales. Consequently, NMFS intends to authorize mortality and we consider the 10 potential mortalities from across the seven species potentially effected over the course of 5 years in our negligible impact determination (NMFS only intends to authorize a total of 10 beaked whale mortality takes, but since they could be of any of the species, we consider the effects of 10 mortalities of any of the seven species).

False Killer Whale—The Navy's acoustic analysis indicates that 761 exposures of false killer whales (53 exposures to the Hawaii insular stock) to sound levels likely to result in Level B harassment may occur from sonar or other active acoustic stressors associated with training and testing activities in the HRC. False killer whales are not expected to be present within the SOCAL Range Complex. These takes are anticipated to be in the form of behavioral harassment and no injurious takes of false killer whales from active acoustic stressors or explosives are requested or proposed for authorization. Behavioral responses can range from a mild orienting response, or a shifting of attention, to flight and panic.

No areas of specific importance for reproduction or feeding for false killer whales have been identified in the HSTT Study Area.

Short-beaked Common Dolphin—The Navy's acoustic analysis indicates that 1,122,030 exposures of short-beaked common dolphins to sound levels likely to result in Level B Harassment may occur from sonar and other active acoustic stressors associated with training and testing activities and sound or energy from explosions. Analysis also indicates that 110 exposures to sound levels likely to result in Level A Harassment may occur from active acoustic stressors and sound or energy from explosions. Up to 16 short-beaked common dolphin mortalities are also requested as part of an unspecified ''any small odontocete and pinniped species'' take. Short-beaked common dolphins are one of the most abundant dolphin species in SOCAL. Behavioral responses can range from alerting, to changing their behavior or vocalizations, to avoiding the sound source by swimming away or diving. The high take numbers are due in part to an increase in expended materials. However, this species generally travels in large pods and should be visible from a distance in order to implement mitigation measures and reduce potential impacts.

No areas of specific importance for reproduction or feeding for short-beaked common dolphins have been identified in the HSTT Study Area.

California Sea Lion—The Navy's acoustic analysis indicates that 139,999 exposures of California sea lions to sound levels likely to result in Level B harassment may occur from sonar and other active acoustic stressors associated with training and testing activities and sound or energy from explosions. Analysis also indicates that 42 exposures to sound levels likely to result in Level A Harassment may occur from active acoustic stressors and sound or energy from explosions. Up to 10 California sea lion mortalities are also requested as part of an unspecified ''any small odontocete and pinniped species'' take. California sea lions are the most abundant pinniped species along the California coast. Research and observations show that pinnipeds in the water are tolerant of anthropogenic noise and activity. California sea lions may not react at all until the sound source is approaching within a few hundred meters and then may alert, ignore the stimulus, change their behavior, or avoid the immediate area by swimming away or diving. Significant behavioral reactions are not expected, based on previous observations. The high take numbers are due in part to the explosive criteria being based on newborn calf weights. Assuming that the majority of the population is larger than a newborn calf, the model overestimates the effects to California sea lions. The criteria for slight lung injury are also very conservative and may overpredict the effects. Research and observations show that pinnipeds in the water are tolerant of anthropogenic noise and activity. They may react in a number of ways depending on their experience with the sound source and what activity they are engaged in at the time of the exposure.

Northern Fur Seal—The Navy's acoustic analysis indicates that 21,171 exposures of northern fur seals to sound levels likely to result in Level B Harassment may occur from sonar and other active acoustic stressors associated with training and testing activities in the SOCAL Range Complex and sound or energy from explosions. Analysis also indicates that eight exposures to sound levels likely to result in Level A Harassment may occur from active acoustic stressors and sound or energy from explosions. Northern fur seals are common in SOCAL. Behavioral responses can range from a mild orienting response, or a shifting of attention, to flight and panic. Research and observations show that pinnipeds in the water are tolerant of anthropogenic noise and activity. They may react in a number of ways depending on their experience with the sound source and what activity they are engaged in at the time of the exposure.

A small population breeds on San Miguel Island, outside of the SOCAL Range Complex.

Northern Elephant Seal—The Navy's acoustic analysis indicates that 25,228 exposures of northern elephant seals to sound levels likely to result in Level B Harassment may occur from sonar and other active acoustic stressors associated with training and testing activities in the SOCAL Range Complex and sound or energy from explosions. Analysis also indicates that 27 exposures to sound levels likely to result in Level A Harassment may occur from active acoustic stressors and sound or energy from explosions. The majority of predicted effects would be from anti-submarine warfare events involving surface ships, submarines, and hull mounted sonar, while a small percentage of effects would be from mine countermeasure events. Northern elephant seals are common in SOCAL and the proposed take is less than 21 percent of the California breeding population. Behavioral responses can range from a mild orienting response, or a shifting of attention, to flight and panic. Research and observations show that pinnipeds in the water are tolerant of anthropogenic noise and activity. They may react in a number of ways depending on their experience with the sound source and what activity they are engaged in at the time of the exposure.

Different age classes of northern elephant seals haul out on the Channel Islands within SOCAL and spend 8–10 months at sea each year.

Hawaiian Monk Seal—The Navy's acoustic analysis indicates that 1,650 exposures of Hawaiian monk seals (listed as endangered under the ESA) to sound levels likely to result in Level B harassment may occur from sonar or other active acoustic stressors associated with training and testing activities in HRC. No exposures to sound levels likely to result in Level A harassment are expected to occur and takes from injury or mortality are not requested or proposed for authorization. The majority of exposures from testing have ranges to TTS less than 50 m. Behavioral effects are not expected to be significant because (1) Significant behavioral effects are more likely at higher received levels within a few kilometers of the source, (2) Hawaiian monk seals may avoid the activity area; and (3) mitigation measures would be implemented. Hawaiian monk seals predominantly occur in the Northwestern Hawaiian Islands and the Papahanaumokuakea National Marine Monument, which is outside of the main Hawaii Operating Area. Ranges to TTS for hull mounted sonars can be on the order of several kilometers for monk seals, and some behavioral impacts could take place at distances exceeding 173 km, although significant behavioral effects are much more likely at higher received levels within a few kilometers of the sound source and therefore, the majority of behavioral effects are not expected to be significant. Activities involving sound or energy from sonar and other active acoustic sources would not occur on shore in designated Hawaiian monk seal critical habitat where haul out and resting behavior occurs and would have no effect on critical habitat at sea.

Preliminary Determination

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

Subsistence Harvest of Marine Mammals

NMFS has preliminarily determined that the issuance of 5-year regulations and subsequent LOAs for Navy training and testing exercises in the HSTT Study Area would not have an unmitigable adverse impact on the availability of the affected species or stocks for subsistence use, since there are no such uses in the specified area.

ESA

There are eight 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: blue whale, humpback whale, fin whale, sei whale, sperm whale, the Hawaiian insular stock of false killer whale, Guadalupe fur seal, and Hawaiian monk seal. The Navy will consult with NMFS pursuant to section 7 of the ESA, and NMFS will also consult internally on the issuance of LOAs under section 101(a)(5)(A) of the MMPA for HSTT activities. Consultation will be concluded prior to a determination on the issuance of the final rule and an LOA.

NMSA

Some Navy activities may potentially affect resources within National Marine Sanctuaries. The Navy will continue to analyze potential impacts to sanctuary resources and has provided the analysis in the Navy's HSTT DEIS/OEIS to NOAA's Office of National Marine Sanctuaries. The Navy will initiate consultation with NOAA's Office of National Marine Sanctuaries pursuant to the requirements of the NMSA as warranted by ongoing analysis of the activities and their effects on sanctuary resources.

NEPA

NMFS has participated as a cooperating agency on the HSTT DEIS/OEIS, which was published on May 11, 2012. The HSTT DEIS/OEIS is posted on NMFS' Web site: *http://www.nmfs.noaa.gov/pr/permits/incidental.htm#applications.* NMFS intends to adopt the Navy's final HSTT EIS/OEIS (FEIS/OEIS), if adequate and appropriate. Currently, we believe that the adoption of the Navy's HSTT FEIS/OEIS will allow NMFS to meet its responsibilities under NEPA for the issuance of regulations and LOAs for HSTT. If the Navy's HSTT FEIS/OEIS is deemed inadequate, NMFS would supplement the existing analysis to ensure that we comply with NEPA prior to the issuance of the final rule or LOA.

Classification

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

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

List of Subjects in 50 CFR Part 218

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

Dated: January 23, 2013.

Alan D. Risenhoover,

Director, Office of Sustainable Fisheries, performing the functions and duties of the Deputy Assistant Administrator for Regulatory Programs, National Marine Fisheries Service.

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

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

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

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

■ 2. Subpart H is added to part 218 to read as follows:

Subpart H—Taking and Importing Marine Mammals; U.S. Navy's Hawaii-Southern California Training and Testing (HSTT)

Sec.

Subpart H—Taking and Importing Marine Mammals; U.S. Navy's Hawaii-Southern California Training and Testing (HSTT)

§ 218.70 Specified activity and specified geographical region.

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

(b) The taking of marine mammals by the Navy is only authorized if it occurs within the HSTT Study Area, which is comprised of established operating and warning areas across the north-central Pacific Ocean, from Southern California west to Hawaii and the International Date Line (see Figure 1–1 in the Navy's application). The Study Area includes three existing range complexes: the Southern California (SOCAL) Range Complex, Hawaii Range Complex

(HRC), and Silver Strand Training Complex (SSTC). In addition, the Study Area also includes Navy pierside locations where sonar maintenance and testing occurs within the Study Area, and areas on the high seas that are not part of the range complexes, where training and testing may occur during vessel transit.

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

(1) Non-impulsive Sources Used During Training:

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

(A) MF1—an average of 11,588 hours per year.

(B) MF1K—an average of 88 hours per year.

(C) MF2—an average of 3,060 hours per year.

(D) MF2K—an average of 34 hours per year.

(E) MF3—an average of 2,336 hours per year.

(F) MF4—an average of 888 hours per year.

(G) MF5—an average of 13,718 items per year.

(H) MF11—an average of 1,120 hours per year.

(I) MF12—an average of 1,094 hours per year.

(ii) High-frequency (HF) and Very High-frequency (VHF) Source Classes:

(A) HF1—an average of 1,754 hours per year.

(B) HF4—an average of 4,848 hours per year.

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

(A) ASW1—an average of 224 hours per year.

(B) ASW2—an average of 1,800 items per year.

(C) ASW3—an average of 16,561 hours per year.

(D) ASW4—an average of 1,540 items per year.

(iv) Torpedoes (TORP) Source Classes:

(A) TORP1—an average of 170 items per year.

(B) TORP2—an average of 400 items per year.

(2) Non-impulsive Sources Used During Testing:

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

(A) LF4—an average of 52 hours per year.

(B) LF5—an average of 2,160 hours per year.

(C) LF6—an average of 192 hours per year.

(ii) Mid-frequency (MF):

(A) MF1—an average of 180 hours per year.

(B) MF1K—an average of 18 hours per year.

(C) MF2—an average of 84 hours per year.

(D) MF3—an average of 392 hours per year.

(E) MF4—an average of 693 hours per year.

(F) MF5—an average of 5,024 items per year.

(G) MF6—an average of 540 items per year.

(H) MF8—an average of 2 hours per year.

(I) MF9—an average of 3,039 hours per year.

(J) MF10—an average of 35 hours per year.

(K) MF12—an average of 336 hours per year.

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

(A) HF1—an average of 1,025 hours per year.

(B) HF3—an average of 273 hours per year.

(C) HF4—an average of 1,336 hours per year.

(D) HF5—an average of 1,094 hours per year.

(E) HF6—an average of 3,460 hours per year.

(iv) ASW:

(A) ASW1—an average of 224 hours per year.

(B) ASW2—an average of 2,260 items per year.

(C) ASW2H—an average of 255 hours per year.

(D) ASW3—an average of 1,278 hours per year.

(E) ASW4—an average of 477 items per year.

(v) TORP:

(A) TORP1—an average of 701 items per year.

(B) TORP2—an average of 732 items per year.

(vi) Acoustic Modems (M):

(A) M3—an average of 4,995 hours per year.

(vii) Swimmer Detection Sonar (SD):

(A) SD1—an average of 38 hours per year.

(viii) Airguns (AG):

(A) AG—an average of 5 airgun uses per year.

(ix) Synthetic Aperture Sonar (SAS):

(A) SAS1—an average of 2,700 hours per year.

(B) SAS2—an average of 4,956 hours per year.

(C) SAS3—an average of 3,360 hours per year.

(3) Annual Number of Impulsive Source Detonations During Training:

(i) Explosive Classes:

(A) E1 (0.1 to 0.25 lb NEW)—an average of 19,840 detonations per year.

(B) E2 (1.26 to 0.5 lb NEW)—an average of 1,044 detonations per year.

(C) E3 (0.6 to 2.5 lb NEW)—an average of 3,020 detonations per year.

(D) E4 (>2.5 to 5 lb NEW)—an average of 668 detonations per year.

(E) E5 (>5 to 10 lb NEW)—an average of 8,154 detonations per year.

(F) E6 (>10 to 20 lb NEW)—an average of 538 detonations per year.

(G) E7 (>20 to 60 lb NEW)—an average of 407 detonations per year.

(H) E8 (>60 to 100 lb NEW)—an average of 64 detonations per year.

(I) E9 (>100 to 250 lb NEW)—an average of 16 detonations per year.

(J) E10 (>250 to 500 lb NEW)—an average of 19 detonations per year.

(K) E11 (>500 to 650 lb NEW)—an average of 8 detonations per year.

(L) E12 (>650 to 1,000 lb NEW)—an average of 224 detonations per year.

(M) E13 (>1,000 to 1,740 lb NEW)—an average of 9 detonations per year.

(ii) [Reserved]

(4) Impulsive Source Detonations During Testing:

(i) Explosive Classes:

(A) E1 (0.1 to 0.25 lb NEW)—an average of 14,501 detonations per year.

(B) E2 (0.26 to 0.5 lb NEW)—an average of 0 detonations per year.

(C) E3 (0.6 to 2.5 lb NEW)—an average of 2,990 detonations per year.

(D) E4 (>2.5 to 5 lb NEW)—an average of 753 detonations per year.

(E) E5 (>5 to 10 lb NEW)—an average of 202 detonations per year.

(F) E6 (>10 to 20 lb NEW)—an average of 37 detonations per year.

(G) E7 (>20 to 60 lb NEW)—an average of 21 detonations per year.

(H) E8 (>60 to 100 lb NEW)—an average of 12 detonations per year.

(I) E9 (>100 to 250 lb NEW)—an average of 0 detonations per year.

(J) E10 (>250 to 500 lb NEW)—an average of 31 detonations per year.

(K) E11 (>500 to 650 lb NEW)—an average of 14 detonations per year.

(L) E12 (>650 to 1,000 lb NEW)—an average of 0 detonations per year.

(M) E13 (>1,000 to 1,740 lb NEW)—an average of 0 detonations per year.

(ii) [Reserved]

§ 218.71 Effective dates and definitions.

(a) Regulations are effective January 25, 2013 through Janaury 25, 2018.

(b) The following definitions are utilized in these regulations:

(1) *Uncommon Stranding Event (USE)*—A stranding event that takes place during a major training exercise (MTE) and involves any one of the following:

(i) Two or more individuals of any cetacean species (not including mother/calf pairs), unless of species of concern listed in § 218.71(b)(1)(ii) found dead or live on shore within a 2-day period and occurring within 30 miles of one another.

(ii) A single individual or mother/calf pair of any of the following marine mammals of concern: beaked whale of any species, *Kogia* spp., Risso's dolphin, melon-headed whale, pilot whale, humpback whale, sperm whale, blue whale, fin whale, sei whale, or monk seal.

(iii) A group of two or more cetaceans of any species exhibiting indicators of distress.

(2) *Shutdown*—The cessation of MFAS/HFAS operation or detonation of explosives within 14 nautical miles of any live, in the water, animal involved in a USE.

§ 218.72 Permissible methods of taking.

(a) Under Letters of Authorization (LOAs) issued pursuant to § 218.77, the Holder of the Letter of Authorization may incidentally, but not intentionally, take marine mammals within the area described in § 218.70, provided the activity is in compliance with all terms, conditions, and requirements of these regulations and the appropriate LOA.

(b) The activities identified in § 218.70(c) must be conducted in a manner that minimizes, to the greatest extent practicable, any adverse impacts on marine mammals and their habitat.

(c) The incidental take of marine mammals under the activities identified in § 218.70(c) is limited to the following species, by the identified method of take and the indicated number of times:

(1) Level B Harassment for all Training Activities:

(i) Mysticetes:

(A) Blue whale (*Balaenoptera musculus*)—21,559 (an average of 4,312 per year).

(B) Bryde's whale (*Balaenoptera edeni*)—1,197 (an average of 240 per year).

(C) Fin whale (*Balaenoptera physalus*)—8,531 (an average of 1,707 per year).

(D) Gray whale (*Eschrichtius robustus*)—47,800 (an average of 9,560 per year).

(E) Humpback whale (*Megaptera novaeangliae*)—46,365 (an average of 9,273 per year).

(F) Minke whale (*Balaenoptera acutorostrata*)—4,030 (an average of 806 per year).

(G) Sei whale (*Balaenoptera borealis*)—2,996 (an average of 600 per year).

(ii) Odontocetes:

(A) Baird's beaked whale (*Berardius bairdii*)—22,100 (an average of 4,420 per year).

(B) Blainville's beaked whale (*Mesoplodon densirostris*)—48,172 (an average of 10,316 per year).

(C) Bottlenose dolphin (*Tursiops truncatus*)—158,590 (an average of 32,302 per year).

(D) Cuvier's beaked whale (*Ziphius cavirostris*)—314,790 (an average of 66,246 per year).

(E) Dwarf sperm whale (*Kogia sima*)—101,291 (an average of 22,359 per year).

(F) Dall's porpoise (*Phocoenoidea dalli*)—184,455 (an average of 36,891 per year).

(G) False killer whale (*Pseudorca crassidens*), Hawaii Insular—220 (an average of 49 per year).

(H) False killer whale (*Pseudorca crassidens*)—2,892 (an average of 657 per year).

(I) Fraser's dolphin (*Lagenodelphis hosei*)—8,809 (an average of 2,009 per year).

(J) Killer whale (*Orcinus orca*)—2,427 (an average of 503 per year).

(K) *Kogia* spp.—64,715 (an average of 12,943 per year).

(L) Long-beaked common dolphin (*Delphinus capensis*)—365,565 (an average of 73,113 per year).

(M) Longman's beaked whale (*Indopacetus pacificus*)—17,296 (an average of 3,666 per year).

(N) Melon-headed whale (*Peponocephala electra*)—6,733 (an average of 1,511 per year).

(O) *Mesoplodon* beaked whales—9,970 (an average of 1,994 per year).

(P) Northern right whale dolphin (*Lissodelphis borealis*)—257,980 (an average of 51,596 per year).

(Q) Pacific white-sided dolphin (*Lagenorhynchus obliquidens*)—192,335 (an average of 38,467 per year).

(R) Pantropical spotted dolphin (*Stenella attenuata*)—48,429 (an average of 10,887 per year).

(S) Pygmy killer whale (*Feresa attenuata*)—2,603 (an average of 571 per year).

(T) Pygmy sperm whale (*Kogia breviceps*)—1,093 (an average of 229 per year).

(U) Risso's dolphin (*Grampus griseus*)—437,707 (an average of 87,649 per year).

(V) Rough-toothed dolphin (*Steno bredanensis*)—22,765 (an average of 5,131 per year).

(W) Short-beaked common dolphin (*Delphinus delphis*)—4,996,410 (an average of 999,282 per year).

(X) Short-finned pilot whale (*Globicephala macrorhynchus*)—42,300 (an average of 9,458 per year).

(Y) Sperm whale (*Physeter macrocephalus*)—15,920 (an average of 3,332 per year).

(Z) Spinner dolphin (*Stenella longirostris*)—11,060 (an average of 2,212 per year).

(AA) Striped dolphin (*Stenella coerulealba*)—33,147 (an average of 7,043 per year).

(iii) Pinnipeds:

(A) California sea lion (*Zalophus californianus*)—634,805 (an average of 126,961 per year).

(B) Guadalupe fur seal (*Arctocephalus townsendi*)—13,014 (an average of 2,603 per year).

(C) Harbor seal (*Phoca vitulina*)—29,530 (an average of 5,906 per year).

(D) Hawaiian monk seal (*Monachus schauinslandi*)—6,334 (an average of 1,292 per year).

(E) Northern elephant seal (*Mirounga angustirostris*)—112,580 (an average of 22,516 per year).

(F) Northern fur seal (*Callorhinus ursinus*)—100,415 (an average of 20,083 per year).

(2) Level A Harassment for all Training Activities:

(i) Mysticetes:

(A) Gray whale (*Eschrichtius robustus*)—10 (an average of 2 per year).

(B) [Reserved].

(ii) Odontocetes:

(A) Dwarf sperm whale (*Kogia sima*)—214 (an average of 46 per year).

(B) Dall's porpoise (*Phocoenoidea dalli*)—235 (an average of 47 per year).

(C) *Kogia* spp.—165 (an average of 33 per year).

(D) Long-beaked common dolphin (*Delphinus capensis*)—10 (an average of 2 per year).

(E) Northern right whale dolphin (*Lissodelphis borealis*)—5 (an average of 1 per year).

(F) Pacific white-sided dolphin (*Lagenorhynchus obliquidens*)—5 (an average of 1 per year).

(G) Risso's dolphin (*Grampus griseus*)—5 (an average of 1 per year).

(H) Short-beaked common dolphin (*Delphinus delphis*)—350 (an average of 70 per year).

(iii) Pinnipeds:

(A) California sea lion (*Zalophus californianus*)—125 (an average of 25 per year).

(B) Harbor seal (*Phoca vitulina*)—55 (an average of 11 per year).

(C) Northern elephant seal (*Mirounga angustirostris*)—110 (an average of 22 per year).

(D) Northern fur seal (*Callorhinus ursinus*)—25 (an average of 5 per year).

(3) Mortality for all Training Activities:

(i) No more than 35 mortalities (7 per year) applicable to any small odontocete or pinniped species from an impulse source.

(ii) No more than 10 beaked whale mortalities (2 per year).

(iii) No more than 12 large whale mortalities (no more than 4 in any given year) from vessel strike.

(4) Level B Harassment for all Testing Activities:

(i) Mysticetes:

(A) Blue whale (*Balaenoptera musculus*)—2,140 (an average of 428 per year).

(B) Bryde's whale (*Balaenoptera edeni*)—90 (an average of 18 per year).

(C) Fin whale (*Balaenoptera physalus*)—1,125 (an average of 225 per year).

(D) Gray whale (*Eschrichtius robustus*)—12,850 (an average of 2,570 per year).

(E) Humpback whale (*Megaptera novaeangliae*)—4,605 (an average of 921 per year).

(F) Minke whale (*Balaenoptera acutorostrata*)—395 (an average of 79 per year).

(G) Sei whale (*Balaenoptera borealis*)—255 (an average of 51 per year).

(ii) Odontocetes:

(A) Baird's beaked whale (*Berardius bairdii*)—5,225 (an average of 1,045 per year).

(B) Blainville's beaked whale (*Mesoplodon densirostris*)—4,800 (an average of 960 per year).

(C) Bottlenose dolphin (*Tursiops truncatus*)—17,565 (an average of 3,513 per year).

(D) Cuvier's beaked whale (*Ziphius cavirostris*)—34,340 (an average of 6,868 per year).

(E) Dwarf sperm whale (*Kogia sima*)—11,880 (an average of 2,376 per year).

(F) Dall's porpoise (*Phocoenoidea dalli*)—26,075 (an average of 5,215 per year).

(G) False killer whale (*Pseudorca crassidens*), Hawaii Insular—20 (an average of 4 per year).

(H) False killer whale (*Pseudorca crassidens*)—255 (an average of 51 per year).

(I) Fraser's dolphin (*Lagenodelphis hosei*)—225 (an average of 45 per year).

(J) Killer whale (*Orcinus orca*)—335 (an average of 67 per year).

(K) *Kogia* spp.—6,160 (an average of 1,232 per year).

(L) Long-beaked common dolphin (*Delphinus capensis*)—239,255 (an average of 47,851 per year).

(M) Longman's beaked whale (*Indopacetus pacificus*)—2,180 (an average of 436 per year).

(N) Melon-headed whale (*Peponocephala electra*)—620 (an average of 124 per year).

(O) Mesoplodon beaked whales—1,725 (an average of 345 per year).

(P) Northern right whale dolphin (*Lissodelphis borealis*)—28,645 (an average of 5,729 per year).

(Q) Pacific white-sided dolphin (*Lagenorhynchus obliquidens*)—24,620 (an average of 4,924 per year).

(R) Pantropical spotted dolphin (*Stenella attenuata*)—3,425 (an average of 685 per year).

(S) Pygmy killer whale (*Feresa attenuata*)—305 (an average of 61 per year).

(T) Pygmy sperm whale (*Kogia breviceps*)—585 (an average of 117 per year).

(U) Risso's dolphin (*Grampus griseus*)—44,260 (an average of 8,852 per year).

(V) Rough-toothed dolphin (*Steno bredanensis*)—2,050 (an average of 410 per year).

(W) Short-beaked common dolphin (*Delphinus delphis*)—613,740 (an average of 122,748 per year).

(X) Short-finned pilot whale (*Globicephala macrorhynchus*)—4,380 (an average of 876 per year).

(Y) Sperm whale (*Physeter macrocephalus*)—1,315 (an average of 263 per year).

(Z) Spinner dolphin (*Stenella longirostris*)—835 (an average of 167 per year).

(AA) Striped dolphin (*Stenella coerulealba*)—6,335 (an average of 1,267 per year).

(iii) Pinnipeds:

(A) California sea lion (*Zalophus californianus*)—65,190 (an average of 13,038 per year).

(B) Guadalupe fur seal (*Arctocephalus townsendi*)—1,345 (an average of 269 per year).

(C) Harbor seal (*Phoca vitulina*)—4,460 (an average of 892 per year).

(D) Hawaiian monk seal (*Monachus schauinslandi*)—1,790 (an average of 358 per year).

(E) Northern elephant seal (*Mirounga angustirostris*)—13,560 (an average of 2,712 per year).

(F) Northern fur seal (*Callorhinus ursinus*)—5,440 (an average of 1,088 per year).

(5) Level A Harassment for all Testing Activities:

(i) Mysticetes:

(A) Gray whale (*Eschrichtius robustus*)—5 (an average of 1 per year).

(B) [Reserved].

(ii) Odontocetes:

(A) Dwarf sperm whale (*Kogia sima*)—140 (an average of 28 per year).

(B) Dall's porpoise (*Phocoenoidea dalli*)—160 (an average of 32 per year).

(C) *Kogia* spp.—30 (an average of 6 per year).

(D) Long-beaked common dolphin (*Delphinus capensis*)—10 (an average of 2 per year).

(E) Northern right whale dolphin (*Lissodelphis borealis*)—5 (an average of 1 per year).

(F) Pacific white-sided dolphin (*Lagenorhynchus obliquidens*)—5 (an average of 1 per year).

(G) Pantropical spotted dolphin (*Stenella attenuata*)—10 (an average of 2 per year).

(H) Pygmy sperm whale (*Kogia breviceps*)—5 (an average of 1 per year).

(I) Risso's dolphin (*Grampus griseus*)—5 (an average of 1 per year).

(J) Short-beaked common dolphin (*Delphinus delphis*)—200 (an average of 40 per year).

(K) Spinner dolphin (*Stenella longirostris*)—5 (an average of 1 per year).

(L) Striped dolphin (*Stenella coerulealba*)—5 (an average of 1 per year).

(iii) Pinnipeds:

(A) California sea lion (*Zalophus californianus*)—85 (an average of 17 per year).

(B) Harbor seal (*Phoca vitulina*)—15 (an average of 3 per year).

(C) Northern elephant seal (*Mirounga angustirostris*)—25 (an average of 5 per year).

(D) Northern fur seal (*Callorhinus ursinus*)—15 (an average of 3 per year).

(3) Mortality for all Testing Activities:

(i) No more than 95 mortalities (an average of 19 per year) applicable to any small odontocete or pinniped species from an impulse source.

(ii) No more than 3 large whale mortalities (no more than 2 in any given year) from vessel strike.

§ 218.73 Prohibitions.

Notwithstanding takings contemplated in § 218.72 and authorized by an LOA issued under §§ 216.106 and 218.77 of this chapter, no person in connection with the activities described in § 218.70 may:

(a) Take any marine mammal not specified in § 218.72(c);

(b) Take any marine mammal specified in § 218.72(c) other than by incidental take as specified in § 218.72(c);

(c) Take a marine mammal specified in § 218.72(c) if such taking results in more than a negligible impact on the species or stocks of such marine mammal; or

(d) Violate, or fail to comply with, the terms, conditions, and requirements of these regulations or an LOA issued under §§ 216.106 and 218.77.

§ 218.74 Mitigation.

(a) When conducting training and testing activities, as identified in § 218.70, the mitigation measures contained in the LOA issued under §§ 216.106 and 218.77 of this chapter must be implemented. These mitigation measures include, but are not limited to:

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

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

(ii) Lookouts positioned in aircraft or on boats will, to the maximum extent practicable and consistent with aircraft and boat safety and training and testing requirements, comply with the observation objectives described above in § 218.74 (a)(1)(i).

(iii) Lookout measures for non-impulsive sound:

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

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

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

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

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

(iii) Lookout measures for explosives and impulsive sound:

(A) Aircraft conducting IEER sonobuoy activities will have one lookout.

(B) Surface vessels conducting anti-swimmer grenade activities will have one lookout.

(C) During general mine countermeasure and neutralization activities using up to a 500-lb net explosive weight detonation (bin E10 and below), vessels greater than 200 ft will have two lookouts, while vessels less than 200 ft will have one lookout.

(D) General mine countermeasure and neutralization activities using a 501 to 650-lb net explosive weight detonation (bin E11), will have two lookouts. One lookout will be positioned in an aircraft and one in a support vessel.

(E) Mine neutralization activities involving diver-placed charges using up to a 20-lb net explosive weight detonation will have one lookout.

(F) Mine neutralization activities involving diver-placed charges using a 21 to 100-lb net explosive weight detonation (E8) will have two lookouts. One lookout will be positioned in each of the two support vessels. If aircraft are used, the pilot or member of the aircrew will serve as an additional lookout. The divers placing the charges on mines will report all marine mammal sightings to their dive support vessel.

(G) When mine neutralization activities using diver-placed charges with up to a 20-lb net explosive weight detonation (bin E6) are conducted with a time-delay firing device, four lookouts will be used. Two lookouts will be positioned in each of two small rigid hull inflatable boats. When aircraft are used, the pilot or member of the aircrew will serve as an additional lookout. The divers placing the charges on mines will report all marine mammal sightings to their dive support vessel.

(H) Surface vessels conducting line charge testing will have one lookout.

(I) Surface vessels or aircraft conducting small- and medium-caliber gunnery exercises will have one lookout.

(J) Surface vessels or aircraft conducting large-caliber gunnery exercises will have one lookout.

(K) Surface vessels or aircraft conducting missile exercises against surface targets will have one lookout.

(L) Aircraft conducting bombing exercises will have one lookout.

(M) During explosive torpedo testing, one lookout will be used and positioned in an aircraft.

(N) During sinking exercises, two lookouts will be used. One lookout will be positioned in an aircraft and one on a surface vessel.

(O) Each surface vessel supporting at-sea explosive testing will have at least one lookout.

(P) During pile driving, one lookout will be used and positioned on the platform that will maximize the potential for marine mammal sightings (e.g., the shore, an elevated causeway, or on a ship).

(Q) Surface vessels conducting explosive and non-explosive large-caliber gunnery exercises will have one lookout. This may be the same lookout used during large-caliber gunnery exercises with a surface target.

(iv) Lookout measures for physical strike and disturbance:

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

(B) During activities using towed in-water devices, one lookout will be used.

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

(D) During activities involving non-explosive bombing exercises, one lookout will be used.

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

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

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

(iii) Mitigation zones for non-impulsive sound: [1]

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

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

(C) The Navy shall ensure that low-frequency and hull-mounted mid-frequency active sonar transmissions are ceased if any detected marine mammals are within 200 yd (183 m) of the sonar dome. Transmissions will not resume until the marine mammal has been seen to leave the area, has not been detected for 30 minutes, or the vessel has transited more than 2,000 yd beyond the location of the last detection.

(D) When marine mammals are detected by any means, the Navy shall ensure that high-frequency and non-hull-mounted mid-frequency active sonar transmission levels are ceased if

[1] The mitigation zone would be 200 yd for low-frequency non-hull mounted sources in bin LF4.

any detected marine mammals are within 200 yd (183 m) of the source. Transmissions will not resume until the marine mammal has been seen to leave the area, has not been detected for 30 minutes, or the vessel has transited more than 2,000 yd beyond the location of the last detection.

(E) Special conditions applicable for dolphins and porpoises only: If, after conducting an initial maneuver to avoid close quarters with dolphins or porpoises, the Officer of the Deck concludes that dolphins or porpoises are deliberately closing to ride the vessel's bow wave, no further mitigation actions are necessary while the dolphins or porpoises continue to exhibit bow wave riding behavior.

(F) Prior to start up or restart of active sonar, operators shall check that the mitigation zone radius around the sound source is clear of marine mammals.

(G) Generally, the Navy shall operate sonar at the lowest practicable level, not to exceed 235 dB, except as required to meet tactical training objectives.

(iv) Mitigation zones for explosive and impulsive sound:

(A) A mitigation zone with a radius of 600 yd (549 m) shall be established for IEER sonobuoys (bin E4).

(B) A mitigation zone with a radius of 350 yd (320 m) shall be established for explosive sonobuoys using 0.6 to 2.5 lb net explosive weight (bin E3).

(C) A mitigation zone with a radius of 200 yd (183 m) shall be established for anti-swimmer grenades (bin E2).

(D) A mitigation zone ranging from 350 yd (320 m) to 850 yd (777 m), dependent on charge size, shall be established for mine countermeasure and neutralization activities using positive control firing devices. Mitigation zone distances are specified for charge size in Table 11–2 of the Navy's application.

(E) A mitigation zone with a radius of 1,000 yd (915 m) shall be established for mine neutralization diver placed mines using time-delay firing devices (bin E6).

(F) A mitigation zone with a radius of 900 yd (823 m) shall be established for ordnance testing (line charge testing) (bin E4).

(G) A mitigation zone with a radius of 200 yd (183 m) shall be established for small- and medium-caliber gunnery exercises with a surface target (bin E2).

(H) A mitigation zone with a radius of 600 yd (549 m) shall be established for large-caliber gunnery exercises with a surface target (bin E5).

(I) A mitigation zone with a radius of 900 yd (823 m) shall be established for missile exercises with up to 250 lb net explosive weight and a surface target (bin E9).

(J) A mitigation zone with a radius of 2,000 yd (1.8 km) shall be established for missile exercises with 251 to 500 lb net explosive weight and a surface target (E10).

(K) A mitigation zone with a radius of 2,500 yd (2.3 km) shall be established for bombing exercises (bin E12).

(L) A mitigation zone with a radius of 2,100 yd (1.9 km) shall be established for torpedo (explosive) testing (bin E11).

(M) A mitigation zone with a radius of 2.5 nautical miles shall be established for sinking exercises (bin E12).

(N) A mitigation zone with a radius of 1,600 yd (1.4 km) shall be established for at-sea explosive testing (bin E5).

(O) A mitigation zone with a radius of 60 yd (55 m) shall be established for elevated causeway system pile driving.

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

(A) A mitigation zone of 500 yd (457 m) for observed whales and 200 yd (183 m) for all other marine mammals (except bow riding dolphins) shall be established for all vessel movement, providing it is safe to do so.

(B) A mitigation zone of 250 yd (229 m) shall be established for all towed in-water devices, providing it is safe to do so.

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

(A) A mitigation zone of 200 yd (183 m) shall be established for small, medium, and large caliber gunnery exercises using a surface target.

(B) A mitigation zone of 1,000 yd (914 m) shall be established for bombing exercises.

(vii) Mitigation zones for the use of Navy sea lions:

(A) If a monk seal is seen approaching or within 100 m of a Navy sea lion, the handler will hold the Navy sea lion in the boat or recall the Navy sea lion immediately if it has already been released.

(3) Humpback Whale Cautionary Area

(i) The Navy will maintain a 5-km (3.1-mi) buffer zone between December 15 and April 15 where conducting exercises will require authorization by the Commander, U.S. Pacific Fleet (CPF).

(ii) If authorized, the CPF will provide specific direction on required mitigation prior to operational units transiting to and training in the area.

(iii) The Navy will provide NMFS with advance notification of any mid-frequency active sonar training and testing activities in the humpback whale cautionary area.

(4) Stranding Response Plan

(i) The Navy shall abide by the letter of the ''Stranding Response Plan for Major Navy Training Exercises in the HSTT Study Area,'' to include the following measures:

(A) Shutdown Procedures—When an Uncommon Stranding Event (USE—defined in § 218.71(b)(1)) occurs during a Major Training Exercise (MTE) in the HSTT Study Area, the Navy shall implement the procedures described below.

(*1*) The Navy shall implement a shutdown (as defined § 218.71(b)(2)) when advised by a NMFS Office of Protected Resources Headquarters Senior Official designated in the HSTT Study Area Stranding Communication Protocol that a USE involving live animals has been identified and that at least one live animal is located in the water. NMFS and the Navy will maintain a dialogue, as needed, regarding the identification of the USE and the potential need to implement shutdown procedures.

(*2*) Any shutdown in a given area shall remain in effect in that area until NMFS advises the Navy that the subject(s) of the USE at that area die or are euthanized, or that all live animals involved in the USE at that area have left the area (either of their own volition or herded).

(*3*) If the Navy finds an injured or dead animal floating at sea during an MTE, the Navy shall notify NMFS immediately or as soon as operational security considerations allow. The Navy shall provide NMFS with species or description of the animal(s), the condition of the animal(s), including carcass condition if the animal(s) is/are dead, location, time of first discovery, observed behavior (if alive), and photo or video (if available). Based on the information provided, NFMS will determine if, and advise the Navy whether a modified shutdown is appropriate on a case-by-case basis.

(*4*) In the event, following a USE, that qualified individuals are attempting to herd animals back out to the open ocean and animals are not willing to leave, or animals are seen repeatedly heading for the open ocean but turning back to shore, NMFS and the Navy shall coordinate (including an investigation of other potential anthropogenic stressors in the area) to determine if the proximity of mid-frequency active sonar training activities or explosive detonations, though farther than 14 nautical miles from the distressed animal(s), is likely contributing to the animals' refusal to return to the open water. If so, NMFS and the Navy will further coordinate to determine what measures are necessary to improve the probability that the animals will return to open water and implement those measures as appropriate.

(B) Within 72 hours of NMFS notifying the Navy of the presence of a USE, the Navy shall provide available information to NMFS (per the HSTT Study Area Communication Protocol) regarding the location, number and types of acoustic/explosive sources, direction and speed of units using mid-frequency active sonar, and marine mammal sightings information associated with training activities occurring within 80 nautical miles (148 km) and 72 hours prior to the USE event. Information not initially available regarding the 80-nautical miles (148-km), 72-hour period prior to the event will be provided as soon as it becomes available. The Navy will provide NMFS investigative teams with additional relevant unclassified information as requested, if available.

(b) [Reserved]

§ 218.75 Requirements for monitoring and reporting.

(a) As outlined in the HSTT Study Area Stranding Communication Plan, the Holder of the Authorization must notify NMFS immediately (or as soon as operational security considerations allow) if the specified activity identified in § 218.70 is thought to have resulted in the mortality or injury of any marine mammals, or in any take of marine mammals not identified in § 218.71.

(b) The Holder of the LOA must conduct all monitoring and required reporting under the LOA, including abiding by the HSTT Monitoring Plan.

(c) General Notification of Injured or Dead Marine Mammals—Navy personnel shall ensure that NMFS (regional stranding coordinator) is notified immediately (or as soon as operational security considerations allow) if an injured or dead marine mammal is found during or shortly after, and in the vicinity of, a Navy training or testing activity utilizing mid- or high-frequency active sonar, or underwater explosive detonations. The Navy shall provide NMFS with species or description of the animal(s), the condition of the animal(s) (including carcass condition if the animal is dead), location, time of first discovery, observed behaviors (if alive), and photo or video (if available). The Navy shall consult the Stranding Response Plan to obtain more specific reporting requirements for specific circumstances.

(d) Annual HSTT Monitoring Plan Report—The Navy shall submit an annual report describing the implementation and results (through November of the same year) of the HSTT Monitoring Plan, described in § 218.75. Data collection methods will be standardized across range complexes and study areas to allow for comparison in different geographic locations. Although additional information will be gathered, the protected species observers collecting marine mammal data pursuant to the HSTT Monitoring Plan shall, at a minimum, provide the same marine mammal observation data required in § 218.75. The HSTT Monitoring Plan may be provided to NMFS within a larger report that includes the required Monitoring Plan reports from multiple range complexes and study areas.

(e) Annual HSTT Exercise Report—The Navy shall submit an annual HSTT Exercise Report. This report shall contain information identified in subsections § 218.75 (e)(1–5).

(1) MFAS/HFAS Major Training Exercises—This section shall contain the following information for Major Training Exercises (MTEs, which include RIMPAC, USWEX, and Multi Strike Group) conducted in the HRC:

(i) Exercise Information (for each MTE):

(A) Exercise designator.

(B) Date that exercise began and ended.

(C) Location.

(D) Number and types of active sources used in the exercise.

(E) Number and types of passive acoustic sources used in exercise.

(F) Number and types of vessels, aircraft, etc., participating in exercise.

(G) Total hours of observation by watchstanders.

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

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

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

(ii) Individual marine mammal sighting info (for each sighting in each MTE).

(A) Location of sighting.

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

(C) Number of individuals.

(D) Calves observed (y/n).

(E) Initial Detection Sensor.

(F) Indication of specific type of platform observation made from (including, for example, what type of surface vessel, i.e., FFG, DDG, or CG).

(G) Length of time observers maintained visual contact with marine mammal.

(H) Wave height (in feet).

(I) Visibility.

(J) Sonar source in use (y/n).

(K) Indication of whether animal is <200 yd, 200 to 500 yd, 500 to 1,000 yd, 1,000 to 2,000 yd, or >2,000 yd from sonar source in paragraph (f)(1)(ii)(J) of this section.

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

(M) If source in use (see paragraph (f)(1)(ii)(J) of this section) is hull-mounted, true bearing of animal from ship, true direction of ship's travel, and estimation of animal's motion relative to ship (opening, closing, parallel).

(N) *Observed behavior.* Watchstanders shall report, in plain language and without trying to categorize in any way, the observed behavior of the animals (such as animal closing to bow ride, paralleling course/speed, floating on surface and not swimming, etc.).

(iii) An evaluation (based on data gathered during all of the MTEs) of the effectiveness of mitigation measures designed to avoid exposing animals to mid-frequency active sonar. This evaluation shall identify the specific observations that support any conclusions the Navy reaches about the effectiveness of the mitigation.

(2) *ASW Summary.* This section shall include the following information as summarized from both MTEs and non-major training exercises (i.e., unit-level exercises, such as TRACKEXs):

(i) Total annual hours of each sonar source bin.

(ii) Total hours (from December 15 through April 15) of hull-mounted active sonar operation occurring in the dense humpback areas plus a 5-km buffer, but not including the Pacific Missile Range Facility.

(iii) Total estimated annual hours of hull-mounted active sonar operation conducted in the Humpback Whale Cautionary area between December 15 and April 15.

(iv) *Cumulative Impact Report.* To the extent practicable, the Navy, in coordination with NMFS, shall develop and implement a method of annually reporting non-major (i.e., other than RIMPAC, USWEX, or Multi-Strike Group Exercises) training exercises utilizing hull-mounted sonar. The report shall present an annual (and seasonal, where practicable) depiction of non-major training exercises geographically across the HSTT Study Area. The Navy shall include (in the HSTT annual report) a brief annual progress update on the status of development until an agreed-upon (with NMFS) method has been developed and implemented.

(3) *SINKEXs.* This section shall include the following information for each SINKEX completed that year:

(i) Exercise information (gathered for each SINKEX):

(A) Location.

(B) Date and time exercise began and ended.
(C) Total hours of observation by lookouts before, during, and after exercise.
(D) Total number and types of explosive source bins detonated.
(E) Number and types of passive acoustic sources used in exercise.
(F) Total hours of passive acoustic search time.
(G) Number and types of vessels, aircraft, etc., participating in exercise.
(H) Wave height in feet (high, low, and average during exercise).
(I) Narrative description of sensors and platforms utilized for marine mammal detection and timeline illustrating how marine mammal detection was conducted.
(ii) Individual marine mammal observation (by Navy lookouts) information (gathered for each marine mammal sighting):
(A) Location of sighting.
(B) Species (if not possible, indicate whale, dolphin, or pinniped).
(C) Number of individuals.
(D) Whether calves were observed.
(E) Initial detection sensor.
(F) Length of time observers maintained visual contact with marine mammal.
(G) Wave height.
(H) Visibility.
(I) Whether sighting was before, during, or after detonations/exercise, and how many minutes before or after.
(J) Distance of marine mammal from actual detonations (or target spot if not yet detonated).
(K) Observed behavior—Lookouts will report, in plain language and without trying to categorize in any way, the observed behavior of the animal(s) (such as animal closing to bow ride, paralleling course/speed, floating on surface and not swimming etc.), including speed and direction.
(L) Resulting mitigation implementation—Indicate whether explosive detonations were delayed, ceased, modified, or not modified due to marine mammal presence and for how long.
(M) If observation occurs while explosives are detonating in the water, indicate munition type in use at time of marine mammal detection.
(4) *IEER Summary.* This section shall include an annual summary of the following IEER information:
(i) Total number of IEER events conducted in the HSTT Study Area.
(ii) Total expended/detonated rounds (buoys).
(iii) Total number of self-scuttled IEER rounds.
(5) Explosives Summary—To the extent practicable, the Navy will provide the information described below for all of their explosive exercises. Until the Navy is able to report in full the information below, they will provide an annual update on the Navy's explosive tracking methods, including improvements from the previous year.
(i) Total annual number of each type of explosive exercises (of those identified as part of the ''specified activity'' in this final rule) conducted in the HSTT Study Area.
(ii) Total annual expended/detonated rounds (missiles, bombs, etc.) for each explosive source bin.
(g) Sonar Exercise Notification—The Navy shall submit to the NMFS Office of Protected Resources (specific contact information to be provided in LOA) either an electronic (preferably) or verbal report within fifteen calendar days after the completion of any major exercise (RIMPAC, USWEX, or Multi Strike Group) indicating:
(1) Location of the exercise.
(2) Beginning and end dates of the exercise.
(3) Type of exercise (e.g., RIMPAC, USWEX, or Multi Strike Group).
(h) *HSTT Study Area 5-yr Comprehensive Report.* The Navy shall submit to NMFS a draft report that analyzes and summarizes all of the multi-year marine mammal information gathered during ASW and explosive exercises for which annual reports are required (Annual HSTT Exercise Reports and HSTT Monitoring Plan reports). This report will be submitted at the end of the fourth year of the rule (November 2018), covering activities that have occurred through June 1, 2018.
(i) *Comprehensive National ASW Report.* By June 2019, the Navy shall submit a draft Comprehensive National Report that analyzes, compares, and summarizes the active sonar data gathered (through January 1, 2019) from the lookouts in accordance with the Monitoring Plans for HSTT, AFTT, MITT, and NWTT.
(j) The Navy shall respond to NMFS' comments and requests for additional information or clarification on the HSTT Comprehensive Report, the draft National ASW report, the Annual HSTT Exercise Report, or the Annual HSTT Monitoring Plan report (or the multi-Range Complex Annual Monitoring Plan Report, if that is how the Navy chooses to submit the information) if submitted within 3 months of receipt. These reports will be considered final after the Navy has addressed NMFS' comments or provided the requested information, or three months after the submittal of the draft if NMFS does not comment by then.

§ 218.76 Applications for Letters of Authorization.

To incidentally take marine mammals pursuant to the regulations in this subpart, the U.S. citizen (as defined by § 216.106) conducting the activity identified in § 218.70(c) (the U.S. Navy) must apply for and obtain either an initial LOA in accordance with § 218.77 or a renewal under § 218.78.

§ 218.77 Letters of Authorization.

(a) An LOA, unless suspended or revoked, will be valid for a period of time not to exceed the period of validity of this subpart.
(b) Each LOA will set forth:
(1) Permissible methods of incidental taking;
(2) Means of effecting the least practicable adverse impact on the species, its habitat, and on the availability of the species for subsistence uses (i.e., mitigation); and
(3) Requirements for mitigation, monitoring and reporting.
(c) Issuance and renewal of the LOA will be based on a determination that the total number of marine mammals taken by the activity as a whole will have no more than a negligible impact on the affected species or stock of marine mammal(s).

§ 218.78 Renewal of Letters of Authorization and Adaptive Management.

(a) A Letter of Authorization issued under §§ 216.106 and 218.77 for the activity identified in § 218.70(c) will be renewed based upon:
(1) Notification to NMFS that the activity described in the application submitted under § 218.78 will be undertaken and that there will not be a substantial modification to the described work, mitigation, or monitoring undertaken during the upcoming period of validity;
(2) Timely receipt (by the dates indicated in these regulations) of the monitoring reports required under § 218.75(c–j); and
(3) A determination by the NMFS that the mitigation, monitoring, and reporting measures required under § 218.74 and the LOA issued under §§ 216.106 and 218.78, were undertaken and will be undertaken during the upcoming period of validity of a renewed Letter of Authorization.
(b) If a request for a renewal of an LOA issued under this § 216.106 and § 218.78 indicates that a substantial modification, as determined by NMFS, to the described work, mitigation or monitoring undertaken during the upcoming season will occur, NMFS will provide the public a period of 30 days for review and comment on the request.

Review and comment on renewals of LOAs are restricted to:

(1) New cited information and data indicating that the determinations made in this document are in need of reconsideration; and

(2) Proposed changes to the mitigation and monitoring requirements contained in these regulations or in the current LOA.

(c) A notice of issuance or denial of an LOA renewal will be published in the **Federal Register**.

(d) NMFS, in response to new information and in consultation with the Navy, may modify the mitigation or monitoring measures in subsequent LOAs if doing so creates a reasonable likelihood of more effectively accomplishing the goals of mitigation and monitoring. Below are some of the possible sources of new data that could contribute to the decision to modify the mitigation or monitoring measures:

(1) Results from the Navy's monitoring from the previous year (either from the HSTT Study Area or other locations).

(2) Compiled results of Navy-funded research and development (R&D) studies (presented pursuant to the ICMP (§ 218.75(d)).

(3) Results from specific stranding investigations (either from the HSTT Study Area or other locations, and involving coincident mid- or high-frequency active sonar or explosives training or not involving coincident use).

(4) Results from the Long Term Prospective Study.

(5) Results from general marine mammal and sound research (funded by the Navy (or otherwise)).

§ 216.79 Modifications to Letters of Authorization.

(a) Except as provided in paragraph (b) of this section, no substantive modification (including withdrawal or suspension) to the LOA by NMFS, issued pursuant to §§ 216.106 and 218.77 of this chapter and subject to the provisions of this subpart shall be made until after notification and an opportunity for public comment has been provided. For purposes of this paragraph, a renewal of an LOA under § 218.78, without modification (except for the period of validity), is not considered a substantive modification.

(b) If the Assistant Administrator determines that an emergency exists that poses a significant risk to the well-being of the species or stocks of marine mammals specified in § 218.72(c), an LOA issued pursuant to §§ 216.106 and 218.77 of this chapter may be substantively modified without prior notification and an opportunity for public comment. Notification will be published in the **Federal Register** within 30 days subsequent to the action.

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